Solar Geoengineering in a Regional Analytic Climate Economy

Felix Meier and Christian Traeger

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Abstract

The paper analyzes geoengineering and strategic interactions in an integrated assessment model (IAM) of climate change. For this purpose, we (i) derive a new class of solutions to analytic IAMs that allows us to (ii) solve an integrated assessment model with sulfur-based geoengineering and damages in closed form, and (iii) to model realistic strategic interactions between countries in a regional IAM. The paper builds on the analytic climate economy (ACE) by Traeger (2018). In our extension, temperatures respond to carbon dioxide (standard carbon cycle), sulfur injections into the stratosphere (fitted to scientific data), and a potential counter-engineering agent that can offset some of the sulfur-based cooling. Damages arise from the increase in temperatures, the chemical agent(s) employed for geoengineering, and the modulation of the radiative energy balance through geoengineering. Our dynamic game involves two players that are either partially or fully affected by the other country's geoengeneering measures and have the ability to contribute, do nothing, or offset some of the other country's cooling measures. We show that introducing even moderate costs of injecting the chemical agents into the stratosphere substantially changes the doomsday nature of the "free-driver" problem popularized by Weitzman (2015). There is a large range of equilibria where one country does the cooling and the other country takes no action. In particular, Weitzman's (2015) battle over the optimal temperature arises only if such a battle also comes at little cost to the players.

1 Introduction

Worldwide greenhouse gas emissions are still on the rise (Tollefson 2018) leading to potentially severe consequences for the world economy. Future warming may reduce global economic growth rates by 0.28 percentage points per year (Carleton and Hsiang 2016). In light of these recent developments, the idea to engineer a cooler climate remains a hot topic. The two most studied solar geoengineering techniques are stratospheric aerosol injections and marine cloud brightening (Boucher et al. 2017). The use of stratospheric aerosols to