Endogeneity matters: Essays on cooperation and coordination

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Chapter 1

Introduction

This thesis consists of a series of studies to better understand how cooperation and coordination can emerge in strategic situations where this does not arise naturally or happen automatically. In practice cooperation and coordination are often difficult to achieve when there is no facilitating institution that fosters outcomes that are more beneficial to all parties. Theoretically the problem is that either socially better outcomes are not supported in equilibrium (in social dilemmas for example), or there are simply too many equilibria and players do not know which one to coordinate on (in coordination problems for example). This thesis consists of three core chapters, each of them investigating a different strategic situation. Chapter 2 studies a social dilemma, that is, a pure cooperation problem. Chapter 3 investigates an oligopolistic market, where cooperation is present again (in the form of collusion), but also coordination plays a prominent role. Finally, Chapter 4 moves to a pure coordination game by studying a team-production setting.

All three chapters offer an institution to achieve outcomes that are beneficial for the parties involved (though not necessarily for society, see Chapter 3). A common element in all three chapters is *endogeneity*. In the first two chapters players can endogenously decide about weakening their own position. By doing so they might be able to show their cooperative intentions in the game to other players. If we remove the endogeneity of this decision, and assume that agents are exogenously sorted to play the game under circumstances they could have otherwise

chosen, we remove an important possibility to signal such cooperative intentions. In Chapter 2 players can endogenously make themselves vulnerable (punishable), and thereby signal their cooperativeness to others. In Chapter 3 firms are able to endogenously share information about their own past production, giving a unilateral informational advantage to competitors. The intuition in both chapters is that if players are endogenously vulnerable, they credibly signal their intentions for cooperation as defection or competitive behavior would not be a logically consistent follow-up choice after having voluntarily decided to weaken one's own position (if one is going to defect or behave competitively anyway, it does not make much sense to weaken one's position beforehand). This is not necessarily the case when players are exogenously imposed to be vulnerable during the game.

Finally, endogeneity in Chapter 4 is of a different nature. Here players cannot weaken their own position to achieve coordination on better outcomes. Instead, we consider endogenous group-formation: a manager can endogenously decide about replacing workers in her team. By doing so, she might be able to efficiently enhance team-production, as she has a tool to discipline workers if they do not meet the standard set by the manager. Here, even though the manager cannot communicate with the workers, she is able to show them the output she expects by replacing under-performing workers. Note, however, that here we do not study a natural exogenous institution: we do not exogenously impose a firing strategy on managers (which would be the equivalent of exogenously imposed vulnerability). Managers either have the firing possibility, or it is limited, but these firing possibilities do not depend on workers' behavior.

Theoretically, the mechanism in Chapter 2 supports cooperation in equilibrium even though the underlying game the players play (the prisoner's dilemma) does not. The second and third institutions (information sharing and exclusion) do not give clear-cut predictions about what should happen during the game as either multiple equilibria still exist (Chapter 4), or the mechanism does not have an impact on standard theory (Chapter 3). However, it has already been shown that people are not necessarily rational and their behavior does not always follow standard theory. Thus, even though these institutions would not necessarily enhance cooperation or

coordination in theory, in practice they may very well do. To test their effect we use laboratory experiments in all three chapters.

Laboratory experiments are more and more widespread in economics to test theoretical predictions regarding people's behavior and reaction to certain changes in a controlled environment. They are sometimes judged as too artificial or having low external validity. However, lab experiments certainly offer a great tool to disentangle different effects of possible influencing factors, and to test different policies, for example. In a laboratory experiment the researcher is able to maintain full control over treatment variations, as randomization between sessions and treatments ensures that no underlying unobservables drive the results. Furthermore, we can implement policies or institutions in the lab that would be problematic to experiment with in real life (either because of impossibility of implementing e.g. different information structures, as in Chapter 3, or simply because of lack of cooperating firms). That is why experiments in industrial organizations can also give insights into how different policies affect market outcomes. The most frequent critique against experiments in IO is their external validity, whether firms can be represented by subjects, or not. However, firms are also managed by individuals (or teams), and some studies already showed that there are no substantial behavioral differences between the usual subject pool (undergraduate students) and professionals.[1]

Thesis outline

In Chapter 2 we design a mechanism to increase cooperation in a two-player prisoner's dilemma game. Players can choose their own possible punishment level prior to the prisoner's dilemma. After the prisoner's dilemma they *might* be punished by this level if the partner decides to punish. By voluntarily choosing high punishment levels, players can signal their willingness for cooperation and that there thus will be no need for punishment. In the "Gradual" version of the mechanism, players may condition their incremental enhancements of their own vulnerability

[1]Fréchette (2011) gives an overview about experimental papers comparing professionals and usual subject pools. Most papers in his review find no difference in behavior. Fréchette (forthcoming) also reviews other types of subject pools (e.g. children, elderly people).

on the other's choices. In the "Leap" version of the mechanism, they unconditionally choose their vulnerability. Theoretically both mechanisms support cooperation, though there is a larger set of cooperative equilibria under the Gradual mechanism.

The experiment confirms the theoretical predictions. After an initial learning phase subjects start using the mechanism, and a higher level of cooperation is achieved when either of the mechanisms is implemented compared to the Baseline prisoner's dilemma where the mechanism is absent. In agreement with the theory, subjects choose higher possible punishment levels in Gradual than in Leap resulting in higher mutual cooperation as well. Furthermore, endogeneity is important in this setting: if we exogenously impose the same possible punishment levels that subjects voluntarily choose in other sessions, cooperation and efficiency falls. The intuition here is that in that case a high possible punishment level not necessarily indicates a willingness to cooperate.

In Chapter 3 we investigate how different types of information (aggregate vs. individual) and information structures (no information, full information, endogenous information) affect market outcomes in an oligopoly. We consider a Cournot oligopoly with homogenous goods where firms decide about their production in a market consisting of three firms. The main starting point is that competition authorities consider the exchange of disaggregated production data highly anticompetitive, as cartels are more sustainable when individual data is available. The reason is that individual production data enhances cooperation and coordination among firms. They can easily see whether other members have broken a tacit cartel agreement, and as the defector is identifiable, they can also punish him. However, previous laboratory experiments have shown that it need not be the case that more disaggregated information about competitors lead to more collusion (see e.g. Huck et al., 1999 and 2000 and Offerman et al., 2002). Yet these experiments lack an important characteristic of information structure, namely that information sharing is a firm's own decision. We introduce this possibility; in our experiment subjects can decide about sharing their past production decisions. The voluntary nature of information sharing may enhance the possibility of cooperation (i.e. collusion) among firms, as sharing low

production levels might indicate an intention for collusion.

The experiment in Chapter 3 reveals no significant difference in average total outputs across information types and information structures. However, we observe (insignificantly) more attempts for collusion when individual information is available, especially when it is made available endogenously. We find that subjects use voluntary sharing to show their intentions to cooperate. Those who share information, produce significantly less than those who do not share information, irrespective of the type of information they can share (aggregate vs. individual). If individual information was shared voluntarily, firms tried to collude more often, but not with aggregate data. This shows that the voluntary nature of information sharing may be important in some markets but also that it does not automatically lead to collusion.

In Chapter 4 we focus on a pure coordination problem and investigate whether team-production with weakest-link characteristics can be increased by exclusion from the team. In contrast to previous ostracism studies with weakest-link or public good games (see e.g. Croson et al., 2015 and Maier-Rigaud et al., 2010) exclusion does not take place automatically or by voting within the group. Instead, we move closer to real production settings and place a manager above a group of 6 members who benefits from team-production without exerting effort herself. The manager has the possibility to monitor her workers' performance (either perfectly or imperfectly) and in some cases to replace some of her workers in her team. Workers in the weakest-link game choose an effort level which determines their productivity (via a noisy component in case of imperfect monitoring). Team output equals the minimum of the productivities. The manager can observe all productivity levels and, if applicable, she can decide about replacing some of her workers. With this experiment we explore whether the manager's stick is efficient to increase team-production, even under imperfect monitoring, and whether after removing the stick workers are still able to maintain high effort levels. To address these questions we introduce different contract types besides the different information structures (noisy vs. perfect monitoring). The manager can either fire in every round, or can never fire, or workers start with a probation phase of 5 rounds, after which they cannot be fired any more.

The experimental results show that the fear of exclusion has a profound effect on team performance even if workers are imperfectly monitored; the most flexible contract induces the highest team-output while the one with no firing possibilities leads to the lowest production. However, once the fear is eliminated for some workers, because some of the workers get promoted to a permanent position after their probation phase, effort levels steadily decrease. This latter result is in line with the "Peter principle" (Lazear, 2004) that also originates from the observation that workers' performance reduces after being promoted.

Chapter 5 summarizes the thesis and the main findings.