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Can violence harm cooperation? Experimental evidence

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ABSTRACT

In this paper we argue that natural resource conservation is jeopardised by the ability of users to resort to violence to appropriate resources when they become scarce. We provide evidence from a lab experiment that participants interacting in a dynamic game of common pool resource extraction reduce their cooperation on efficient levels of resource extraction when given the possibility to appropriate the resource at some cost, i.e. through conflict. Theoretically, cooperation is achievable via the threat of punishment strategies, which stop being subgame perfect in the presence of conflict. Accordingly we argue that the observed reduction of cooperation in the game's early stages in the lab is a consequence of participants (correctly) anticipating the use of appropriation when resources become scarce.

1. Introduction

The over-exploitation of commonly-managed renewable natural resources (CPR), exacerbated by the familiar "tragedy of the commons", has become increasingly concerning (Hardin, 1968; Homer-Dixon, 1999; Stern, 2007). Infinitely repeated models of resource management show that efficient resource extraction rates can be sustained among users under the threat of a general reversion to over extraction in case of noncompliance by some users (Cave, 1987; Dutta, 1995; Sorger, 2005; Dutta and Radner, 2009). This class of models, however, entirely disregards the fact that scarcities could push resource-users to seek alternative ways of securing access to the resource, like using violence.

The collapse of Easter Island's society, as documented by Diamond (2005) is one case in point. According to Diamond, the society of Easter Island plunged into chaos because of resource depletion that was provoked by their clans' permanent quest for prestige. The society was organised in hierarchical clans that peacefully competed with each other for power supremacy by erecting stone statues weighing up to 80 tons. To that end, the island's tallest trees needed to be cut down, as a result of

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which a rapid deforestation occurred.[1] The exhaustion of this valuable natural resource implied an incapacity to build new large canoes permitting high sea fishing, as a consequence of which the rate of consumption of on-land food necessarily increased. In 1680, amidst dramatic levels of deprivation, a prolonged period of internecine wars started. By the time the first European expedition reached the island in 1722, deforestation was almost complete. Brander and Taylor generalise this argument stating that "[r]ather than being the cause of decline, violent conflict is commonly the result of resource degradation and occurs after the civilisation has started to decline, as on Easter Island" (Brander and Taylor, 1998: 132). The "Cod Wars", in which Iceland and United Kingdom confronted each other in the 1950s-1970s over fishing rights in the Atlantic, represents another salient example (Barston and Hannesson, 1974; Glantz, 1992). Perhaps even more strikingly, some of the most cruel violence in recent history, like the Rwandan and the Sudanese genocides, have been interpreted in light of natural resource pressure (André and Platteau, 1998; Prunier, 2009; Verpoorten, 2012; Olsson and Siba, 2013).

Starting from this simple observation, Sekeris (2014) amended a standard dynamic model of natural resource conservation by explicitly empowering players with the ability to violently appropriate resources. As a result, rational agents never choose to cooperate on the efficient level of extraction, with the tragedy of the commons unfolding at equilibrium. The intuition behind this can be summarised as follows: since conflict will eventually occur over scarce resources, the threat of a collective reversion to over-extraction (i.e. punishment) "for ever after" to deter deviations from the efficient extraction level is no longer credible since strategic interaction is bound to stop once conflict is initiated. Reasoning backward from the point at which conflict is a rational response, there is no incentive to cooperate at the point in time just before the moment of conflict, or at any earlier time period – the game becomes finite at the moment of conflict and unravels like a finite prisoner's dilemma problem.

Given the far-reaching potential implications of this finding for resource conservation, we reproduce the setting of Sekeris (2014) and study the extraction rates of resource users in a controlled lab environment. This leads to the main contribution of the present paper: we provide the first experimental evidence that the option to violently appropriate resources reduces the incentives to cooperate on the conservation of natural resources.

We first adapt the model in Sekeris (2014) so it can be used in an experimental setting. We then design two treatments and compare cooperation rates across them. Each treatment involves 58 participants for a combined total of 116 students from the University of York (UK). In both treatments participants are randomly matched into pairs and then called to decide on the amount of 'points' to extract from a pool of points (resources) at each 'round' of the game, and given a pre-defined regeneration rate of the CPR. In the first treatment, which we label the 'conflict' treatment, participants get to choose between three options during each 'round'. Participants can either extract a 'low' level of points – corresponding to the theoretical prediction of a cooperative extraction –, or extract a 'high' level of points – corresponding to the theoretical prediction of a non-cooperative (Markov-perfect) extraction –, or to opt for resource appropriation, denoted by 'chance'.[2] If chance is chosen, the CPR is split equally between the two paired subjects, at some cost which is increasing in the stock of the CPR.[3] If at some time period 'chance' is played, the optimal extraction path is imposed on participants from the subsequent time period and thereafter.

The second treatment, named 'control', is identical to the conflict treatment, except for the cost of opting for resource appropriation, which is substantially increased, such that playing chance is theoretically suboptimal. So, we offer participants the same three options as in the conflict treatment (i.e. low, high extraction rates and chance), but if 'chance' is chosen, 60% of the CPR is destroyed, thus making this choice suboptimal for any level of resources.

To emulate the infinite horizon environment required for folk theorems to be applicable, we follow the methodology in Vespa (2014), which was first introduced by Roth and Murnighan (1978), and later applied by Cabral et al. (2014). The technique introduces an uncertain time horizon by allowing the software to terminate the game at any 'time period' with some predetermined probability. This practice – which in theory is equivalent to an infinite time horizon, if individuals are risk neutral – has been shown not to be innocuous in practice (Dal Bó, 2005; Fréchette and Yuksel, 2017). Since both our control and treatment groups are subject to the same random termination rule, however, the validity of our experiment is not jeopardised.

Our experimental findings support our theoretical predictions. In the initial rounds of the game (or alternatively for high levels of the CPR), where conflict is unlikely to have been selected in either treatment, the level of cooperation is lower in the conflict treatment compared to the control treatment, and non-cooperation is higher. Hence, the expectation of a higher likelihood of chance being played in later stages of the game in the conflict treatment seems to reduce cooperation in favour of non-cooperation in the early stages of the game.

We find that participants who experienced violence in a specific game were more likely to behave according to predictions in the subsequent game. This evidence lends additional intuitive support to our conjecture that a higher *expectation* of chance being played in later rounds induces participants to substitute cooperation for non-cooperation. Furthermore, we show that participants in a slightly amended treatment, in which chance is imposed for low resource stocks, also reduce their cooperation level, which once more supports our interpretation of the results. Lastly, we track individual paths of play by participants, and find that in 24% of the games played in the conflict treatment, participants behave according to theoretical predictions. In the control treatment, however, no single participant made these same choices. This constitutes suggestive evidence that our

[1] A controversy on the real causes of the Island's deforestation is still open among scientists (Hunt and Lipo, 2011).

[2] We deliberately chose a neutral tag to denote the conflict action in our experiment to avoid any framing bias. In particular, had we named our resource appropriation 'conflict' or 'violence', changes in cooperation rates across treatments may have been the consequence of different moral/ethical values among participants.

[3] Notice that this assumption is an endogenous feature in Sekeris (2014), where conflict is modelled as a standard contest success function.