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Noisy leadership: An experimental approach

Werner Güth [a], Wieland Müller [b], Yossi Spiegel [c,*]

[a] *Max Planck Institute of Economics, Kahlaische Strasse 10, 07745 Jena, Germany*
[b] *Department of Economics, PO Box 90153, 5000LE Tilburg, The Netherlands*
[c] *Recanati Graduate School of Business Administration, Tel Aviv University, Ramat Aviv, Tel Aviv 69978, Israel*

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Abstract

We examine the strategic behavior of leaders and followers in sequential duopoly experiments with errors in communication: followers either perfectly observe the leaders' actions or else they observe nothing. Consistent with the theory, the leaders in our experiments enjoy a greater first-mover advantage when followers observe their actions with higher probability, albeit their advantage is weaker than the theory predicts and is only weakly increasing with the probability that their actions will be observed. Our results also show that (i) when informed, followers hardly ever underreact to the leaders' quantities but tend to overreact slightly, and (ii) when uninformed, followers try to predict leaders' quantities and react optimally. This suggests that followers view the symmetric Cournot outcome as "fair," and when informed, "punish" leaders who try to exploit their first-mover advantage. In turn, such punishments by overreactions induce leaders to behave more softly than the theory predicts.

JEL classification: C72; C91

Keywords: Commitment; Imperfect observability; Errors in communication; Sequential games; Oligopoly; Experiments

* Corresponding author. Fax: +972 3 640 7739.
E-mail addresses: gueth@mpiew-jena.mpg.de (W. Güth), w.mueller@uvt.nl (W. Müller), spiegel@post.tau.ac.il (Y. Spiegel).
URLs: http://www.econ.mpg.de/esi/gueth/ (W. Güth), http://center.uvt.nl/staff/muller/ (W. Müller), http://www.tau.ac.il/~spiegel (Y. Spiegel).

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1. Introduction

The idea that first movers (leaders) may gain a strategic advantage by committing to a certain course of action is one of the most celebrated insights of non-cooperative game theory and is widely used in such diverse fields as macroeconomics, international trade, and industrial organization. This idea dates back at least to von Stackelberg (1934) and was popularized by Schelling (1960) who emphasized that in order to confer a strategic advantage, the leader's action must be reliably communicated to second movers (followers). In reality however, it is highly likely that the actions of leaders will only be imperfectly observed by followers. Using the terminology of van Damme and Hurkens (1997) one can distinguish at least two types of possible imperfections. First, there could be errors in the followers' perceptions about the action that the leader has taken. That is, followers may receive a noisy signal about the leader's action and may therefore erroneously believe that the leader has played some other action than the one that was actually played. Second, there could be errors in communication: followers may simply fail to observe the leader's action altogether. Since in specific applications either type of error is highly likely, it is clearly important to explore the implications of imperfect observability for the strategic behavior of leaders and followers and in particular for the value and robustness of commitment.

Given its importance for applied work, so far, surprisingly little research was done on noisy-leadership games. This research has focused almost exclusively on the errors in perceptions case under the special assumption that the noise structure has full support (with some probability, followers may observe any action from the leader's strategy set). Bagwell (1995) shows that in this case, the pure strategy equilibrium outcome jumps discretely from the Stackelberg outcome (the subgame perfect equilibrium of the sequential-move game) when there is no noise to the Cournot outcome (the Nash equilibrium of the simultaneous move game) when there is even the slightest amount of noise. Van Damme and Hurkens (1997) show that the same model admits a mixed strategy equilibrium that converges to the subgame perfect equilibrium as the noise vanishes. Moreover, this equilibrium is selected by a "reasonable" selection criterion. Maggi (1999) shows that when the leader has private information about his cost, an increase in the ratio between the noise in the signal and the noise in the leader's type shifts the equilibrium outcome smoothly from the Stackelberg to the Cournot outcome. Oechssler and Schlag (2000) analyze Bagwell's noisy leader's game with a wide variety of evolutionary and learning dynamics and find that almost all of them admit the Cournot equilibrium as a possible outcome, and often select it uniquely. Only the continuous best-response dynamic selects the Stackelberg outcome as the unique long-run outcome if the noise is small.

Experimental evidence by Huck and Müller (2000) and Müller (2001) in the context of a 2×2 game with a full-support noise structure reveals that followers seem to ignore small levels of noise and play a best-response against the observed leader's action even though with some probability this might be the "wrong" action. Leaders quickly learn to exploit this tendency and play the Stackelberg leader's quantity.[1] By contrast, with high levels of noise the Cournot equilibrium is unique and indeed play converges to this equilibrium. Morgan and Várdy (2004) conduct experiments on Várdy's (2004) model in which followers can perfectly observe the leaders' choices at a cost. They find that the value of commitment is almost completely preserved when the cost of observation is small, but is lost when it is large. The general conclusion from

[1] With small noise levels, the game admits beside the Cournot equilibrium also two mixed strategy equilibria, one of which converges to the Stackelberg equilibrium as noise vanishes. Play seems to converge to this equilibrium.