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Thesis abstract

Essays in theoretical and experimental economics

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This thesis consists of three essays studying both theoretically and experimentally various aspects of coordination problems. Indeed, in this thesis we focus on dynamic games of information acquisition and transmission, organizational design and simple contract environments.

In the first chapter of this dissertation, we consider a dynamic public-good problem, where the public good in question is the *evolving information* about agents' common state of the world. Innovation and social learning are often the work of pioneers, who, by bearing the costs of experimenting with a new approach, create informational spill-overs for others. Whether we consider R&D, resource exploration, or the testing of a new drug, the information produced by a relatively small set of agents benefits a much larger group of agents. Indeed, R&D is universally recognized as an important factor of economic growth (Romer 1990; Grossman & Helpman 1993).[1] An economy's productivity level depends on innovation, which is driven by knowledge emerging from cumulative R&D experience as well as an economy's overall knowledge stock (Griliches 1988; Coe & Helpman 1995). Indeed, economic agents often endeavor to learn over time about some payoff-relevant aspect of their environment.

Think, for instance, of a pharmaceutical company conducting costly clinical trials to find out the effectiveness of a drug. Learning often requires a costly investment in information acquisition, so that agents face a dynamically evolving trade-off on how much information to acquire. Indeed, in light of the signals it receives, the pharmaceutical company will revise its beliefs and decide whether to incur the costs necessary to acquire additional information by continuing its trials, or to give up. It is thus important for economists to analyze pioneers' incentives for information production in the presence of informational spill-overs. Bandit problems involve the trade-off between exploration and exploitation. In their simplest form an agent has a choice between a safe arm with a known payoff or a risky arm whose likelihood of a payoff is unknown and can only be learned through experimentation. However, in the presence of information spillovers, agents can learn from others' experimentation. As a result, agents have an incentive to free-ride and experiment strategically through complex coordination. We implement such dynamic public-good problems in the experimental laboratory and find strong support for the prediction of free-riding because of strategic concerns. We also find strong evidence for behavior that is characteristic of Markov per-

[1] See the full thesis for the references — Ed.

fect equilibrium: non-cutoff behavior, lonely pioneers and frequent switches of action.

In the second chapter, we study organizational design and its role in coordination failure using the *network minimum game*: a (generalized) version of the minimum-effort game where dependencies between players are captured by a directed network. Indeed, organizations create patterns of coordinated activity. A key challenge in shaping these patterns is that fostering tacit coordination among large teams is difficult. An extensive experimental literature documents that coordination failure is almost inevitable in sufficiently large groups. Coordination problems in these studies are represented by the minimum-effort game (Harrison & Hirshleifer 1989; Van Huyck, Battalio, & Beil 1990), where players in a group aim to match the minimum action of the rest of the group. The minimum-effort game presents an extremely stylized view of organizational coordination, where each individual is held responsible for coordinating with everyone else. In practice, the scope and complexity of interactions within most organizations is limited—*by design*. Tasks are allocated and incentives are designed so that most individuals are responsible for coordinating only with a subset of coworkers. A subordinate executes instructions from his superior; production workers on the same assembly line coordinate with each other; a CEO is held responsible for the execution of his strategy by senior managers. In abstract terms, we take the perspective that organizational design specifies a network of interdependencies (in actions and payoffs) between individuals. Organization-wide coordination emerges from this ensemble of network interactions. We conduct a laboratory experiment to study how network structure influences coordination. Our experimental setting captures the notion of repeated interactions within long-lived organizations with persistent structure: subjects play in fixed groups, with fixed network structure, for ten rounds. Indeed, players are connected by an (exogenous) directed network, and each player has to match actions with his direct connections. We find that cycles of dependencies in the network minimum game are particularly destructive to coordination: coordination degrades if cycles are introduced into the network. Furthermore, our results highlight an interaction between network cycles and network density: coordination failure is most dramatic when the network is both dense and cyclic. Players consistently choose almost-maximal actions—regardless of connection density—on acyclic networks. In contrast, coordination is significantly more successful on sparse cyclic networks than on dense cyclic networks. So, density matters, but only for cyclic networks. Conversely, cycles matter, especially for dense networks. Indeed, the difference between the dense acyclic and dense cyclic network is a single dependency which, by completing cycles in the heretofore acyclic network, has catastrophic effects on overall coordination. Furthermore, acyclic networks make coordination resilient: initial coordination failure is often overcome after repeated play in acyclic networks, but not in cyclic networks. Our findings provide a novel perspective on the near-ubiquity of acyclic (e.g., hierarchical) structures in organizations.

In the final chapter, we study a simple contract environment with an ex-ante investment stage and where ex-post bargaining takes place under one-sided asymmetric information. There are two principal ways to organize economic activity: markets

and firms. Understanding the demarcation between the two has long occupied the attention of economists—at least since Coase (1937) famously asked why, if markets are an efficient means of allocating resources, do firms exist at all? Given that about half of all economic activity takes place in markets, and half in firms, it is perhaps not surprising that the study of the boundary between firms and markets has been an important topic for economists—indeed, giving rise to three Nobel prizes (Coase, Williamson, and Hart). Coase (1937) introduced the concept of transaction costs as a rationale for why using the price mechanism can be costly, and hence why transacting inside the firm may be preferable. In a series of contributions, Williamson (1971, 1975, 1979) unpacked the broad concept of transaction costs, emphasizing ex-post frictions such as haggling.

The modern theory of the firm—Property-Rights Theory—pioneered by Grossman & Hart (1986) and Hart & Moore (1990), emphasizes the ex-ante friction of underinvestment. Specifically, parties anticipate renegotiation of their (incomplete) contract, and because only one party can hold residual control rights through asset ownership, the other party underinvests in the relationship. Recent theoretical work in PRT has moved toward emphasizing ex-post frictions, however, through the introduction of behavioral ingredients, in particular "reference points" and "aggrievement". This is quite clearly an attempt to formally model haggling costs and to allow asset ownership to play a role. Even though it is relatively early days, this approach has proved quite fruitful.

To an economist, however, perhaps the most natural haggling cost arises from bargaining under *asymmetric information*. And, of course, PRT lends itself to just such an analysis if one does not assume symmetric information at the renegotiation stage. It is this avenue that we pursue in this chapter. We introduce a buyer–seller contracting model with ex-post bargaining under one-sided asymmetric information based on Aghion, Fudenberg, Holden, Kunimoto & Tercieux (2012), and where the seller can make an ex-ante investment that increases the buyer's valuation, as in Che & Hausch (1999). This is also similar in spirit to Bester & Münster (2016), who emphasize the value of outside options in a closely related model of performance evaluation. We offer a model where only the presence of an outside option allows for approximately ex-ante efficiency. Without an outside option, any static or sequential mechanism performs worse, which we view as a rationale for the role of ownership allocation in contracting environments with asymmetric information. We take these theoretical predictions to a laboratory setting and find that outside options as implemented through asset ownership are valuable, not because of efficient ex-ante investment but because they reduce ex-post frictions.

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