



Well-designed incentive schemes: introduction to the special issue in honor of Semih Koray

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Should one had to pick a single notion that covers the scholarly work of Semih Koray, this would be *Economic Design*. He has a deep vision of this area, which I think of as *à la Sertel*. This special issue entitled *Well-Designed Incentive Schemes* is a tribute to his ongoing career and aims to reflect that vision, the sharpest expression of which can be found in the introduction of *Advances in Economic Design*, edited by Semih, together with Murat R. Sertel (Sertel and Koray 2003):

"Every existing institution is one from among many possibilities, and in many cases, it is very doubtful that the existing world is the best among all possible worlds that we could have had."

One immediate corollary is that we should seek better designs, for better institutions. A further exposition of this vision can be found in another introduction of Sertel (1999), entitled "*Discoveries vs Inventions in Economics*", where he refers to the Aims and Scope of the *Review of Economic Design* (initially called *Economic Design*), which he drafted as its founding editor:

"In this age of Economic Design, the accumulated traditions and wealth of knowledge in normative and positive economics and the strategic analysis of game theory are applied with novel ideas in the creative tasks of designing and assembling diverse legal-economic instruments. These include constitutions and other assignments of rights, mechanisms for allocation or regulation, tax and incentive schemes, contract forms, voting and other choice aggregation procedures, markets, auctions, organizational forms such as partnerships together with supporting membership and other property rights, and information systems. These designs, the methods of analysis used in their scrutiny, as well as the mathematical techniques and empirical knowledge they employ, along with comparative assessments of the performance of known economic systems and implemented designs, all of these form natural components of the subject matter of *Economic Design*."

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The work of Semih Koray as an economic theorist spans several “natural components of the subject matter of Economic Design” (from the same Aims and Scope). He started his academic career as a pure mathematician, with a doctoral dissertation on semigroups completed in 1980 at Boğaziçi University. During the same period Murat Sertel left the United States to work in his home country of Turkey. Happily, the two men met. It will come as no surprise to those who knew Murat, an endless source of inspiration, that he guided Semih towards economic theory.

Semih has been an iconoclast when it comes to the efficiency of unregulated markets. His coherent research agenda has been shaped, in part, by his view that prevailing opinions as to the applicability of market theory to the real world have been marked by overconfidence. Taking the risk of stating the obvious for the economic design community, I will make a few remarks on this overconfidence, hoping to put the research agenda of Semih Koray into perspective.

While the two fundamental theorems of welfare economics establish the equivalence between allocations that are Pareto efficient and those that are obtained through markets, both theorems hold under restrictive assumptions that exclude several real-life situations.¹ Moreover, it is arguable whether an institution should be praised solely because it leads to Pareto efficient allocations. After all, we know from Piccione and Rubinstein (2007) that the two welfare theorems apply not only to markets but also to jungle-like institutions that induce a pernicious power relation among individuals.

To be sure, I don't mean to overlook the virtues of markets, particularly their capacity to aggregate information, as argued by Hayek (1945).² But the two welfare theorems should be interpreted with caution, which is sometimes missing. *Laissez faire, laissez passer* may be good advice in certain instances but these instances are rather restricted and unconditional statements such as “when everyone follows his self-interest the outcome is good for the society” do not follow from the two welfare theorems. In fact, such a statement can completely miss the mark, as it does for the prisoners' dilemma game where the self-interested non-cooperative solution is Pareto dominated by the cooperative one.

There is, then, no invisible hand that implements a desired set of social goals, or that even knows what that desired set may be. For this, we need social organizations that give appropriate incentive schemes—schemes that are *well-designed*. This lesson has served as a guiding principle in Semih Koray's research.

Any summary of the life-long work of a leading scholar is doomed to be incomplete. Nonetheless, I will attempt to outline the major contributions of Semih Koray.

Pretend-by-perform mechanisms

“Either appear as you are, or be as you appear” says the 13th-century poet, Rumi. Interpreting this expression from an economic design perspective, “appearing as one is” would correspond to incentive compatibility. The dual approach that inspired Sertel

¹ One can see Stiglitz (1991) for an eloquent discussion of these restrictions and Blaug (2007) for a historical account of the two theorems.

² One can see Smith (1982, 2010) for experimental examinations of this *Hayek hypothesis*.

(1982) to define a *pretend-but-perform mechanism* reflects the second part, “being as one appears”. In these mechanisms, a player is allowed to pretend to have any identity, as long as she behaves in accordance with her pretended identity. Pretend-but-perform mechanisms have been analyzed by Koray and Sertel (1983) through normal form games and the application of two separate solution concepts—one for the game in which players get to choose their pretended identities and the other for the original game under the pretended identities. Thus, there is a composed solution concept that may differ from the component solution concepts employed at the two separate stages. The analysis yields a dozen-fold classification of two-person games.

An elegant application of two-player pretend-but-perform mechanisms for design purposes is made by Koray and Sertel (1988, 1990), who show how to regulate a Cournot oligopoly by asking the firms to announce their cost parameters. While firms can pretend to have any cost structure, once the announcement is made they are required to exhibit the non-cooperative behavior compatible with the fictitious oligopoly based on the pretended cost structures. This triggers a competition for the market share that would otherwise be absent.

Regulating firms whose costs are private information

The Bayesian mechanism of Baron and Myerson (1982) for monopolies, which assumes that the regulator has an unchallenged prior belief about the private cost function of the monopolist, remains a seminal contribution to regulating firms whose costs are private information. Koray and Sağlam (2005) analyze what happens if this prior belief itself is manipulable. They start by showing that with a Baron and Myerson mechanism, consumers and the regulated monopoly are highly sensitive to the regulator’s prior belief about the cost function of the monopolist. Thus, a regulator who is not held accountable for her beliefs has both the incentive and the opportunity to change or misrepresent her prior belief when facing pressure or payoffs from interest groups representing either the consumers or the regulated firm.

As a result, the outcomes under a Baron and Myerson mechanism can vary over a wide spectrum, depending on which interest group is favored. Sağlam and Koray (2007) examine the social desirability of learning about the regulated agent in a generalized principal-agent model with incomplete information. They show the existence of situations in which the agent prefers a Bayesian regulator to have more (yet still incomplete) information about his private type. These findings suggest caution when putting the insights of Bayesian regulatory theory into practice.

Incentives for multi-principals and multi-agents

Ichiishi and Koray (2000) propose a job market model with a group of informed job applicants and a group of uninformed employers. Every applicant has private information about his type and chooses an education level that serves as a message. All employers are of the same type but may have different information structures on actions of the applicants. A wage schedule specifies a wage level for each education

level. There is a game which starts with each employer proposing a wage schedule. This is followed by each applicant first choosing an education level and then choosing an employer according to the best available wage schedule for him. So, different wage schedules offered by employers are endogenously determined. It is assumed that applicants behave non-cooperatively. In this environment, there does not exist any equilibrium at which employers exhibit cooperative behavior. On the other hand, equilibria in which employers exhibit non-cooperative behavior do exist in many cases. In these equilibria, it is the possession of the right information (in the sense that it best serves the needs of applicants) rather than the informational advantage (defined as the abundance of measurable sets) that makes an employer better off.

Kerschbamer and Koray (2001) study contractual arrangements that result from a game among multiple principals acting non-cooperatively. To solve this contract-design game they introduce the notion of an *Epsilon Contracting Equilibrium*. In perfectly symmetric environments, pure strategy Epsilon Contracting Equilibria may not exist. For mixed strategies, coordination failures among principals may lead to suboptimal institutional arrangements. Despite the inefficiency of these institutional arrangements relative to incentive constraints, the solution can nevertheless be improved if principals overlook the existing informational interdependence by restricting themselves to independent contracts.

Self-selective social choice functions

Koray (2000) introduces a new concept of consistency for social choice functions, called *self-selectivity*, which requires that a social choice function chooses itself when this social choice function is employed by the society to decide which social choice function to use for all future decisions of a certain kind. When self-selectivity fails, a social choice function rejects itself according to its own rationale, and this can be regarded as a sort of inconsistency. Nevertheless, adopting this criterion results in a strong impossibility theorem: A unanimous and neutral social choice function ensures self-selectivity at every preference profile if and only if it is dictatorial. This impossibility result assumes that all unanimous and neutral social choice functions are available. Koray and Ünel (2003) establish that the impossibility persists when the available social choice functions are confined to those that satisfy the tops-only property. On the other hand, Koray and Slinko (2008) show that making inefficient social choice rules unavailable leads to the existence of non-trivial self-selective social choice functions that can be completely described.

Implementation via rights structures

Sertel (2001) formalizes the power distribution in a society using the concept of a rights structure. This concept is used by Koray and Yıldız (2018) who introduce a new institutional framework for implementation whose point of departure is the distribution of power. They formulate and characterize implementability via rights structures under different specifications, and identify how implementation via rights

structures is related to implementation via mechanisms. With at least three individuals, they identify two distinct classes of rights structures under which implementability is equivalent to Nash implementability and strong Nash implementability, respectively.

The work of Semih Koray enriches our understanding of the relationship between social goals and the incentive schemes induced by social organizations. For this special issue in his honor, we called for papers that take this perspective and address questions around these themes to which Semih Koray has eloquently contributed. The economic design community responded enthusiastically. The contributions of distinguished scholars from all over the world resulted in a collection of 19 papers. Moreover, I invited Semih Koray to submit an unpublished paper that he had co-authored with Murat Sertel more than three decades ago. We have thus been able to compose two volumes that are impressive in both the quality of the work and the rich diversity of themes they contain.

We initially designed no relationship among the collected papers. Of course, there are connections due to the nature of the special issue, and one might use such connections to establish an ex-post structure, but any imposed structure may be artificial and of questionable utility. After all, the interested reader can preview the two volumes simply by looking at the abstracts. As a result, I will be content with presenting a rough taxonomy of the contributions.

Among the ten papers in the first volume, seven explore issues relevant to design in various markets and three address questions related to preference aggregation.

Design of markets

- Eric Maskin considers solutions to market failures under emergencies such as a pandemic, when a society suddenly and urgently needs a huge amount of virus test kits.
- Bhaskar Dutta, Anirban Kar and John A. Weymark investigate the strategy-proof provision and financing of indivisible club good facilities when individuals are subject to congestion costs that are nondecreasing in the number of other club members and in a private type parameter.
- Dominik Keehan, Dodge Cahan, John McCabe-Dansted and Arkadii Slinko propose a spatial competition model for firms instead of the more standard linear model in which customers always shop at the nearest firm.
- İsmail Sağlam integrates bargaining theory with the problem of regulating a natural monopoly under symmetric information or asymmetric information with complete ignorance.
- Arzu Kıbrıs, Özgür Kıbrıs and M. Yiğit Gürdal construct a game theoretic model that treats an increase in trade protectionism as a rational reaction of the voters to their increased concern that the policy choices of their governments are being influenced by international actors.
- Lars Ehlers studies the problem of locating multiple public goods for a group of agents with single-peaked preferences over an interval.
- Simon Loertscher and Leslie M. Marx consider goods such as non-fungible tokens, where rivalry is a choice variable of the designer. They address the question of when

a profit-maximizing seller prefers to provide an asset as a private good or as a public good.

Preference aggregation

- Fatma Aslan, Hayrullah Dindar and Jean Lainé consider the election of committees with designated seats and investigate the conditions on preference extensions for which seat-wise Condorcet candidates, whenever they exist, form the Condorcet winners among committees.
- Burak Can, Mohsen Pourpouneh and Tom Storcken propose a new axiomatization of the Kemeny rule.
- Onur Doğan and Ayça E. Giritligil present a group-theoretical method to analyze and compare necessary and sufficient conditions on the size of the social choice problem for the existence of anonymous, neutral and resolute social choice and social welfare rules.

Among the ten papers in the second volume, one is a survey of the literature on the axiomatic approach to conflict resolution by William Thomson; four address issues related to matching or allocation problems; four are on implementation theory and one is an early work of Semih Koray on pretension games.

Matching or allocation problems

- Ariel Rubinstein and Kemal Yıldız analyze the object assignment model by enriching it with orderings over agents, which provide potential criteria for determining the suitability of agents to be assigned to an object.
- Duygu Nizamoğulları and İpek Özkal Sanver analyze roommate problems with a limited number of rooms, for which the outside option is "having no room" rather than "remaining single".
- Murat Yılmaz and Özgür Yılmaz consider object allocation problems for which individuals can be indifferent between two objects, and compare allocations produced by the top-trading cycles algorithm to those in the bargaining set.
- Marek Pycia and M. Utku Ünver analyze the allocation of indivisible goods without transfers when agents have the outside option of opting out, thus accounting for individual rationality constraints.

Implementation theory

- Mehmet Barlo and Nuh Aygün Dalkıran, after offering a theoretical analysis of the scope of Nash implementation for a given mechanism, study the formal framework for the computational identification of Nash implementability and provide computational tools for Nash implementation in finite environments.

- Claus-Jochen Haake and Walter Trockel define socio-legal systems by combining Debreu's social system with Hurwicz's idea of embedding a "desired" game form into a "natural" game form that includes all feasible behavior, even if it is "illegal" according to the desired form. They analyze the resulting socio-legal system by extending Debreu's concepts of a social system and its social equilibria to a socio-legal system with its Debreu–Hurwicz equilibria.
- Sulagna Dasgupta and Debasis Mishra explore the consequences of weakening the notion of incentive compatibility from strategy-proofness to ordinal Bayesian incentive compatibility in the random assignment model.
- Shurojit Chatterji and Arunava Sen study the mechanism design problem when the planner can observe ex-post the first-ranked alternatives or peaks of voter preferences, and contrast this with the design problem where the planner has ex-ante information regarding the peaks of voter preferences.

Last but not the least, in a paper written more than 30 years ago, Koray and Sertel generalize pretension/delegation games for linear oligopolies by introducing the idea of a game cascade of a finite order. Focusing on a linear duopoly, they show that any game cascade of order k is unstable in the sense that it gives incentives for redelegation, i.e., for extending the chain length to $k + 1$. They also show that as the length of the delegation chain grows beyond bound, the equilibrium output converges monotonically to the socially efficient output that would be obtained by marginal-cost pricing). Thus, in a linear duopoly context, socially efficient outcomes can be arbitrarily closely approximated by the use of pretend-by-perform mechanisms of order sufficiently large. The findings of the paper remained original and novel throughout the three decades that followed their discovery and I am happy that this special issue has been an opportunity to publish them. Moreover, I am particularly moved that Murat Sertel has been able to posthumously contribute to this special issue in honor of his close collaborator and friend.

Semih Koray is among the founders of the Review of Economic Design and served as its Editor-in-Chief for many years. These two volumes reflect a willingness of many distinguished scholars from different generations to express their recognition of and respect for Semih Koray as a leader in the field of economic design. In fact, his outstanding academic contributions, dedicated mentorship to countless students, and distinguished service to the community are sources of inspiration to many of us. In terms of service, his organization of the Bosphorus Workshop on Economic Design, gathering economists from all over the world for the past 40 years, stands out in particular. We offer these two volumes of the *Review of Economic Design*, produced by his colleagues, students and friends, as a modest yet heartfelt expression of the gratitude our community feels for him.

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