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Analysis

Status concern and the exploitation of common pool renewable resources☆

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ABSTRACT

We examine the impact of social status concern in a common pool renewable resource oligopoly. A small number of players share access to a common pool resource and sell their production in a common market where they are oligopolists. We depart from the mainstream literature on common pool resource oligopolies by considering that each player cares about her social status. We allow for two channels to impact a player's welfare: harvest and profits. Under the first channel, a player has a bump in her utility when her harvest is larger than the average harvest of the rest of the players. In this case we show that the presence of this channel exacerbates the tragedy of the commons. Under the second channel, a player enjoys a bump in her utility if she manages to earn more profits than the average profits of the other players. In this case we show that social status concern may temporarily alleviate the tragedy of the commons: it results in a decrease of extraction over an interval of stock sizes.

1. Introduction

The utility that an economic agent derives from her consumption, income, or wealth tends to be affected by how these compare to other economic agents' consumption, income or wealth. This has been established in different contexts. While we label this status concern, some authors label it as envy, or positional externalities, or keeping up with the Joneses[1] (Veblen, 1899; Pollack, 1976; Frank, 1985, 1990, 2007). Veblen (1899) emphasizes the pervasiveness of emulation, which he defines as 'the stimulus of an invidious comparison which prompts us to outdo those with whom we are in the habit of classing ourselves.' He claims that 'with the exception of the instinct for self-preservation, the propensity for emulation is probably the strongest and most alert and persistent of economic motives proper.' Emulation can lead to direct contests, and to wasteful use of efforts and other real resources.[2]

The main finding in the context of a common pool resource extraction problem is that status concern tends to exacerbate the tragedy of the commons; i.e., it results in a more aggressive grabbing of the resource, and this leads to lower welfare for all. The importance of the relative performance of an individual compared to the group is not limited to economic environments. The evolutionary biologist Richard Dawkins (1986, p.184) noted:

> Why, for instance, are trees in the forest so tall? The short answer is that all the other trees are tall, so no one tree can afford not to be. It would be overshadowed if it did... But if only they were all shorter, if only there could be some sort of trade-union agreement to lower the recognized height of the canopy in forests, all the trees would benefit. They would be competing with each other in the canopy for exactly the same sun light, but they would all have "paid" much smaller growing costs to get into the canopy.

Because of status concern, private decisions on consumption or asset accumulation generate externalities, and as a result one can no longer presume that a competitive equilibrium is Pareto efficient. A number of papers have studied the effects of status concern on saving behavior, labor supply, public good provision, bequest and inequality (e.g., Fisher and Hof, 2000; Long and Shimomura, 2004; Alvarez-Cuadrado et al. 2004; Liu and Turnovsky, 2005; Wendner and Goulder 2008; Alvarez-Cuadrado and Long, 2012; Eckerstorfer and Wendner, 2013).

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[1] In this paper, these terms could be used interchangeably.

[2] For a recent survey of the theory of contests, see Long (2013).

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Several authors have studied the effect of status concern on environmental quality (Ng and Wang, 1993; Howarth, 1996, 2000, 2006; Brekke and Howarth, 2002).[3]

In the case of a common pool renewable resource the effect of harvesting on the net rate of renewal of the resource plays an important role in the future availability of the resource. The effect of status concern on resource depletion needs to be examined within the context of a dynamic model that accounts for biological reproduction. Long and McWhinnie (2012) examine this question in a dynamic game with a logistic growth function.[4] They show that status concern results in a lower stock of the resource in the steady state. They find that this result is robust to changes in the source of status concern; i.e. whether fishermen are affected by the relative catches or relative profits, status concern leads to a more aggressive depletion of the resource in the long-run. The analysis of Long and McWhinnie (2012) relies on two key assumptions: first, each agent takes as given the time paths of resource exploitation of other agents (i.e., the authors restrict attention to open-loop strategies); and second, the agents take the market price of the extracted resource as given (i.e., the goods markets are perfectly competitive).

In this paper, we relax those assumptions. We model the situation where (a) each agent anticipates that at any point of time in the future, other agents will choose their harvesting levels based on their concurrent observation of the resource stock level[5]; and (b) each agent can influence the market price in each period, by controlling her supply to the market. Our model thus displays three types of externalities. First, there is the well-known common pool externality. Second, there is status externality. Third, the oligopolistic market structure is a form of externality: when one agent increases her output, the market price falls, resulting in lower revenue for other firms.

Why might oligopolists be concerned about their relative output? One reason may be that a firm's relative output is a proxy for its market share. Companies are often ranked in terms of their market share. Another possible reason is that there is a high correlation between a firm's output and its employment level, or the size of its fleet. These can function as status symbols.

We show that when agents use feedback strategies and the transition phase is taken into account, the well established result that status concern exacerbates the tragedy of the commons must be seriously qualified. More specifically, when agents are concerned about their relative profit, we show that there exists an interval of the stock size of the resource for which the extraction policy under status concern is less aggressive than the extraction policy in the absence of status concern. However, it remains true that starting at any common initial stock, the steady-state equilibrium stock reached in a game where agents are concerned with relative status is lower than that reached in a game where they are not. It is well known that when rivalrous agents are heterogeneous (so that there are winners and losers in the race for status), the implications of status concern on welfare depend, among other things, on whether the pleasure derived from outdoing others and the pain suffered by the losers should be accounted for in the measure of social welfare.[6] In this paper, we consider the welfare implication of status concern in the presence of a different source of heterogeneity: there are non-active agents whose welfare matters. In our symmetric oligopoly game, when we take into account the effects of price changes on the consumers' surplus, we find that the impact of status concern on social welfare depends on the initial stock of the resource.

The benchmark renewable resource oligopoly model we use has recently been exploited to examine a number of important questions related to dynamic oligopolies and productive assets, such as the role of property rights (Colombo and Labrecciosa, 2013a, 2013b), Bertrand rivalry versus Cournot rivalry (Colombo and Labrecciosa, 2015), the role of nonlinear strategies (Colombo and Labrecciosa, 2015; Lambertini and Montavani, 2014) and the impact of market integration in an international trade framework (Fujiwara, 2011). None of these papers has examined the impact of status concern on the exploitation of the resource.

2. Model

Consider a common property resource exploited by n players. Let $c_i(t) \geq 0$ denote player i's output (or harvest) at time t. The total harvest at t is

$$C(t) = \sum_{i=1}^{n} c_i(t).$$

The total harvest is sold in the market, and under a linear demand function, the market clearing price is

$$p_i(t) = A - C(t).$$

Player i's marginal cost is a constant, $b_i > 0$, and her profit is

$$\pi_i(t) = [A - C(t)]c_i(t) - b_i c_i(t).$$

We assume that $A > b$. Let us define

$$a_i \equiv A - b_i > 0.$$

Then the profit of player i is $(a_i - C)c_i$.

We assume that the utility of each player is the sum of three terms

$$u_i = (a_i - C)c_i + \theta(c_i - c_{-i}) + \beta\left((a_i - C)c_i - \frac{\Sigma_{j\neq i}(a_j - C)c_j}{n-1}\right)$$

where we define c_{-i} as the average harvest of all other agents:

$$c_{-i} \equiv \frac{1}{n-1}\sum_{j\neq i} c_j = \frac{C - c_i}{n-1}.$$

The first term in the utility of each player is the profit from her harvest c_i. The second term corresponds to the case of other-regarding preferences where players compare their catch to the average of the other players' catches and the last term captures the fact that each player compares her profits to the average profit of the other players.

The resource stock, denoted by X, evolves according to the following differential equation

$$\dot{X} = F(X) - \Sigma_i c_i, \quad X(0) = X_0 \tag{1}$$

[3] Brekke and Howarth (2002) use a dynamic model to show that the concern for status may lead agents to underestimate non-market environmental services. Extending the work of Stokey (1998), they show that consumption interdependence exacerbates the rate of environmental degradation.

[4] Alvarez-Cuadrado and Long (2011) examine the impact of envy on resource depletion, but they abstract from strategic behavior. Katayama and Long (2010) investigate the role of status-seeking in a dynamic game with a non-renewable natural resource and physical capital accumulation. Long and Wang (2009) modify the linear-growth model of Tornell and Lane (1999) to account for the impact of status concerns on the rate of resource grabbing.

[5] Technically, this means that we use the concept of Markov perfect equilibrium, as opposed to open-loop equilibrium. See Dockner et al. (2000) or Long (2010) for discussions on the relative merits of these equilibrium concepts.

[6] Rawls (1970, p. 545) wrote "Suppose...that how one is valued by others depends upon one's relative place in the distribution of income and wealth. (...) Thus, not everyone can have the highest status, and to improve one person's position is to lower that of someone else. Social cooperation to increase the conditions of self-respect is impossible. Clearly this situation is a great misfortune."