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Optimal abatement policies and related behavioral aspects of climate change

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ABSTRACT

Climate change is one of the most urgent problems facing the earth. Its facets are multiple: environmental, economic, and social, and its consequences could become dire if drastic and concerted action is not taken immediately. This paper uses existing economic and physical models to devise CO_2 emission trajectories for the whole world that optimize a neo-classical welfare function as well as an alternative function inspired by research on subjective well-being, while keeping temperature rise at 2 °C above preindustrial levels. These trajectories are then linked with certain behavioral traits that are strongly connected with the attitudes that would realize such policies. It is demonstrated that the 2 °C target is still feasible but the corresponding behavioral changes are quite demanding. Difficult as the problem might be, it is encouraging that humanity can still resolve it if no time is wasted and political action is taken immediately.

1. Introduction

Climate change, primarily due to anthropogenic emissions of greenhouse gases (GHG), is a scientific fact backed by an enormous volume of publications as for example the latest Intergovernmental Panel on Climate Change report (IPCC, 2013), the 2013 report to the US President (PCAST, 2013), or a joint report for the general public issued jointly by the Royal Society and the US National Academy of Sciences in 2014 (Cicerone and Nurse, 2014). The consequences of climate change have been amply explained, demonstrated and measured, although uncertainties exist. We now know from data records that sea level and average temperatures are rising and the frequencies of extreme weather phenomena are increasing. Climate change is already exerting a host of stresses on the environment and the society that will intensify with time.

In the face of this reality, humanity has done little to avert possible catastrophes. Puzzling as this behavior might appear at first, it can be partially explained by behavioral economics and psychology. However, human climate inaction is often attributed to a degree to plain economics. We stand to lose economically more than we gain. Is this true?

Models that estimate the costs of climate change have been amply criticized on various grounds. An oft cited criticism is that they underestimate the costs of climate change (e.g., Revesz et al., 2014). Ironically they show that the cost of climate change could become astronomical. For example, in Kanellos et al. (in press) it is demonstrated that a business-as-usual (BAU) scenario by 2200 will raise the average temperature by about 6 °C above year 1900 at a cost of about $850 trillion (2005 constant prices), whereas, if action is taken and temperature is contained at 3 °C above year 1900, the cost will be

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about $580 trillion. One has to look elsewhere for better explanations.

Another interesting fact about climate change and the economy has to do with the attitudes of rich nations towards climate action. A negative correlation between income and climate concern has been reported in several studies (e.g., Norgaard, 2011). Also, the higher the share of a nation's global CO_2 emissions the less its citizens and governments are willing to reduce them. The USA and China are two cases in point.

One could posit that ignorance about the facts of climate change is one of the main causes of global inaction. However, as levels of information about climate change increase the willingness to take personal responsibility and action decreases (Norgaard 2011). People often realizing the enormous scale and complexity of the problem prefer to distance themselves from it. Redeployment of attention (Kahneman and Sugden, 2005), a common psychological mechanism of adaptation, plays an important role. People push back the unpleasant facts about climate change and redeploy their attention to other issues related to daily life.

People and, by extension, governments sometimes resort to a number of strategies to justify inaction. They isolate themselves from unpleasant information or blame others for doing a far greater damage and present polluting policies as environmentally benign. For example, according to Hovden and Lindseth (2002) the Norwegian government justified stepping up oil production in the 1990s and argued that "since Norwegian petroleum products are not the dirtiest in the international market, Norwegian oil and gas production is good climate policy internationally." More importantly, ignoring scientific facts and showing no tolerance for scientific uncertainty, no matter how small, lead to a kind of false collective rationality that justifies burning oil and the resulting short term local economic benefits.

Gifford (2011) outlines a number of barriers that prevent us from acting despite knowledge about the effects of climate change. One of them has to do with our ancient brain that has evolved to deal with immediate and visible dangers. Humans often resort to judgmental discounting, that is, they believe that dangers lurk large but not for their localities and not presently. Also, when they hear a lot about the problem they tend to become numb and insensitive. A major barrier presents itself in the guise of scale. Most people believe that their impact will be minimal given the global scale of climate change. However, even if they take action, they might develop feelings of unfairness since there are so many who do nothing. Other barriers include ideologies, political (conservative, liberal) or religious (God will not permit total destruction), or reactance by people who mistrust science or have a strong interest in the fossil fuel industry.

One could view climate inaction partially as the result of the bystander effect. Initially it was defined as a social psychological phenomenon whereby individuals do not help people in urgent need, such as victims of assaults or accidents, when others are present (Darley and Latané,1968). The more bystanders present the less likely it becomes for someone to help. Explanations of the bystander phenomenon hinge on the ambiguity of the situation (e.g., is it a real emergency, what are the others doing?) and diffusion of responsibility (someone else will help). By extension, people convince themselves that they are powerless and leave action to others.

It is rather clear that climate action is not so much a problem of scientific information but a problem of human behavior. In this paper we model some aspects of this behavior and investigate how public opinion about climate change and willingness to take action could be integrated into environmental policymaking. To do this we employ a climate model in conjunction with an economic model and examine emissions and temperature dynamics under certain economic growth scenarios. Consumption, carbon emissions, and resulting temperature trajectories are then optimized so that a utility function is maximized with the goal of keeping temperature rise within 2 °C above preindustrial levels. Two measures of satisfaction from consumption are considered: a logarithmic utility and a novel, hump-shaped function. The latter is consistent with recent findings about the relation between life satisfaction and income. It turns out that the emissions trajectories to 2100 are similar for the two utility functions, but consumption levels differ and optimizing the second function leads to a reduction of economic inequalities among rich and poor nations. The resulting scenarios are compared with a No-Abatement scenario in which consumption is the only control variable while carbon emissions and temperature rise are unrestricted.

The goal of this paper is twofold. First, it investigates the question of whether the 2 °C target is still attainable in an optimal sense and what reductions are needed to achieve it. Second, the paper makes a connection between such reductions and certain behavioral aspects that could make the reductions a reality. These two goals might appear technically distinct and to some extent they are. However, there exists a strong cause-and-effect connection between the two since sharp emission reductions require strong political consensus on the part of politicians, decision makers, and citizens that hinge upon human behavior. A meta-analysis follows that links the optimal emissions trajectories with corresponding behavioral requirements. Thus, climate action is presented in a more integral way whereby technical and behavioral attributes are systematically connected.

2. Surveys and cognitive awareness toward climate change

2.1. Climate change surveys

We start with a survey that we recently conducted in Greece and Ecuador in 2013 and 2014. This survey augments an existing survey for 16 developing and developed countries (World Bank, 2009) to be discussed in the next section. Ecuador was chosen since the lead author spent a sabbatical leave there, whereas Greece is the country of origin of all the authors.