Research Statement

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Gorkem Celik
Associate Professor of Economics
ESSEC Business School

I am an economic theorist with interest in Economics of Information and Contract Theory. My research explores 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. Another concern here is the possibility that these agents collude on their reports to the mechanism. Therefore a desirable property of multi-agent mechanisms is collusion proofness. Mechanism Design with Collusive Supervision (Journal of Economic Theory, 2009) is on the identification of the optimal collusion proof mechanism in a principal – supervisor – agent hierarchy. In this paper, 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, Review of Economic Design, 2008) 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 rate of violations, instead of a large fine.

I have been collaborating with Okan Yilankaya to study auctions where bidders incur a participation cost to submit their bids. Such costs arise naturally in many real-life auctions. We probe into the optimality and efficiency consequences of these costs in two separate papers. In Optimal
Auctions with Simultaneous and Costly Participation \cite{BECJ2009}, we characterize the revenue maximizing auction mechanism. We show that, even when the potential bidders are (ex-ante) symmetric, it may be optimal to design an auction which treats the bidders asymmetrically. We investigate conditions under which the optimal auction is symmetric/asymmetric and the nature of the asymmetries. In Resale in Second-Price Auctions with Costly Participation \cite{BECJ2014}, we focus on the second-price auction under costly bidding. We show that, when bidder valuations are drawn from a strictly convex distribution function, this auction has a class of asymmetric equilibria which are more efficient than the symmetric equilibrium. If the winner is allowed to resell the good (to the other bidders by using an optimal auction), the asymmetries become more pronounced. Moreover, under a sufficient condition, resale increases efficiency of these asymmetric equilibria.

Decision to participate in a mechanism is also an important concern in my joint work with Mike Peters. We have two papers on the theme of \textit{games played with mechanisms}. In Equilibrium Rejection of a Mechanism \cite{GEB2011}, it is an outside designer who offers a mechanism to the players of the game. The agents can revert to the non-cooperative play of the game by refusing to participate in the mechanism. Mike and I show that offering a mechanism which will be rejected by the players in some states of nature may be necessary to achieve certain objectives. In our construction, the players use the act of rejection to signal their private information to their rival and these signals affect the non-cooperative play of the game in the absence of an agreement. In Reciprocal Relationships and Mechanism Design \cite{BECJ2014}, we replace the hypothetical mechanism designer with a \textit{reciprocal contracting game}. In this game, each player can commit to his own mechanism which is contingent on the mechanisms of the other players. We characterize the equilibrium outcomes of the reciprocal contracting game and the implications of this characterization for modeling collusion in multi-agent mechanisms.

More recently, I became interested in environments where the private information of the agents is revealed over time (rather than all at once). I discuss my results on this topic in Implementation by Gradual Revelation \cite{RJE2017}. I show that, with independently distributed types, private values, and transferable utilities satisfying a single-crossing property, an ex-post monotonicity condition is sufficient for budget-balanced implementation of any incentive-compatible allocation rule with any gradual-revelation scheme. When this single-crossing property is extended over the set of randomized allocations, a weaker monotonicity condition is both necessary and sufficient for budget-balanced implementation by gradual revelation.

In what follows, I describe these research papers in more detail.
RESEARCH PAPERS

A) Partial Verifiability of Private Information


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.

B) Collusion Proof Mechanism Design


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*.

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. 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.

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, and discussed in detail by Mookherjee and Tsumagari (2004), Che and Kim (2006), and Mookherjee (2006).


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

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1 Collusion proofness is defined formally in the work of Laffont and Martimort (1997, 2000) and revisited more recently by Che and Kim (2006).


3 See Mookherjee (2006) for a discussion of double marginalization of the information rents.

4 These papers include Faure-Grimaud et al. (2003), Martimort (2006), and Baliga and Sjostrom (2009).
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 compensation of the agent 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.


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.

C) Costly Participation in Auctions

Traditional auction models assume 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. Okan Yilan-kaya and I have written two papers to investigate the effects of these costs in the design of optimal and efficient auctions. In both papers, private values of the bidders are independently and identically distributed. Even though the bidders are symmetric in the ex-ante sense, an asymmetry among them may arise either as a part of the optimal design or as an equilibrium phenomenon.


In the absence of participation costs, Myerson (1981) identifies the optimal auction which maximizes the seller’s expected revenue for independent private values setting. When 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.

Our paper starts 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

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5 Our research is based on the costly bidding setup introduced by Samuelson (1985).
first or second-price auctions enhanced with bidder specific entry fees or bid subsidies. 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.

Resale in Second-Price Auctions with Costly Participation, joint work with Okan Yilankaya, 2014.

In this paper, Okan and I turn to investigating the efficiency effects of costly participation in the context of second-price auctions. We know from earlier research that, even when bidders are (ex-ante) symmetric, second-price auctions may have asymmetric equilibria where some bidders are (ex-ante) more likely to participate than others. Such equilibria allocate the auctioned object to the highest valuation bidder among the participants. Yet, there is a possibility that a non-participating bidder has a higher valuation than the winner of the auction. This allocative inefficiency implies that there are potential gains from further trade through resale.

We first show that, when the valuations are distributed according to a strictly convex cumulative distribution function, there are asymmetric equilibria which are ex-ante more efficient than the symmetric equilibrium. These equilibria partition bidders into two arbitrary groups using two different participation cutoffs. Each bidder participates in the auction if her valuation is higher than her group-specific cutoff.

Suppose that there exists a two-cutoff asymmetric equilibrium of the second-price auction without resale, where one group (aggressive participants) has a low cutoff and the other group has a higher one. As our second result in this paper, we show that there also exists an equilibrium that partitions bidders the same way when resale is allowed. Moreover, this resale equilibrium is more asymmetric than the corresponding no-resale equilibrium: The low cutoff decreases and the high cutoff increases. The prospect of reselling the good induces the low-cutoff bidders to enter even more aggressively and the possibility of buying the object in the resale phase makes the high-cutoff bidders even more hesitant to enter. There is also overbidding by low-cutoff bidder types who hope to resell: They bid their adjusted values (expected payoffs inclusive of the resale phase), which are higher than their use values.

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6 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).

7 See Stegeman (1996) for an example, and Tan and Yilankaya (2006) for sufficient and necessary conditions for existence of asymmetric equilibrium.

8 Existence of asymmetric equilibria under strict convexity has been established by Tan and Yilankaya (2006). We complement this finding by showing that these two-cutoff equilibria provide a higher expected social surplus (net of participation costs) than does the symmetric equilibrium.

9 Xu, Levin, and Ye (2013) make similar observations in the context of a model where resale opportunities arise because of the differences in the bidders’ participation costs for the second-price auction.
Fixing participation and bidding behavior in the initial auction, resale enhances efficiency as the object is potentially transferred to a higher-value bidder. However, resale may also affect the equilibrium cutoffs and bids. Nevertheless, provided that a sufficient condition is satisfied, allowing resale improves ex-ante efficiency: Whenever there is a two-cutoff asymmetric equilibrium without resale, the corresponding more asymmetric equilibrium with resale yields a higher social surplus. This sufficient condition is on the distribution of valuations and hence independent of the magnitude of the participation cost and the number of bidders.

**D) Games played with Mechanisms**

My joint work with Mike Peters focuses on how economic agents can use mechanism design to coordinate their behavior in a default game. We consider settings where each player can veto the mechanism and revert back to playing the default game non-cooperatively. Our lead example here 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 in order to increase prices. If they fail to agree, they make their production decisions non-cooperatively. Other examples captured by this setting include bidders colluding through a bidding ring, disputing governments negotiating a peace settlement, and even a couple contemplating marriage. This setup differs from the standard mechanism design setup, since the outside option of a player is playing the default game instead of receiving an exogenous (possibly type contingent) allocation.

The research question here is characterizing which allocation rules (economic allocations as functions of the state of nature) are implementable (can be supported by equilibria of mechanisms that will be offered to the players). Mike and I have two papers on this issue. With the first paper, we study a setting where the mechanism is offered by an outside designer. We show that this designer should offer mechanisms which are rejected with a positive probability in order to implement certain allocation rules. In the second paper, we replace this centralized design approach with a reciprocal contracting game and characterize the set of implementable allocation rules by this game.


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 supports 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.


In our earlier work, we demonstrate that the equilibrium path belief update opportunities enlarge the set of implementable allocation rules. However, the additional allocation rules achieved through such signaling require that the mechanism is rejected with a positive probability. With our second paper, Mike and I consider a model which increases the signaling opportunities of the players by letting them design their own contracts.

More formally, our model endows each player with the ability to communicate with other players and to make commitments based on these communications. In particular, we let each player write a reciprocal contract which conditions his default game action directly on the contracts of the other players. If all the reciprocal contracts agree with one another, then they implement some kind of cooperative action. If they do not agree, then the contracts are null and void, so each player is free to choose any action he wants in the default game.

Our main result is the characterization of all the outcome functions that can be supported as (perfect Bayesian) equilibrium outcomes in our reciprocal contracting game. An important subset of these outcomes is supported by equilibria which do not involve any information revelation by the players during the negotiation of the contract. We argue that these pooling equilibrium outcomes coincide with the outcomes that can be sustained by a mechanism designer. This designer is constrained to offer a contract that is acceptable to all players regardless of their private information and who cannot influence the play in the default game when a player unexpectedly rejects the contract.

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10 This connects our paper to the recent literature on contracts which can condition on one another. See Tennenholtz (2004), Kalai et al. (2010), Peters and Szentes (2012),Forges (2013) and Peters (2013) among others.
We also show that the reciprocal contracting game has separating and partially separating equilibria which support outcomes that this constrained mechanism designer cannot. The ability to reveal partial information during the contracting process changes the outside option of players in the default game, should they decide not to cooperate. In a separating equilibrium, a player could still trigger the non-cooperative play of the default game by not reciprocating with the other players. In this case, the default game would be played under the updated beliefs on the types of the non-deviating players. This is because of the signaling that occurs through the contract offers that these players make. As a consequence, the payoff that the deviating player receives is the expectation of his non-cooperative payoff against the various posterior beliefs he might face. This expectation could well be lower than what this player would have received in the default game played under the prior beliefs.

Mike and I discuss the implications of our analysis for modeling collusion between multiple agents interacting with the same principal. We show that, if the agents are colluding through reciprocal contracts, the principal can implement outcomes which are deemed to be prone to collusion by the earlier literature. However, the discrepancy between our results on collusion and those of the earlier literature disappears under the private values, single crossing, and transferable payoff conditions.

E) Gradual Revelation of Information

Implementation by Gradual Revelation, accepted for publication, Rand Journal of Economics.

We learn from the revelation principle that any allocation rule implementable through an arbitrary mechanism is also implementable via a direct revelation mechanism, which simply asks the agents to report their types. These direct mechanisms must be constructed to motivate the agents to reveal all their private information simultaneously. In this paper, I investigate if there is a way to motivate the agents to reveal their private information gradually. For instance, I want to know if we can find a gradual revelation mechanism such that we first learn something about agent 1’s type, then agents 2 and 3 simultaneously reveal some information about themselves, and then agent 1 reveals some more pieces of information, etc. In the paper, I discuss the real-life relevance of gradual-revelation mechanisms by using examples from auction design, intra-firm resource allocation problems, and civil litigation.11

Under a gradual revelation mechanism, the agents’ and the observers’ information will evolve according to a martingale.12 The research question here is which allocation rules can be implemented with which martingales.13 I study this question in the context of an economy with inde-

11 Mookherjee and Tsumagari (2014) motivate a similar mechanism by referring to communication costs.


13 This research question implies that what is important for the evaluation of the mechanism is not only the resulting allocation, but also the way that this allocation is supported. Using the terminology of Baliga and Sjostrom (2007), gradual revelation mechanisms have non-consequential values in addition to the standard consequential values.
pendently distributed types, private values, and transferable utilities satisfying a single-crossing property. A well-known condition that is indispensable both for implementation by simultaneous revelation (as prescribed by the revelation principle) and for implementation by gradual revelation is incentive compatibility: An implementable allocation rule should provide each agent with the incentive to report his type truthfully under his prior beliefs regarding the types of the other agents. The results of this paper identify other conditions that guarantee implementation of an allocation rule by using a gradual-revelation mechanism.

There is one class of allocation rules that can be trivially implemented through gradual-revelation schemes. When an allocation rule is dominant-strategy incentive compatible, truthful revelation remains the optimal strategy of an agent regardless of what he learns about the types of the other agents. Mookherjee and Reichelstein (1992) establish that an incentive-compatible allocation rule can be transformed into a dominant-strategy incentive-compatible allocation rule when the original allocation rule is ex-post monotone. The allocation rule resulting from this transformation is identical to the original allocation rule up to a transfer function that yields the same interim expected payoff for the agents as in the original allocation rule. Mookherjee and Reichelstein prove this result in a continuous-type environment by invoking the revenue equivalence theorem. I extend their transformation to the discrete type model I study in this paper.

I then turn to the issue of budget balance in the context of gradual revelation mechanisms. It is well known that dominant-strategy implementation is generally incompatible with balancing the budget. Therefore the Mookherjee-Reichelstein type of transformation discussed above requires outside intervention to provide agents with the appropriate transfers. However, I show that the ex-post monotonicity condition, which is sufficient for dominant-strategy implementation of an incentive-compatible allocation rule, is also sufficient for its budget-balanced implementation under any possible sequence that the private information may be revealed.

Ex-post monotonicity is a sufficient condition to reconcile gradual revelation with a balanced budget, but it is not a necessary condition. In the paper, I also introduce a weaker monotonicity condition that is defined with respect to the intended sequence of revelations. When the single-crossing property is extended over the stochastic allocations, this weaker monotonicity condition is necessary and sufficient for budget-balanced implementation by gradual revelation.
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