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Do voluntary international environmental agreements work?

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Abstract

We consider the effects of international environmental agreements using the 1988 Sofia Protocol on the reduction of nitrogen oxides. Panel data on 23 European countries for the period 1985–96 is used to evaluate the impact on emissions by dividing countries into participants and non-participants: that is, those that did and those that did not ratify the Sofia Protocol. Using a difference in difference estimator and controlling for country-specific variables, we find that signing the treaty had a significant positive impact on emission reduction. The estimated yearly reduction in emissions is approximately 2.1% greater than it would have been without the Sofia Protocol.

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1. Introduction

Since the detrimental effects of cross-border pollution were first recognized in the 1950s, an increasing number of international environmental agreements (IEAs) have been signed. Accordingly, by 1994 more than 100 IEAs were in force [4]. Of course, there is general agreement that environmental problems that cross country borders, such as global warming and acidification, require some form of international cooperation. Without cooperation, each country

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has an incentive to free-ride on emission reductions from other countries, and countries that would benefit from cooperation may end in the situation of a prisoner's dilemma. The existence of IEAs is thus often seen as evidence that these voluntary agreements are successful. However, signing an IEA does not necessarily imply full realization of cooperative gains. Whether an agreement is successful or not depends on whether it has an effect on the signatory countries' pollution policies. Consequently, we consider an IEA to be successful if the signatory countries reduce their emissions more than they would have done without the agreement. In this paper, we aim to provide a partial answer through a case study of the Sofia Protocol on nitrogen oxide reduction.

The bulk of the economics literature on the evaluation of IEAs concludes that they "... tend to codify Nash behavior and, as such, do not present much of a cooperative gain". [2] This conclusion is empirically supported by Murdoch et al. [18], who evaluated both *The 1985 Helsinki Protocol on the Reduction of Sulphur Emissions or their Fluxes by at least 30 percent* and *The 1988 Sofia Protocol Concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes* by estimating emission reductions for 25 European countries from 1980 to 1990. Likewise, Murdoch and Sandler [17] analyzed *The 1987 Montreal Protocol on Substances that Deplete the Ozone Layer*, and showed that agreed emission ceilings under this agreement were more in line with non-cooperative Nash behavior, rather than cooperative behavior by governments. This point was further supported by simulation studies of other IEAs, such as the 1985 Helsinki Protocol on the reduction of sulfur [15], *The 1994 Oslo Protocol on Further Reduction of Sulphur Emissions* [10], and the 1987 Montreal Protocol on the emission of ozone-depleting substances [5].

Much of the theoretical literature on cooperation in IEAs predicts that cooperation is rather limited. Barrett [4] explores a self-enforcing IEA within a two-period model. In the first period, countries decide whether to participate, and in the second period, participating and non-participating countries determine their emission levels non-cooperatively. This model predicts that the number of participating countries is limited, and that self-enforcing international agreements may not be able to improve substantially upon the non-cooperative outcome. The results of similar models in Carraro and Siniscalco [7,8] and Hoel [12] also predict that cooperation is relatively limited. On the other hand, Lange and Vogt [14] explain the large amount of observed international cooperation by arguing that these are driven by preference for equity in addition to self-interest. Further, repeated intergovernmental relations in managing environmental commons, as well as other relationships included in EU integration, NATO enlargement, and international trade agreements may overcome incentives to free-ride. Ostrom [20], for example, argues that local communities handle incentives to free-ride by voluntary cooperation when supplying public goods. In the same manner, governments may manage to, at least partly, deal with incentives to free-ride.

In this paper, we take another approach to assessing the potential impact of IEAs. We focus on actual emission reductions and, in particular, on the question whether signatory countries reduce their emissions more than they would have done without agreement. In our framework, agreements may have some success even though they do not fully realize the potential cooperative gains. For instance, Murdoch et al. [18,19] hypothesized that countries act according to a non-cooperative Nash model. Since this hypothesis cannot be rejected, Murdoch et al.'s [18,19] results provide support for the no effect of voluntary agreements. In the current paper, we consider the 1988 Sofia Protocol on emissions of nitrogen oxides. In the 1988 Sofia Protocol, as in most other

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