Research Statement

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I am an economic theorist with interest in Economics of Information and Contract Theory. The general theme in my research is studying what kind of economic institutions and mechanisms are needed to achieve specific objectives. My focus is on settings where individuals hold relevant *private information* (such as the cost of providing a specific commodity or the value of acquiring it), but are unwilling to reveal this information due to conflicting interests. To study these settings, I apply game theory to analyze interactions between economic agents.

The theory of Bayesian mechanisms provides a methodology to understand which economic mechanisms would be optimal for a given set of conditions. In the absence of an incentive mechanism, an economic agent can misreport her private information. The mechanism designer's task is motivating the agent to report truthfully. In the paper **Mechanism Design with Weaker Incentive Compatibility Constraints** (*Games and Economic Behavior*, 2006), I study an agent who can misreport her information in one possible direction only. I investigate the optimal mechanism which gives the right incentives for this agent. I identify a sufficient condition for this optimal mechanism to be identical to the optimal mechanism in a standard environment where the agent is able to make any misreport she wants.

In many economic settings, mechanisms deal with more than one single agent. In these *multi-agent* environments, when formulating her own report to the mechanism, each agent considers how the others will respond to the mechanism as well. One such environment is an auction setup, where a seller designs a mechanism for many potential buyers with unknown values. In **Optimal Auctions with Simultaneous and Costly Participation** (joint work with Okan Yilankaya), we look for the revenue maximizing auction mechanism when there is a bidding cost. We show that the optimal auction can be asymmetric in our completely symmetric setup and investigate the conditions under which the optimal auction is symmetric/asymmetric. Multiple agents' decisions to participate in a mechanism are also the main focus in **Equilibrium Rejection of a Mechanism** (joint work with Michael Peters). In this paper, we assume that the agents can revert to playing a *default game* by refusing to participate in the mechanism. We show that designing a

mechanism, which will be rejected in some states of nature, may be necessary to achieve certain objectives.

When a mechanism is designed for multiple agents, another concern is the possibility that these agents collude on their reports to the mechanism. Therefore a desirable property of multi-agent mechanisms is *collusion proofness*. My best known paper, **Mechanism Design with Collusive Supervision** (forthcoming in *Journal of Economic Theory*), is on the identification of the optimal collusion proof mechanism in a principal – supervisor – agent hierarchy. I show that the optimal design in this setup requires the principal's interaction with both the supervisor and the supervised agent. This scheme gives the principal a direct control over the outside option of collusion. In **Counter Marginalization of Information Rents: Implementing Negatively Correlated Compensation Schemes for Colluding Parties** (*The B.E. Journal of Theoretical Economics, Contributions*, 2008), I analyze the extent that the principal can manipulate the outside option of collusion in a hierarchy. In comparison to the earlier mentioned papers, **On the Optimality of Nonmaximal Fines in the Presence of Corruptible Law Enforcers** (joint work with Serdar Sayan, forthcoming in *Review of Economic Design*) is a more policy-oriented contribution. In this paper, we analyze the collusion potential between corrupt law enforcers and potential offenders. We provide an example where an intermediate fine minimizes the violation of a rule, instead of a large fine.

In all of the above papers, at the time that the economic interaction starts, the involved parties are already endowed with private information. In contrast, in **Interested Experts: Do They Know More?**, I analyze the search process that creates the information and the verifiable evidence for an expert who wants to influence a decision maker's choice. I show that the information generated through this process cannot be fully conveyed.

In what follows, I describe these research papers and my work in progress in more detail.

Research Papers

Mechanism Design with Weaker Incentive Compatibility Constraints, *Games and Economic Behavior*, 2006

One area of research where the theory of mechanism design has been indispensable is regulation of a monopolist with a productivity parameter (production cost) unknown to the regulator. Baron and Myerson (1982) study this regulator's design problem and provide a *second best* solution to it. They assume that the monopolist (the *agent* in the language of mechanism design) can misreport her productivity. The regulator (the *principal*) designs a mechanism to motivate the monopolist not to misreport.

Baron and Myerson's monopolist is assumed to be able to misrepresent her productivity in any way she wants. In practice, a monopolist can find it easier to conceal her access to productivity enhancing technology as compared to disclosing a technology that does not actually exist. This would make overstating the monopolist's productivity much harder than understating it. My paper is motivated by this disparity. In my model, the agent has *partially verifiable* information. She is capable of understating her productivity but is not able to overstate it. I study the optimal mechanism for a principal interacting with this agent.

When the *monotone hazard rate condition* is assumed over the distribution of the productivity levels, the only relevant incentive for the agent is imitating a less productive type to increase compensation. However, if one is not willing to make any assumption over the distribution, the ability to imitate a more productive type matters. In this paper, I provide a sufficient condition for the solution under this partially verifiable information setup to be the same as the Baron and Myerson's second best solution, which is derived under the assumption of non-verifiable information. This sufficient condition depends on the principal's and the agent's payoff functions. However, unlike the monotone hazard rate condition, it is independent of the specifics of the distribution function.

Optimal Auctions with Simultaneous and Costly Participation, joint work with Okan Yilankaya

Another example where the theory of mechanism design comes in handy is the design of an auction to maximize the seller's expected revenue. For the independent private values setting, Myerson (1981) finds a solution to this problem. When the bidders are ex-ante symmetric, this optimal auction can be implemented through one of the common auction formats (e.g. first price or second price sealed bid auctions) with an appropriately chosen reserve price.

Myerson's model assumes away any cost of participation in an auction. Yet, in many environments, bidders are required to prequalify, to register, to be present in the auction site, to submit a detailed plan of operations (especially for procurement auctions), to post a bid bond, or to make advanced arrangements for financing. These activities involve incurring costs which can be avoided by not submitting a bid. In our paper, we study the optimal auction problem with costly participation. To do so, we utilize a model where ex-ante symmetric bidders make their participation decisions independently after observing the seller's mechanism.[1]

[1] Samuelson (1985) studies the first price auction where bidders make costly participation decisions independently. Under the same costly participation assumptions, Stegeman (1996) shows that the second price auction has an (possibly asymmetric) equilibrium which is (ex-ante) efficient. Tan and Yilankaya (2006) indentify sufficient conditions for uniqueness and multiplicity of equilibria in the second price auction.

We start with an example showing that the optimal auction is not always symmetric in our completely symmetric setup. Unlike in the cost free case, the seller may find it optimal to favor some of the bidders in expense of the others. We then investigate when the optimal auction will be symmetric – as in the zero participation cost case, and asymmetric – as in the example we construct. We identify distributions (of the bidder valuations) for which the optimal auction is asymmetric/symmetric independent of the magnitude of the participation cost and the number of bidders. We also have results about the nature of possible asymmetries that simplify the task of finding the optimal auction.

When the optimal auction is asymmetric, the extent of the preferential treatment of some bidders can go as far as "sole-sourcing," i.e. making a take-it-or-leave-it offer to one of the bidders and ignoring the others. Otherwise, the seller can implement the asymmetric optimal auction with first or second price auctions enhanced with *bidder specific* entry fees or bid subsidies.[2] Surprisingly, the seller does not necessarily need an auction format with discriminatory rules to implement an asymmetric auction. We show that, under some conditions, an asymmetric equilibrium of a second price auction (with a reserve price and an entry fee – both of which are common across the bidders) implements the revenue maximizing auction.

Equilibrium Rejection of a Mechanism, joint work with Michael Peters

This paper is also about multiple agents' decisions to take part in a mechanism. However, unlike in the previous paper, there is no exogenous participation cost here. The agents are players of a *default game*. The mechanism is the means of coordinating how they would play this default game. By refusing to participate, a player can veto the mechanism and revert back to playing the default game *non-cooperatively*. Our lead example in this paper is a cartel agreement between two competing firms, which may have private information regarding their production cost. By signing an agreement, these firms can limit their output levels. If they fail to agree, they make their production decisions non-cooperatively. This setup differs from the standard design setup, since the outside option of a player is playing the default game instead of receiving an exogenous (possibly type contingent) allocation.[3]

[2] Similar instruments have been used for preferential treatment of some bidder groups (domestic firms, small businesses, or minority groups) in government-run auctions (generally motivated by welfare concerns).

[3] A monopolist makes zero profit by rejecting the regulator's offer. A bidder receives zero payoff by not participating in the auction. However the payoff of a firm which does not participate in the cartel agreement is determined by its future interaction with the competitor firm.

In order to say more on this design setup, we would like to know which *allocation rules* (economic allocations as functions of the state of nature) are *implementable* (can be supported by equilibria of mechanisms that a designer can offer to the players). In standard design problems, where the outside option is exogenous, the *revelation principle* is an important tool in characterizing the implementable set: For any implementable allocation rule, there exists a direct revelation mechanism and a truthful equilibrium (where the agents unanimously participate in the mechanism and reveal their types) of the ensuing game, which support the allocation rule in question. In contrast, when the outside option is playing a default game, our paper illustrates with an example that there are allocation rules that can only be supported with equilibria in which some types of some players refuse to participate in the mechanism.

It is important to understand what complicates the players' participation decisions when there is a default game. Existence of the default game implies a sequential interaction between the players. The solution concept we use imposes *sequential rationality* of the strategies. If a mechanism is rejected, how the players will play the default game depends on their beliefs about each other. When Player 1 rejects a mechanism, Player 2 updates her belief about Player 1's type. More importantly for the construction of our example, following her own rejection of a mechanism, Player 1 also updates her *higher order beliefs* on what Player 2 knows about Player 1's type. The default game is played under these updated beliefs. If all players are expected to participate in a mechanism for sure, the equilibrium cannot support the same updated beliefs for the default game. Therefore the expected payoffs from the default game played under the updated beliefs cannot be replicated with the unanimous acceptance of the mechanism.

The design setup with the default game has been studied by Myerson and Holmstrom (1983), Crawford (1985), Lagunoff (1995), and Cramton and Palfrey (1995) among others. The earlier papers either identify mechanisms which will be accepted by all types of all players or look for default games where all alternative mechanisms will be rejected by at least one agent. Our paper complements this literature by studying mechanisms which are accepted under some states of nature but rejected under some others. These are the only mechanisms to support the information revelation that is necessary to implement certain allocation rules.

Mechanism Design with Collusive Supervision, forthcoming in *Journal of Economic Theory*

The theory of mechanism design, in its most standard form, deals with the incentives of individual agents. Each agent who is taking part in a mechanism should be provided with the incentive not to misreport her private information. When there is possibility of collusion between the agents, the design problem is

generally more demanding. In this case, the mechanism designer should account for any side deal that these agents can make to collectively misreport their types.

In this paper, I study the collusion problem in the context of a principal – supervisor – agent hierarchy. The principal designs a mechanism for a productive agent and the agent's supervisor, who is partially informed on the production cost. The partial information is represented as a *connected partition* of the agent's type space, i.e. the supervisor does not observe the production cost but she observes an interval of costs, including the realized production cost. Once the principal commits to a mechanism, the supervisor and the agent collude on how they would respond to it. The principal's task is finding a mechanism which is *collusion proof*.[4]

A natural remedy to the problem of collusion seems to be accommodating it as a part of the mechanism. The principal cannot forbid a side deal between her subordinates. So, perhaps, the best she can do is to contract with the supervisor exclusively, and to delegate her the authority to deal with the agent. A substantial portion of the earlier research on collusion suggests that this delegation scheme must be the principal's optimal response to collusion.[5] However, in this paper, I get quite the opposite result regarding the performance of delegation. I show that, under monotonicity of the hazard rate, delegating to the supervisor is even worse than not having any access to a partially informed supervisor. Under delegation, the supervisor has to leave an information rent to the agent to acquire her private information. Moreover the principal has to pay a further markup to the supervisor to obtain the same information from the supervisor. This duplication of the information premium is referred to as the *double marginalization* of the information rents.[6]

Even when delegation fails as an organizational response to collusion, I show that it is possible for the principal to benefit from the supervisory information. However, for beneficial supervision, it is vital to keep the principal's communication with the agent open. Through this communication channel, the agent can "blow the whistle" on the supervisor and contract directly with the principal. This gives the principal a control over the agent's outside option to colluding with the supervisor. The principal can manipulate this outside option to hinder collusion.

This paper has received a lot of attention in the concurrent literature, especially due to its implications on the value of delegation. It is cited by many papers,[7] and discussed in detail by Mookherjee and Tsumagari (2004), Che and Kim (2006), and Mookherjee (2006).

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[4] Collusion proofness is defined by Laffont and Martimort (1997, 2000), and more recently by Che and Kim (2006).

[5] See Baliga and Sjostrom (1998) in the context of moral hazard, and Laffont and Martimort (1998) in the context of adverse selection.

[6] See Mookherjee (2006) for a discussion of double marginalization of the information rents.

[7] These papers include Faure-Grimaud et al. (2003), Martimort (2006), and Baliga and Sjostrom (forthcoming).

Counter Marginalization of Information Rents: Implementing Negatively Correlated Compensation Schemes for Colluding Parties, *The B.E. Journal of Theoretical Economics (Contributions tier)*, 2008

In the paper on collusive supervision, I show how a principal may benefit from manipulating a productive agent's outside option to collusion. With this second paper on the topic of collusion, I analyze the extent of the manipulation the principal can support. The underlying interaction between the principal and the agent is quite similar to the one in the previous paper. The principal wants to get the most out of the productive agent, whose cost level is private information. To benefit from the techniques of dynamic optimization, the agent's type space is assumed to be a continuum here. There is no supervisor who has relevant information on the agent's type. Instead, the third player here is an insurer who can insure the "budget constrained" principal against the variation in the monetary transfer to be paid to the agent.

If there were no possibility of collusion, the principal could have designed a mechanism, where she could be fully insured and therefore could be making the same amount of monetary payment in all states of nature. The insurer would cover the difference between the principal's payment and the agent's compensation. The full insurance scheme is susceptible to collusion between the insurer and the agent. Under this scheme, the insurer is willing to bribe the agent to affect the latter's production decision.

The first part of the paper is about the characterization of the compensation schemes that the principal can implement in a collusion proof way. The agent's compensation is determined by a familiar first order condition. Her remuneration is decreasing in the cost level, so that she does not prefer to overstate the cost. The principal has more leeway when setting the insurer's compensation. The insurer's payoff may be either decreasing or increasing in the agent's cost level, indicating either double marginalization or *counter marginalization* of the information rents. The continuum of types assumption considerably simplifies the identification of these collusion proof rates of change of the insurer's payoff.

The second part of the paper is on investigating the optimal collusion proof mechanism. Since insuring the principal requires the agent's and the insurer's compensation functions to move in opposite directions, the optimal mechanism demands for counter marginalization. The threat of collusion limits the opportunities of insurance for the principal. The optimal collusion proof mechanism provides the principal with partial insurance only.

On the Optimality of Nonmaximal Fines in the Presence of Corruptible Law Enforcers, joint work with Serdar Sayan, forthcoming in *Review of Economic Design*

In this paper, we develop a model of law enforcement with the possibility of corruption between *enforcers* and *potential offenders*. We assume that potential offenders have different attitudes for cooperation with corrupt enforcers. In this setup, we study how the violation rate changes with the level of the fine imposed on violations. This paper differs from the above discussed papers, since the designer here (the government) has discretion only on the level of one single parameter (the fine), rather than on all possible dimensions of individual compensations.

We provide an example where, in contrast to the conventional wisdom, an intermediate fine level minimizes the violation rate instead of a large fine. This result follows from the fact that an increase in fines would affect different potential offenders differently: Soaring fines would be less effective on individuals who are ready to bribe the enforcers to avoid these fines as compared to individuals who are opposed to bribery. Therefore, increased fine levels may change the composition of the group of offenders, increasing the proportion of individuals (within this group) who view bribes as an acceptable alternative to high fines. This change in the offender profile simultaneously affects the incentive structure for the enforcers. Now facing more corruptible offenders, the enforcers become more likely to ask for a bribe, making violations less costly for some potential offenders. The resulting equilibrium may induce more corruption and more violation than under the lower fine.

After providing our example, we turn to the investigation of conditions under which an intermediate fine, such as the one in the example, would be preferable to a large fine. We show that reducing the fine for the violation could be the best policy to complement increases in the detection effort and the punishment for corruption, or the civil society initiatives to fight corruption.

Interested Experts: Do They Know More?

Courts consider evidence brought by the disputing parties. Potential car buyers make purchasing decisions after talking to the car dealer. The medical profession's general opinion on a drug is influenced by what the pharmaceutical industry reveals about it. These are all examples of settings, where a *decision maker* has to take an action after observing the evidence brought by a self – interested *expert*. These experts usually cannot forge evidence to support their claims. However they can conceal the negative pieces of evidence from the decision maker. Therefore, a sophisticated decision maker interprets the missing evidence to be unfavorable to

the expert's cause. This skeptical attitude of the decision maker compels the expert to reveal whatever information she can.[8]

In some settings, the evidence is not readily available to the expert, but it must be produced through a series of costly trials (such as clinical studies commissioned by a pharmaceutical firm). Accounting for this evidence production technology does not reverse the full revelation result above. The sophisticated decision maker can infer the number of trials to be conducted by the expert and interpret the unreported results as negative.[9]

In this paper, I concentrate on the sequential nature of the evidence search. I assume that the expert decides whether to conduct each trial after observing the evidence that is already accumulated from the earlier trials. Once the expert concludes her evidence search, she reports the positive evidence to the decision maker. The question of interest here is whether the magnitude of the hidden negative evidence (or the intensity of search) is revealed by the magnitude of the reported positive evidence. I provide a negative answer to this question by showing that there is no equilibrium where the extent of the hidden evidence is always unraveled.

Work in Progress

Negotiated Mechanisms, joint project with Michael Peters

My paper with Michael Peters on the equilibrium rejection of a mechanism leaves us with a negative result on the characterization of the implementable allocation rules. It implies that we cannot depend on mechanisms unanimously accepted on the equilibrium path. In this follow up project, we wish to offer a resolution to this problem by letting the mechanism designer to offer mechanisms allowing for negotiations between the players. Specifically, we want to enhance the mechanisms with *ratification messages*. These messages represent what is revealed to the public domain through the negotiations between the players when agreeing on a mechanism. If such a *negotiated mechanism* is accepted by all players, how they play the default game is determined by their ratification messages as well as their reports to the mechanism. If the mechanism is rejected, then the players observe the ratification messages, update their beliefs, and play the default game non-cooperatively under the updated beliefs.

Once we allow for these negotiated mechanisms, we can show that any implementable allocation rule is implementable with unanimous acceptance on the equilibrium path. The designer does not need equilibrium rejections any more. In-

[8] See the *persuasion game* analyses by Grossman (1981) and Milgrom (1981).

[9] See Jovanovic (1982).

stead, she can motivate the players to reveal relevant information through the ratification messages.

For an allocation rule to be implementable in this setting, it must be in the players' interest to send the correct ratification messages. This imposes a constraint much stronger than the standard *individual rationality* constraint ensuring the players' participation. Suppose that this constraint is satisfied and all players accepted the mechanism. The next step for the players is revealing their remaining information to the mechanism. For the standard Bayesian settings, truthful revelation is guaranteed by the interim *incentive compatibility* constraints. However, after observing their rivals' ratification messages, the players' information structure is potentially *finer* than their interim information structure. Therefore the resulting truthtelling constraints are stronger than the interim incentive compatibility constraints as well.

These observations imply that an allocation rule satisfying the standard individual rationality and incentive compatibility constraints may not be implementable under negotiated mechanisms. To say more about the set of implementable allocation rules, we use the concept of *equivalent implementability* as defined by Mookherjee and Reichelstein (1992). An allocation rule is equivalently implementable if it is in essence identical to an implementable allocation rule, i.e. it gives the same interim expected utility to all types of all players as does an implementable allocation rule. Under the assumption of independent private values and transferable utilities, we can show that an allocation rule is equivalently implementable if it satisfies standard individual rationality and incentive compatibility constraints.

"Do Not Mistake Bribe Taking as Corruption"[10]

In both of my collusion papers, the optimal collusion proof mechanism involves sustaining conflicting interests between the potential colluders. These conflicting positions are created through negatively correlated compensation schemes. In either paper, the productive agent's monetary compensation is increasing in her production level, whereas the third party's (the supervisor or the insurer) compensation is decreasing in the same variable. When applied to the theory of the firm, it is possible to interpret this as a *relative performance evaluation*. However, since the third party does not have a productive task in either of my papers, relative performance evaluation takes the form of a wage which is decreasing in the firm's performance.

[10] The working title of this project is a quotation from Vladimir Rushailo, former Russian minister of internal affairs. Time Magazine, April 9, 2001.

What I want to show with this project is that the optimal allocation rule can also be implemented without a decreasing wage function. The resulting mechanism is not collusion proof. However, when the agent and the third party collude, they find it optimal to collude on the principal's optimal allocation rule. The mechanism here leaves the third party with a wage function non-decreasing (possibly constant) in the agent's performance. However, the bribe that the agent pays to the third party is decreasing.

This observation also implies that evidence of corruption does not necessarily indicate an inefficiency of the institutional design. Equilibrium corruption may very well lead to the optimal allocation rule within the set of implementable allocation rules.

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