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Stackelberg in the lab: The effect of group decision making and "Cooling-off" periods

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ABSTRACT

The Stackelberg duopoly is a fundamental model of sequential output competition. The equilibrium outcome of the model results in a first-mover advantage where the first-moving firm produces more output, and earns larger profits, relative to the second-moving firm. Huck, Müller, and Normann (2001) and Huck and Wallace (2002) test the Stackelberg duopoly in a lab setting and find that behavior is largely inconsistent with the equilibrium predictions of the model. We hypothesize that this inconsistency is a result of differences between the decision making environment implemented in the lab and firm environments in the field. In this paper, we experimentally investigate whether group decision making and a decision "cooling-off" period lead to more profit maximizing Stackelberg behavior in the lab. Specifically, we re-test the Stackelberg duopoly in the lab while implementing (i) two-person decision making groups, and (ii) a 10-min cooling-off period for second movers. In line with the previous studies, we find that second-mover response behavior is largely inconsistent with profit maximization. Furthermore, the implementation of groups and a cooling-off period has little effect on second-mover behavior. However, we find that group first-movers choose significantly lower output levels than individuals. While further from the equilibrium prediction, we show that these lower output choices by groups are more in-line with profit maximizing behavior, conditional on the non-profit maximizing response behavior of second-movers.

1. Introduction

The Stackelberg model is a fundamental and frequently applied model of sequential oligopolistic output competition amongst firms. The Subgame Perfect equilibrium (SPE) outcome of the model, assuming a symmetric duopoly, is asymmetric with the first-moving firm producing a larger output level, and earning larger profits, relative to the second-moving firm; A phenomenon referred to as the first mover advantage. However, the results from previous laboratory experimental investigations of the Stackelberg duopoly are, in general, inconsistent with the SPE predictions (Huck, Müller, & Normann, 2001 (HMN henceforth); Huck & Wallace, 2002 (HW henceforth)).[2] Specifically, HMN find that second-movers fail to best respond by choosing non profit maximizing output levels. Similarly, first-movers fail to choose their profit maximizing output level, relative to both the SPE prediction and the empirical response function of second-movers.

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[2] Endogenous timing variation of the Stackelberg model (Hamilton & Slutsky, 1990) have been also tested experimentally and the results are also, in general, inconsistent with the theoretical predictions (see Fonseca, Huck, & Normann, 2005; Fonseca, Müller, & Normann, 2006; Huck, Müller, & Normann, 2002).

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HMN and HW cite social preferences and/or emotional motivations as the primary explanations for the observed deviations in the experimental data from the SPE outcome. In particular, the authors indicate that inequality aversion, e.g. Fehr and Schmidt (1999), would lead to lower than predicted output levels for first-movers and flatter than predicted best-response functions by second-movers.[3] HW also point toward reciprocity motivations as an alternative plausible explanation for the theoretically inconsistent best responses of second-movers.[4] How should such insights be interpreted in the context of firm decision making in the field Would we expect firms to fail to exploit their first-mover advantage because of preferences for equality? Would we expect firms to fail to choose the profit maximizing best-response because of preferences for equality or reciprocity?

We hypothesize that one possible reason for the inconsistency between the SPE predictions of the Stackelberg model and the experimental results of HMN and HW is the differences between the lab environment and firm decision making environments in the field. In particular, we concentrate on two dimensions along which the decision making environment in the lab likely differs from that of firms in the field: (i) the size of the decision making unit, and (ii) the length of the deliberation period before decisions are made. Both HMN and HW use a lab environment where individual decision makers act as firms, and subjects have very little time to deliberate about their decision.[5] However, we contend that important firm decisions in the field, e.g. market output decisions, are likely to be discussed (formally or informally) and jointly decided upon by a committee of executive (see Cox, 2002; Cox & Hayne, 2006; Kocher & Sutter, 2005; Kugler, Kausel, & Kocher, 2012; Messick, Moore, & Bazerman, 1997). Similarly, important firm decisions are likely to be carefully consider and made after some period of deliberation to ensure that the decisions are well-thought. The conventional wisdom being that over this deliberation period, ''cooler heads will prevail'' which will result in more ''rational'' decisions.[6]

The motivation of this paper is to investigate the impact of implementing group decision making and deliberation periods on Stackelberg behavior in the lab. Specifically, we test whether group decision making and a deliberation period lead to more profit maximizing Stackelberg behavior in the lab. In doing so, we experimentally re-test a Stackelberg duopoly market using a lab environment that has been augmented along one of the following two dimensions: (1) *firm* decisions are made by a 2-person unitary group, or (2) the second-moving *firm* makes its decision after a 10-min ''cooling-off'' period.[7] By implementing a lab protocol that uses group decision making and cooling-off periods, we aim at creating a lab environment that comes *closer* to firm decision making environments in the field. In turn, we hypothesize that this will lead to decisions in the lab that are more in line with profit maximization and, consequently, more in line with the SPE predictions of the Stackelberg model.[8]

Clearly, the size of the decision making unit and the length of the deliberation period between decisions do not fully exhaust the set of differences between decision making environments in the lab and firm environments in the field.[9] However, we concentrate on the impact of these two dimensions for two important reasons. First, a growing body of literature (discussed thoroughly in the subsequent section) suggests that both group decision making and cooling-off periods can mitigate the influence of social preferences and emotional motivations, which results in more *selfish* decision making. In the context of a Stackelberg duopoly, selfish decision making, which corresponds to profit maximizing decision making, would lead to behavior more in line with the SPE predictions. Second, both group decision making and cooling-off periods are protocols that can be practically implemented in a lab environment. Hence, the possibility to experimentally investigate the impact of group decision making and cooling-off periods on Stackelberg behavior in the lab.

After we began this study, we became aware of related work in progress by Müller and Tan (2011) (MT henceforth), which was conducted independently, that similarly explores topics related to group decision making in an experimental Stackelberg duopoly market. While there exists some overlap in the motivation and experimental design between their study and ours, there are important differences. Namely, MT investigate the effect of group decision making in both a one-shot and repeated Stackelberg game, while we investigate the effect of a cooling-off period in a Stackelberg game. Additionally, their design features 3-person groups, while we our study features 2-person groups. We will provide more discussion about the comparisons of the two studies, when relevant, in the corresponding sections of the paper. We ultimately view this study as complementary to that of MT, and we refer interested readers to their paper for additional insightful discussion on the impact of group decision making in Stackelberg markets.

[3] Lau and Leung (2010) re-examine the data from HMN and show that the data is consistent with a simplified version of the Fehr and Schmidt model of inequality aversion. Specifically, the authors find that more than 1/3 of the subjects exhibit disadvantageous inequality aversion.

[4] The authors note that second-movers ''quite calmly plan to punish leaders in case they try to exploit their strategic advantage and, at the same time, they are willing to not to exploit cooperative moves by the leader'' (p. 1). Although the authors do not explicitly refer to the second-movers' preferences for reciprocity, this explanation for the behavior of second-movers is consistent with the notion of reciprocity modeled by Dufwenberg and Kirchsteiger (2004). Hence, we refer to this type of second-mover behavior as reciprocity for the remainder of the paper.

[5] The environment used by HMN and HW is prototypical of many lab experiments and is consistent with what Harrison and List (2004) would consider a ''conventional lab experiment''.

[6] Thefreedictionary.com defines the idiom ''cooler head prevail'' as: the ideas or influence of less emotional people prevail.

[7] We note that social psychologists often refer to 2-people as a dyad rather a group.

[8] A recent survey by Armstrong and Huck (2010) outlines several situations in which the assumptions of rationality and profit maximization for actual firms may not be suitable, and discusses how firms may actually benefit in certain settings from such *irrational*behavior. We will further discuss this line of reasoning put forth by Armstrong and Huck, as it related to our experimental findings, in the conclusion.

[9] See Harrison and List (2004) and Levitt and List (2007) for a discussion of other environmental dimensions along which the lab and the field differ.