

Solutions for Cooperative Games with Restrictions to Form and Leave Coalitions

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In the study of games, intermediate possibilities between universal cooperation and no cooperation are typically modeled by a set system of feasible coalitions of the players. In this paper we go a step further and make a distinction between players within a feasible coalition. We model this situation by assigning to every feasible coalition a nonempty subset, its choice set, consisting of players who can form or leave the coalition, for example the set of players who are not dominated by any other player in the coalition. We introduce the notion of quasi-building system to capture such a phenomenon. Many known set systems studied in the literature are covered by quasi-building systems. We study solutions for transferable utility games having a quasi-building system as a cooperation structure. For every quasi-building system there exists a nonempty collection of compatible rooted trees. Such a rooted tree represents a hierarchy structure on the set of players compatible with the restrictions to form and leave coalitions according to the quasi-building system. As solution concept we take the average of the marginal vectors corresponding to all these trees, called the AMV-value. Properties of the AMV-value are studied. To establish the core stability of the AMV-value we introduce appropriate convexity conditions of the game with respect to the underlying quasi-building system. For some specific cases of quasi-building systems, the AMV-value coincides with solutions known in the literature. In case of universal cooperation the solution coincides with the classical Shapley value.

A Partition Function Form Game with Subjective Expectation Formation Rules

Takaaki Abe

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The objective of this paper is to expand the notion of "expectation formation rule" which has been studied by Funaki and Yamato (1999), and Bloch and van den Nouweland (2014). Funaki and Yamato (1999) formulated the "tragedy of the commons" as a partition function form game. They showed the largest coalition in which all agents cooperate can be stable in the sense of the core. Moreover, they proved that the existence of the core depends on whether all agents are "optimistic" or "pessimistic" about the reaction to deviation from the all-player-coalition. Bloch and van den Nouweland (2014) focused on the property of the reaction and defined the notion of "expectation formation rule". They, furthermore, axiomatically characterized some expectation formation rules. In their works, all agents are assumed to have a single expectation formation rule common among all players. This paper relaxes their assumption, and considers that some different types of expectation formation rules coexist. We propose an aggregation rule which associates some different expectations among players with a "social" expectation, and axiomatically characterize it. Moreover, we examine how the diversity of expectations affects the existence of the core in the Cournot oligopoly game studied by Bloch (1997), Yi (1997), and Herings et al. (2010).

The Recursive Core under Risk-Based Behavioural Expectations

Laszlo A. Koczy

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In partition function form games the value of a coalition depends on the entire partition. As a result, a deviating coalition can only form expectations regarding its post-deviation payoff as the latter is a function of the induced residual partition. Existing literature approached the problem from the side of conservatism, assuming the worst often completely ignoring the interests of the residual players. We borrow the idea of risk from the finance literature and compare the risk of staying with the original partition with the risk of deviating. Employing this idea to the core leads to a new concept that we call the risk-based core. We introduce this concept and discuss its properties.

Directional Monotone Comparative Statics

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Many questions of interest can be stated in terms of monotone comparative statics: if a parameter of a constrained optimization problem “increases,” when does its solution “increase” as well. This paper studies monotone comparative statics in different directions in finite-dimensional Euclidean space. The conditions on the objective function are ordinal and retain the same flavor as their counterparts in the standard theory. They can be naturally specialized to cardinal conditions, and to differential conditions using directional derivatives. Conditions on both the objective function and the constraint set do not require new binary relations or convex domains. The results allow flexibility to explore comparative statics with respect to the constraint set, with respect to parameters in the objective function, or both. Results from Quah (2007) are included as a special case. Several examples highlight applications of the results.

Facility Location Situations and Experimental Design Models via Non-Cooperative Games

Lina Mallozzi
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In this paper we present an experimental design problem as a Nash equilibrium problem in the context of Game Theory: the choice of a set of design variables in n experiments is made by virtual players optimizing some suitable objective functions, with the requirement to obtain a distribution of the points in the admissible region with high dispersion, in such a way to better explore all the available possible region. Each player has to decide the location of his design variables by considering his opponents' choice and the situation can be interpreted as a particular non-cooperative game corresponding to a facility location game. The facility is identified with each design variable point and the spatial domain corresponds to the admissible region. The Nash equilibrium solutions will be the optimal solutions of the design variables problem. A concrete application in physics environmental is studied: the optimization of receivers location on ground, under uniform cosmic source distribution, on a bounded settlement area and constrained by a limited number of receivers due to a budget limitation. Assuming the capture range of each receiver (e.g. a radar) to be shaped as a circular area, the 2-dimensional design variables are the coordinates of the receivers in the considered region and we find the optimal configuration of the points under some constraints. The resulting game has nice properties, so that a computational procedure is performed by using genetic algorithm approach and some existence results are obtained.

Prospect Dynamic and Loss Dominance

Jiabin Wu

Ryoji Sawa

This paper studies the role of loss-aversion in shaping the long-run distribution of behaviors in a large population. We propose an evolutionary dynamic called prospect dynamic. Under this dynamic, when a loss-averse player decides whether to switch strategy, he/she compares the payoff corresponding to each strategy profile to the average payoff in the population. We find that risk-dominance is no longer sufficient to guarantee stochastic stability of the corresponding equilibrium given that the players in the population are strongly loss-averse. Therefore, a stronger solution concept is needed. We propose loss-dominance, to capture people's psychological needs to avoid not only risk but loss. We show that the loss dominant equilibrium (if exists) is uniquely stochastically stable under prospect dynamic. Hence, it serves as a natural equilibrium selection refinement for games under prospect theory.

Further Axiomatizations of Egghe's g-Index

Takumi Kongo
Tsuyoshi Adachi

We provide three axiomatic characterizations of Egghe's g-index, which measures a researcher's scientific output based on the number of papers the researcher has published and the number of citations of each paper of the researcher's. We formulate six new axioms for indexes, namely, tail independence (TA), square monotonicity (SM), the cap condition (CC), strong square monotonicity (SSM), increasing marginal citations (IMC), and increasing marginal citations+ (IMC+). Along with the two well-known axioms T1 and T2 (Woeginger, G.J. 2008a. An axiomatic analysis of Egghe's g-index, *Journal of Informetrics* 2, 364--368), the g-index is characterized by (i) T1, T2, TA, SM, and CC, (ii) T1, T2, TA, SSM, and IMC, and (iii) T1, TA, SM, and IMC+. Two out of three characterizations are obtained by adding axioms to our new characterization of the class of indexes satisfying T1, T2, and TA, which are defined as generalizations of the g-index. Furthermore, the independence of our axioms and that of Woeginger's study are investigated. Thus, the remaining four axioms in our first and second characterizations---SM, CC, SSM, and IMC---distinguish the original g-index from other related indexes in the class.

Potential, Voting, and Power

Frank Huettnner
André Casajus

A simple game consists of a finite set of a players and a characteristic function that assigns to any subset (coalition) either the number 1 (winning coalition) or the number 0 (losing coalition). We advocate a new index of absolute power for simple games, the potential index. The potential index sums up to the potential of a simple game. This is motivated by the fact that the potential reflects the likelihood of the formation of a winning coalition. Moreover, this ensures that the total power assigned by the potential index behaves in a plausible way, in contrast to the Banzhaf-Coleman index. We show that the potential index decomposes the Shapley-Shubik index in the inherent power of a player and her power over other players. We provide several formulae and characterizations of the potential index.

Ghost Seats in the Basque Parliament

Annick Laruelle

Nora Ibarzabal

In elections voters have generally four options: to abstain, to cast a blank vote, to cast a null vote, or to vote for a candidate or party. This last option is a positive expression of support, while the other three options reflect lack of interest, or dissatisfaction with the parties or the political system. However only votes for parties or candidates are taken into account in the apportionment method. In particular the number of seats allocated to parties remains constant even if the number of non votes (i.e. blank votes, null votes or abstention) is very large. This paper proposes to treat the non votes as a party in the apportionment method and to leave empty the corresponding seats. These empty seats are referred to as "ghost seats". How this would affect the decision-making is quantified in terms of power indices. We apply this proposal to a case study: the regional Parliament of the Basque Autonomous Community (Spain) from 1980 till 2012.

The Curse of the First-In-First-Out Queue Discipline

Trine Tørnøe Platz

Lars Peter Osterdal

In many everyday situations, people wish to be served by a facility that opens at some specified point in time but has limited service capacity. In such situations, each person must decide when to "arrive" at the facility, taking into account his preferred service time and the waiting time he expects to face upon arrival.

We consider a game in which a large number of identical agents choose when to queue up at a single server after it opens. Agents are impatient for service, and the cost of queueing is proportional to time. We show that the first-in-first-out queue discipline and the last-in-first-out discipline both lead to a unique equilibrium arrival distribution. However, among all work-conserving queue disciplines, the first-in-first-out performs the worst in terms of equilibrium utility and welfare, while the last-in-first-out performs the best.

Equilibrium Arrival Times in a Bottleneck Queue with Specific Queue Disciplines

Jesper Breinbjerg

I consider a queuing environment where customers seek service at a single bottleneck facility that opens at a given point in time. Each customer independently and simultaneously chooses when to arrive for service at the facility. Customers are assumed to prefer service as early as possible, while minimizing the expected wait in the queue. I study a model with a finite number of homogeneous customers with stochastic service times. In this setting, I analyze the existence and uniqueness of equilibrium arrival profiles under the first-come first-serve (FCFS) and the last-come first-serve preemptive (LCFS-PR) queuing discipline. I characterize a unique equilibrium arrival profile that constitutes a symmetric mixed Nash equilibrium under FCFS and LCFS-PR, respectively, and compare their corresponding equilibrium welfare. I find that LCFS-PR provides higher expected equilibrium welfare than FCFS since the customers strategic arrival times induce lower expected congestion.

Welfare Lower Bounds and Strategyproofness in the Queueing Problem

Youngsub Chun
Duygu Yengin

We investigate the implications of welfare lower bounds together with queue-efficiency and strategyproofness in the context of the queueing problem. As a consequence, we provide alternative characterizations of the k -pivotal mechanisms (Mitra and Mutuswami 2011). First, we introduce the k -welfare lower bound, which ensures that no agent is worse off than the case where she is assigned to the k th position in the queue without any monetary transfer. For each k , we show that the k -pivotal mechanisms generate the minimal budget deficit in each queueing problem among all mechanisms satisfying queue-efficiency, strategyproofness and the k -welfare lower bound. Next, we consider a well-known welfare lower bound, the identical preferences lower bound and show that when there are odd number of agents, the k -pivotal mechanisms with $k=(n+1)/2$ generate the minimal budget deficit in each queueing problem among all mechanisms satisfying queue-efficiency, strategyproofness and the identical preferences lower bound.

Stable Matching and Indivisible Goods Trades under Irrational Choice Behavior

Satoshi Nakada

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In the economy including two-sided matching and indivisible goods trades, some novel algorithms work desirably. In the two-sided matching economy, the deferred acceptance algorithm keeps much attention and is widely used in the real world to induce a stable matching. However, this algorithm does not work if agents have some irrational choice behavior like cyclic choices, which are often observed in many laboratory experiments and in the daily situations. In this paper, we incorporate such irrational choice behavior to agents in the sense that they do not necessarily have rational preferences (i.e. complete and transitive), so that their choice behavior do not need to be rationalized. We define a stability concept in this situation and show that, even if such behavior we allow agents to display, a stable matching always exists and it is attained by our Generalized Deferred-Acceptance algorithm. Moreover, if agents are rational, the outcome coincides with the one induced by the deferred acceptance algorithm for which input is preference profile which rationalizes each agent's choice behavior. Also, we consider the same motivated problem in the indivisible goods trading economy. We construct the Generalized Top Trading Cycle algorithm and show that this algorithm induces a core allocation in this economy. Moreover, this allocation coincides with a suitable notion of competitive equilibrium and thus (first) fundamental theorem of welfare economics can be extended.

Paths to Stability in Two-Sided Matching under Uncertainty

Dinko Dimitrov
Emiliya Lazarova

We consider one-to-one matching problems under two modalities of uncertainty that differ in the way types are assigned to agents. Individuals have preferences over the possible types of the agents from the opposite market side and initially know the 'name' but not the 'type' of their potential partners. In this context, learning occurs via matching and using Bayes' rule. We introduce the notion of a stable and consistent outcome, and show how the interaction between blocking and learning behavior shapes the existence of paths to stability in each of the uncertainty environments. Existence of stable and consistent outcomes then follows as a side result.

Designing Matching Mechanisms under General Distributional Constraints

Makoto Yokoo

Masahiro Goto, Fuhito Kojima, Ryoji Kurata, Akihisa Tamura

In this paper, we consider two-sided, many-to-one matching problems where agents in one side of the market (schools) impose some distributional constraints (e.g., a maximum quota for a set of schools), and develop a strategyproof mechanism that can handle a very general class of distributional constraints. We assume distributional constraints are imposed on a vector, where each element is the number of contracts accepted for each school. The only requirement we impose on distributional constraints is that the family of vectors that satisfy distributional constraints must be hereditary, which means if a vector satisfies the constraints, any vector that is smaller than it also satisfies them. When distributional constraints are imposed, a stable matching may not exist. We develop a strategyproof mechanism called Adaptive Deferred Acceptance mechanism (ADA), which is nonwasteful and "more fair" than a simple nonwasteful mechanism called the Serial Dictatorship mechanism (SD) and "less wasteful" than another simple fair mechanism called the Artificial Cap Deferred Acceptance mechanism (ACDA). We show that we can apply this mechanism even if the distributional constraints do not satisfy the hereditary condition by applying a simple trick, assuming we can find a vector that satisfy the distributional constraints efficiently. Furthermore, we demonstrate the applicability of our model in actual application domains.

Imitative Dynamics for Games with Continuous Strategy Space

Man Wah Cheung

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This paper studies imitative dynamics for population games with continuous strategy space. We define imitative dynamics---which include the replicator dynamic as a special case---as evolutionary dynamics that satisfy the imitative property and payoff monotonicity. Our definition of payoff monotonicity is different from the one defined in Oechssler and Riedel (2002). We find that our definition is better at capturing the notion of payoff monotonicity for the finite strategy case (cf. Weibull (1995)), and Oechssler and Riedel (2002)'s definition is closer to aggregate monotonicity in the sense of Samuelson and Zhang (1992). We provide sufficient conditions for imitative dynamics and general evolutionary dynamics to be well-defined. Finally, we extend general properties of imitative dynamics as well as global convergence and local stability results in potential games from finite strategy settings to continuous strategy settings.

Finite Horizon Linear Quadratic Dynamic Games for Discrete-Time Stochastic Systems

Huai-Nian Zhu
Zhang Cheng-Ke

In this paper, dynamic games for a class of finite horizon linear stochastic system governed by Ito's difference equation are investigated. Particularly, Pareto and Nash strategies are both discussed. After defining the equilibrium condition, the sufficient conditions for the existence of the strategy sets are obtained, which are associated with the solvability of the corresponding matrix-valued equations. Furthermore, an iterative algorithm is proposed to solve the related matrix-valued equations and a simple numerical example is given to show the reliability and usefulness of the considerable results.

Dynamic Cooperative Games with Transferable Attributes

Imma Curiel

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We study discrete time dynamic cooperative games in which each player owns an attribute. We consider two cases. In the first case the set of attributes is a strictly, totally ordered set. Each player has the same preference relation over the attributes. The profit that a player can make depends on his attribute. The players can increase their total profit by cooperating and exchanging attributes. In each stage the players start with the attribute that they ended with in the previous stage as a result of the profit maximizing process that took place. For different types of profit functions we study how the game evolves. If the game in each stage is balanced the relationship between the core elements in each stage and a core element of the overall game is explored. It turns out that additional compensation is required to arrive at a stable allocation using elements of the cores of all the stages. In the second case we study these questions while relaxing the condition that all the players have the same preference relation over the set of attributes.

Characterization Sets for the Nucleolus in Balanced Games: the Case of Bankruptcy Games

Balazs Sziklai
Tamas Solymosi

We provide a new modus operandi for the computation of the nucleolus in cooperative games with transferable utility. Using the concept of dual game we extend the theory of characterization sets. Dually essential and - if the game is monotonic - dually saturated coalitions determine both the core and the nucleolus whenever the core is non-empty. We show how these two sets are related to the existing characterization sets. In particular we prove that if the grand coalition is vital then the intersection of essential and dually essential coalitions forms a characterization set itself. We conclude with a sample computation of the nucleolus of bankruptcy games - the shortest of its kind.

What Makes the Nucleolus Essentially Different: Axiomatic and Strategic Perspectives

Min-Hung Tsay
Chun-Hsien Yeh, Cheng-Cheng Hu

We explore essential differences between the nucleolus and other solution from both axiomatic and strategic perspectives. A class of resource allocation problems in which the cost of a public service has to be shared among agents having different needs for it is considered. We adopt Right-endpoint Subtraction (RS) formulation to define a reduced problem underlying the two properties, RS bilateral consistency and RS converse consistency. As we show, the nucleolus is the only RS bilaterally consistent (or RS conversely consistent) rule satisfying equal treatment of equals and last-agent cost additivity. Besides, a game exploiting the two properties is introduced to strategically justify the nucleolus. Our results together with Hu et al. (2012)'s Left-endpoint Subtraction (LS) bilateral consistency (or LS converse consistency) axiomatization and strategic justification of the constrained equal benefits rule pin down the essential differences between the two rules: they are RS bilateral consistency and LS bilateral consistency (or RS converse consistency and LS converse consistency). Interestingly, these results imply that adopting different formulations to define a reduced problem leads to axiomatizing and in particular, strategically justifying different rules.

The Egalitarian Solution Versus the Nucleolus: a Strategic Comparison

Chun-Hsien Yeh
Min-Hung Tsay

We investigate relations between the nucleolus and the egalitarian solution from strategic perspective. A class of resource allocation problems in which agents having different needs for a public facility need to share its cost is considered. We first introduce a 2-stage extensive form game and show that it strategically justifies the egalitarian solution. We then construct another game obtained from the one just introduced by assigning a different role to an agent with the largest cost. Surprisingly, as we show, the resulting game strategically justifies the nucleolus. The results pin down the strategic relations between the two solutions and interestingly, indicate that assigning different roles to a particular agent leads to strategically justifying different solutions.

Cost Sharing for the ASEAN Power Grid Program

Yunji Her

Youngho Chang, Youngsub Chun

The ASEAN Power Grid (APG) is a program consisting of bilateral trade with long-term Power Purchase Agreements among ASEAN member countries. The fact that APG program is profitable to member countries has been well-established. In this paper we focus on the cost sharing of this program to 5 countries located in the Greatest Mekong Subregion (GMS), Cambodia, Laos, Myanmar, Thailand, and Vietnam, by applying solutions developed in the cooperative game theory, such as the Myerson value and the nucleolus. We also consider the stability of the APG program by analyzing the existence of the core. As it has an empty core so that it is not stable. However, if we reduce the program to 4 countries by excluding Vietnam, the program becomes stable.

Game Theoretic Approaches to Allocation Problems with Multiple Criteria for Evaluation

Jing Fu
Shigeo Muto

This research deals with the problem of fairly allocating a certain amount of benefit among individuals or organizations when they are evaluated with multiple criteria for their performance. We first formulate the problem as a strategic form non-cooperative game and study the Nash equilibrium, the coalition-proof Nash equilibrium and the strong equilibrium. We show that the Nash equilibrium always exists, and make clear the condition that the coalition-proof Nash equilibrium coincides with the Nash equilibrium. The strong Nash equilibrium may not exist.

Then based on the strategic form game, we construct a TU characteristic function form cooperative game. It is shown that the game is constant-sum and the core is non-empty if and only if the game is inessential, that is, the evaluation indices are identical for all the criteria for each player. This means that in most cases the core is empty.

We then give an NTU characteristic function form game, and study the α -core and the β -core. We show that the α -core is always non-empty, but the β -core is empty in most cases.

Sharing the Cost of Risky Projects

Jens Leth Hougaard

Herve Moulin

Users share the cost of unreliable non rival projects (items). For instance they pay today for R&D that may deliver a cure to some viruses, they pay for the edges of a network that will cover their connectivity needs, but the edges may fail, and so on. Each user has a binary inelastic need that is served if and only if certain subsets of items are actually functioning. We ask how should the cost be divided ex ante when individual needs are heterogenous. To reach a simple and transparent division method, we impose three powerful separability properties: 'Independence of Timing' ensures neutrality w.r.t. additional information about the output of the projects. 'Cost Additivity' together with 'Separability Across Items' ensure that the cost shares of an item depend only upon the service provided by that item for a given realization of all other items.

Combining these with fair bounds about the liability of agents with more or less flexible needs, and of agents for whom an item is either indispensable or useless, we characterize two rules: the Ex Post Service rule is the expectation of the equal division of costs between the agents who end up served; the Needs Priority rule splits the cost first between those agents for whom an item is critical ex post, or if there are no such agents between those who end up being served. We submit as a reasonable family of rules the convex combinations of these two extreme approaches.

Graduate Admission with Financial Support

Mustafa Oguz Afacan

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We formulate graduate admission with financial support as a matching with contract problem. The current decentralized system entails some severe problems, such as instability, unfairness, and inefficiency. To fix this, we propose a centralized market design. To this end, we first introduce 'Admission with Financial Support' (AwFS) choices for departments. They satisfy certain constraints departments encounter in offering graduate admissions with different types of financial supports. We then propose a cumulative offer process (COP) under AwFS choices. The COP under AwFS choices produces stable outcomes. Furthermore, it is fair and strategy-proof, that is, for every student, it is weakly dominant strategy to submit his/her true preferences. Lastly, we show that no student is worse off as a result of his ranking improvement under our proposal. That is, the COP under AwFS choices respects improvements. These results advocate replacing the current graduate admission system with the proposed one.

A New Solution Concept for the Roommate Problem: Q-Stable Matchings

Elena Inara

Peter Biro, Elena Molis

The aim of this paper is to propose a new solution concept for the roommate problem with strict preferences. We introduce maximum irreversible matchings and consider almost stable matchings (Abraham et al., 2006) and maximum stable matchings (Tan 1990, 1991b). These solution concepts are all core consistent. We find that almost stable matchings are incompatible with the other two concepts. Hence, to solve the roommate problem we propose matchings that lie at the intersection of the maximum irreversible matchings and maximum stable matchings, which we call Q-stable matchings. We construct an efficient algorithm for computing one element of this set for any roommate problem. We also show that the outcome of our algorithm always belongs to an absorbing set (Inarra et al., 2013).

Incentives in Matching Markets: Some Comparative Statics Results

Manabu Toda
Jun Matsui

In order to accommodate the imbalance between the numbers of residents accepted by hospitals across regions, Japanese Residential Matching Program introduced upper bounds over the total numbers of seats offered in major cities like Tokyo, Kyoto and others in 2015. As the Rural Hospital Theorem suggests, the stability and distributional constraints may be incompatible. Kamada and Kojima (2013) propose a weaker notion of stability, which is compatible with exogenously given upper bounds. However, it is obvious that the weak stable matching may not be the first-best optimal for doctors.

In this paper, we restrict our attention to the stable matching and give doctors incentives to apply to vacant positions in local hospitals by financial aids, scholarship, improvement of working conditions and others. More specifically, we ask the following question; if each doctor's ranking of a hospital whose quota is unfilled is increased or at least unchanged, then what happens to the doctor-optimal stable matching. In one-to-one matching markets, a simple comparative statics result is obtained. All doctors are made better off and all hospitals but the vacant one are made worse off. It is a consequence of the Blocking Lemma. We also prove that it is equivalent to the comparative static result when adding a new hospital to the market. In this sense, we provide a new proof and a new insight into the previous result.

The result in one-to-one matchings does not simply extend to one-to-many matchings. If the position of a hospital whose quota is partially filled is increased in the rankings of some doctors, there may exist a doctor who is made strictly worse off. We discuss how to generalize our result in this case.

Representing Distributive Justice Using a Form of Coalition Game, and the Determination of the Optimal Resource Allocation

Mingli Zheng

In this paper, we illustrate how the form of a coalition game (N, ν) can be used to represent the value judgment of distributive justice involved in resource allocation. When some consistency conditions are satisfied, a decision maker's subjective value judgment about distributive justice can be represented by a Choquet integral $W = \int u(x) d\nu$ with respect to a coalition game ν (which is a non-additive measure over N). Using the Mobius transformation of ν , $\mu(T) = \sum_{(B \subset T)} (-1)^{|T/B|} \nu(B)$, we can write $W = \sum_{(T \in \Sigma^*)} \mu_T \nu [\min_{s \in T} u(s)]$, or $W(x) = \sum_{(i \in N)} \mu_i \nu u(x_i) + \sum_{(|T| > 1, T \in \Sigma^*)} \mu_T \nu [\min_{s \in T} u(x_s)]$, where Σ^* is the set of all coalition of N . The value $\mu(i)$ of the Mobius transformation μ of ν for a singleton i represents the deservingness of individual i , and $\mu(A)$ for non-singleton coalition A represents the egalitarian consideration within coalition A . The function u represents the inequality aversion of the decision maker. The optimal resource allocation is the one that maximizes the Choquet integral of function u with respect to ν . Using the technics of optimization, we can find the optimal resource allocation for different ν and u . Individual with high value of deservingness $\mu(i)$ will get more resource. When the decision maker has an egalitarianism consideration, there is a threshold level of resource in the optimal resource allocation. The low deserving individuals obtain resources at the threshold level; whereas for other individuals, their allotted resources increase strictly with their deservingness. A more egalitarian decision maker sets a higher threshold level. This paper can provide a theoretical explanation for the existence of a threshold level in the resource allocations in the real world.

Parallel Games with Noncomparable Pay-offs

Alexandra Gheondea-Eladi

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Societies have historically evolved to accommodate personal life and work life at the same time and a political and economic struggle is still taking place to make way to a specific type of balance between work and life in all European countries. In economic terms this means that at the micro level, the pay-offs resulting from personal life need to be compared to those coming out of one's work related life. Also, at macro level this means that monetary earnings have to be compared to some social pay-offs which are not easily commoditized and which emerge from family relations, community integration and participation, culture and so on. Such comparisons pose serious challenges to the assumption of comparability of pay-offs in game theoretical models of decision-making. The purpose of this paper is to explore ways to accommodate non-comparable pay-offs into game theoretical models of decision-making and to argue that non-comparable pay-offs are not captured in the standard framework of economics and game theory. In order to incorporate such pay-offs into game theoretical models, an analytical framework called parallel games theory is developed. I argue that an interpretation of each objective game takes place and in such games pay-offs are non-monetary and subjective. The question of aggregation of such non-comparable pay-offs is analysed with respect to social decision-making. Empirical results are presented in support of three possible strategies (segmentation, compensation and spill-over) for aggregating pairs of pay-offs which are non-comparable. Also, the results of a modified ultimatum game experiment are analysed in order to evaluate the influence of non-comparable pay-offs.

Rational Tax Scheme behind a Veil of Ignorance

Biung-Ghi Ju

Juan D. Moreno-Ternero

We explore the design of impartial tax schemes when agents' incomes are completely determined by their inborn talents. Building on Harsanyi's veil-of-ignorance approach, we conceptualize an impartial observer who chooses a tax scheme without knowing her own vNM utility function, and the distribution of talents, and whose vNM preferences behind the veil obey Harsanyi's principle of acceptance and are independent of the distribution of talents. Our results in the resulting framework provide three main messages: (i) the veil of ignorance generically implies anonymity of tax schemes; (ii) the veil of ignorance generically rejects utilitarian tax schemes; (iii) the veil of ignorance generically endorses the (Rawlsian) leveling tax scheme.

A Non-Cooperative Foundation for the Continuous Raiffa Solution

Bram Driesen

Peter Eccles, Nora Wegner

This paper provides a non-cooperative foundation for asymmetric generalizations of the continuous Raiffa solution. Specifically, we consider a continuous-time variation of the classic Stahl-Rubinstein bargaining model, in which each player's opportunity to make proposals is produced by an independent Poisson process, and a finite deadline ends the negotiations. Under the assumption that future payoffs are not discounted, it is shown that the payoffs realized in the unique subgame perfect equilibrium of this game approach the continuous Raiffa solution as the time horizon tends to infinity. The weights reflecting the asymmetries among the players, correspond with the Poisson arrival rates of their respective proposal processes.

Characterization and Implementation of Bargaining Solutions with Non-Convex Problems

Cheng-Zhong Qin

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This paper considers a class of bargaining problems arising from a class of economic environments. Problems in this class are star-shaped. Convex and comprehensive bargaining problems are star-shaped but not conversely. We completely characterize single-valued solutions satisfying the Nash axioms on the class of star-shaped bargaining problems. For the case with two players, we show that there are two and only two solutions, with each being a selection of Nash product maximizers in favor of a given player. We design a non-cooperative extensive-form game to implement these solutions. We extend our analysis to allow for asymmetries and for more than two players. Finally, we discuss applications of our results to repeated oligopoly games.

Core and Competitive Equilibria: an Approach from Discrete Convex Analysis

Koji Yokote

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We extend the assignment market (Shapley and Shubik (1972), Kaneko (1976, 1982)) by utilizing discrete convex analysis. We consider the market in which buyers and sellers trade indivisible commodities for money. Each buyer demands at most one unit of commodity. Each seller produces multiple units of several types of commodities. The cost function of each seller is M -natural-convex, which is a concept in discrete convex analysis. We make the quasi-linearity assumption on the sellers, but not on the buyers. We prove that, under some condition, the Core and the competitive equilibria coincide and exist in this market.

Evaluations of Competitive Rent Vectors in Housing Markets with Indivisibilities

Seiken Sai

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We study the difference between the maximum and minimum competitive rent vectors in a rental housing market of Kaneko-Ito-Osawa (2006) that is based on an assignment model where the apartments are classified into a finite number of categories and each household demands at most one apartment unit. It is assumed that every household has an identical utility function but a different initial income. In the model, the maximum/minimum competitive rent vector is represented by the 'upper/lower differential rent vector' which is a solution of a certain system of equations. We show that the difference between the upper and lower differential rent vectors is bounded by the income difference of specific two neighboring households. This result implies that the two rent difference is rather small, and also it shrinks to zero as the market size gets large and the household income distribution becomes dense. Thus, the gap between two comparative statics analyses using the maximum or minimum rent vector is also small. This result gives a foundation for comparative statics analysis based on 'differential rent approach' of Kaneko et al.

Stable Pricing for Excludable Public Goods

Toshiyuki Hirai

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We consider a market with indivisible excludable public goods. Each excludable public good is provided by one firm and traded with buyers via a uniform price. We formulate such a market by a two-sided market model with multilateral contracts. We investigate the core of the market and the price that induces a core allocation, called the stable price. The essential equivalence between the core and the stable prices is proved. We give two sufficient conditions for the existence of the stable price, though the stable price as well as the core allocation may fail to exist in general. First, the stable price exists if there are only two firms. Second, for the case with general finite number of firms, we give a sufficient condition that can be checked efficiently by computing the profit function of the firms. We also propose an algorithm that finds a stable price efficiently, provided that the second condition is satisfied. Further, we argue how to extend the scope of the second sufficient condition. On the other hand, these sufficient conditions are not necessary. Indeed, we show that it is NP-complete to decide whether the core allocation exists in a general case.

A Fraudulent Expert and Short-Lived Customers

Selcuk Ozyurt

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A market where short-lived customers interact with a long-lived expert is considered. An expert privately observes whether or not a particular treatment is necessary for his customers and has an incentive to recommend the treatment even if it is unnecessary. Customers imperfectly observe the expert's past actions. Truthful reporting at all times yields the expert his best equilibrium payoff when the expert is known to be opportunist (i.e., rational in the usual sense). If the customers believe that the expert might be an honest type, who always reports truthfully, then the expert can build his reputation for honesty, so then he defrauds his customers to achieve a higher payoff. Deception during an unbounded length of time is a zero-probability event in equilibrium. However, it is a probability one event (in some of the equilibrium) when the expert's customer is also a long-lived agent.

Teaming up for Sustained Performance: a Repeated-Game Model of Voluntary Horizontal Collaboration

Sasa Pekec
Changrong Deng, Jeannette Song

We present a model to characterize the dynamics of and rationale for voluntary horizontal collaborations commonly seen in global supply chains and organizations. Examples of such collaborations include supply clusters, supplier alliances, and teams of peers within organizations. The model consists of two key elements. One is a repeated game framework that captures the dynamics of the underlying environment, such as the long-term interactions between individual players who have limited capabilities and face uncertain demand. The second element is a peer help mechanism, which articulates the implicit short-term cost and long-term benefit of team production and generate synergies among the players. Our analysis shows that the emergence of horizontal collaborations depends on the difference between the individual players' productivity levels, players' patience, and the prevalence of high performers on the team. We also show that equilibrium team size is determined by the cost/technology structure of the collaboration, which varies depending on what kind of asset (e.g., inventory or capacity) is shared. We further extend the model to a principal-agent framework, in which the principal can benefit from forming teams of agents but cannot enforce or monitor whether peer help occurs. Finally, we characterize the optimal compensation and team structure for the principal to assign agents to teams.

Optimal Solutions for TU-Games in Decision-Making Frame

Hao Sun

Zhixiang Hao, Genjiu Xu

The main goal is to introduce the so-called decision frame, in which the different optimal allocations for TU-games are determined under various optimization criteria, i.e., the quadratic loss function and the quadratic risk function. On one hand, it is shown that the Banzhaf semivalue is an optimal solution without efficiency with respect to individual quadratic loss function. On the other, least square prenucleolus is shown to be optimal with efficiency. Moreover, after solving the optimization problems under the rule of quadratic risk function for single player as well as efficiency condition or not, the least square efficient semivalues and least square semivalues are obtained respectively. Finally, we reveal that the least square values introduced by Ruiz et al. are the optimal allocations with respect to coalition in our decision frame, which also coincide with the least square efficient semivalues under certain conditions.

Informed Middleman As a Bridge Over Asymmetric Information

Irina Kirysheva

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In this paper I look at a two-sided asymmetric information game where agents make a collaborative decision not knowing types of each other. An intermediary has full knowledge about the types of agents and can make a decision that brings information to some types. However, once he puts the information on the table agents are not obliged to pay him, which undermines his incentive to participate in the first place.

I find that, nevertheless, the intermediary is still welfare-improving and restores efficiency. He either brings information to the most vulnerable type or to nobody.

The situation is drastically different when I look at two informed intermediaries that compete in prices. In this case there is no equilibrium in pure strategies. Nonexistence in this sense is similar to that of screening models, although standard ways of dealing with it (e.g. reactive equilibrium concept) do not work here. Once the competition between intermediaries increases sufficiently, equilibrium reoccurs. In this equilibrium there is partial specialisation between intermediaries - every pair of intermediaries sets a different wage and concentrates on a particular match.

My model provides interesting insights into the market of talent agents. The concept of PBE stable to bilateral deviations is developed and applied in the paper.

Asymmetric Information Allocation to Avoid Coordination Failure

Fumitoshi Moriya
Takuro Yamashita

We consider an optimal organization structure in terms of information allocation. In a unique implementation problem of desirable effort levels in the context of team production as in ? and ?, we show that, under certain conditions, it is optimal to asymmetrically inform the agents, even if they are ex ante symmetric.

Repeated Bilateral Contracting under Unawareness

Ryuichiro Ishikawa
Burkhard C. Schipper

We study repeated bilateral contracting similar to Hart and Tirole (1988) except that we allow for unawareness of valuations. Valuations are revealed after a transaction takes place. We show that in any extensive-form rationalizable outcome of the two-period model, spot rental contracts may yield larger expected payoffs to the seller than spot sales contracts or long-term contracts with and without renegotiation. This is in contrast to the standard setting of common awareness.

Two-Stage Bargaining Model for Quasi-Apex Games

Emiko Fukuda

T. Adachi, S. Muto

We propose an extension of an apex game, called a quasi-apex game by introducing a medium scale voter to the ordinary apex game. A quasi-apex game consists of one apex, one medium player and $n-2$ minor players, and it can be applied to case studies of Japanese Diet where the second largest party is way ahead of the other anti-apex parties.

Montero (2002) studied non-cooperative bargaining in apex games and showed the expected equilibrium payoff coincides with the kernel of the game. In their model, a proposer is selected according to the egalitarian protocol or the proportional protocol in each period. In the present paper, we focus on the fact that actual negotiations reach some conclusion without sufficient discussion among whole players. We present a quicker and simpler bargaining model that consists of two stages; in stage 1, two players propose payoff allocations, and in stage 2, other players simultaneously select one of the proposals.

We apply the bargaining model to apex games and to quasi-apex games, and compare their equilibrium outcomes. It turns out that unlike in apex games, in quasi-apex games the apex must raise minor players' share to the maximum value. Moreover we conducted a laboratory experiment to examine the effectiveness of the medium player.

Learning to Play the Dominated Strategy?: Experimental Analysis of a Public Goods Game with Punishment

Ai Takeuchi
Yoshio Kamijo, Yukihiro Funaki

This study analyzes the effects of feedback information in a repeated public goods game with a centralized punishment institution. In the punishment institution, there is a required contribution level and the players who under contributes is punished and pays a fixed fine. In the experiment, we compared two requirement levels--Low and High--holding fix the amount of fine. In both treatments, it is a dominant strategy to contribute as required, so theory predicts higher contributions and higher payoffs in High than Low. However, we observed deviation from theory in the High treatment, resulting in higher payoff in Low. Also we manipulated the amount of feedback information. In one treatment, subjects only received the aggregate amount of information, where as in the other, they were able to observe the contribution of other group members at the individual level. In High treatment, we observed more deviation to complete free riding when the information is provided at the individual level.

Time Pressure in Experimental Normal-Form Games: a Process Based Analysis Approach

Marco Kremer

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Though many strategic economic decisions face a severe time constraint, time pressure raised little attention in the emerging research field of behavioral game theory yet. Works from Sutter et al. (2003), Kocher et al. (2006) and Lindner et al. (2013) count as pioneer studies, despite numerous psychological investigations, which are all lacking the strategic component. The first two addressed studies laid focus on the influence of time pressure on the quality of decision making, based on Equilibrium behavior in the case of an Ultimatum Game and a Beauty Contest Game. The study from Lindner et al. might be the first investigating personal sophistication in terms of cognitive hierarchy and thus switching the general point of view to an individual. In order to experimentally determine the distribution of the level-k-reasoning -types they use Arad & Rubinstein's (2012) 11-20-Game. To their own surprise and contrary to the findings of Kocher et al. and Sutter et al. they find a shift to Equilibrium play under growing time pressure, which they explain by chance.

Applying a more process orientated approach, similar to Costa-Gomes et al. (2001), proved to give better insights in the decision making of people. We therefor developed a process theoretical framework, including adjusted process tracing techniques, which we based on the findings of Costa-Gomes et al. on decision types. We then conducted an ample online experiment in order to investigate the influence of time limitation and task complexity on the individual decision making process in Normal-Form-Games.

Some of the findings, provided by the rich empirical data-set, together with key facts for the elaboration of the process tracing techniques will be presented.

An Experiment in Inductive Game Theory

Jeffrey Kline

Ai Takeuchi, Yukihiro Funaki, Mamoru Kaneko

We conduct an experimental study on behavior and cognition in various 2×2 games with/without role-switching from the perspective of inductive game theory (IGT). Here, subjects have no prior knowledge about payoffs and can only learn them by playing the game. Without role-switching, subjects can, and many do, successfully learn their own payoffs. To learn the payoffs of the other, role-switching is required. While this gives more information about the whole structure, we observe that subjects do not learn all payoffs successfully. This partial learning gives us some room to study interactions between behavior and cognition. We find that role-switching has both behavioral and cognitive effects. On the behavioral side, without role-switching, many subject pairs converged to a Nash equilibrium. With role-switching, a significant number of subject pairs converged to either Nash or (cooperative) ICE maximizing the average payoffs, as predicted by IGT. On the cognitive side, we find that correct learning of payoffs is positively correlated with the number of experiences but is negatively correlated with convergence to some action pairs.

All-Pay Auctions with a Buy-Price Option

Minbo Xu
Sanxi Li, Jianye Yan

This paper studies an all-pay contest (auction) for a product in which there is an option for contestants to guarantee purchases at a seller-specified posted price. We analyze symmetric pure-strategy equilibria in the first- and second-price all-pay auctions with a buy-price option. Under these equilibria, the buy-price option will affect bidders' bidding behavior: while it has no impact on low-value bidders, it makes middle-value bidders bid more aggressive and high-value bidders less aggressive. The buy-price option also increases bidders' surplus and expected payment. Provided the seller chooses the optimal posted price to maximize the expected revenue, the first- and second-price all-pay auctions maintain the same revenue.

Goodwill Can Hurt: a Theoretical and Experimental Investigation of Return Policies in Auctions

Jun Zhang

Bram Casby, Ninghua Du, Ruqu Wang

Will generous return policies in auctions benefit bidders? We investigate this issue using second-price common-value auctions. Theoretically, we find that the bidding equilibrium is unique unless returns are free, in which case there exist multiple equilibria with different implications for sellers. Moreover, more generous return policies hurt bidders by eroding consumer surplus through higher bids. In the experiment, bids increase and bidders' earnings decrease with more generous return policies as predicted. With free returns, many bidders bid above the highest possible value, subsequently returning the item regardless of value. Though consistent with equilibrium behavior, this is not optimal for sellers.

Dual Sourcing Auctions for Unreliable Suppliers: with or without Cost Distribution Information

He Huang

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This paper examines dual-sourcing auctions for risk mitigation when a buyer faces uncertain demand and multiple unreliable suppliers with private cost information. Two scenarios involving three auction formats are considered. In the first scenario, the buyer acquires the cost distribution at a (distribution-) acquisition cost and thus is able to design a Generalized First-price Auction (GFA) which implements the optimal dual-sourcing mechanism. In the second scenario, the buyer does not invest to acquire the distribution and thus saves the acquisition cost. He can either run a simple Generalized English Auction (GEA) at the risk of winner-collusion or employ a complicated Optimal Auction with Learning (OAL) which implements the optimal dual-sourcing mechanism under unknown distribution. We separately design the above dual-sourcing auctions and then examine the buyer's strategic choice. Results show that the buyer in GFA and OAL can adopt any degree of diversification, depending on the balance between reliability level and homogeneity level related to winners' profit-margin contributions to the buyer. However, in GEA, the buyer always equally splits the quantity due to the collusion, which leads to a new tradeoff between collusion and diversification. Considering the auction revenues, the comparison between GFA and OAL shows that the value of prior distribution-acquisition decreases in the number of bidders and retail price, while comparison between OAL and GEA implies that the value of interim distribution-learning decreases in supply risk, number of bidders and retail price. Taking into account the acquisition costs and implementation costs which may both increase in the number of bidders, we conclude that GEA is more likely to be the favorable mechanism when supply risk is high and when the number of bidders is large, while OAL may be preferred if the number of bidders is small.

Measuring Synergy in Coalitions

Talal Rahwan

Tomasz Michalak, Michael Wooldridge, Iyad Rahwan

The intuitive notion of synergy captures a fundamental property of biological, physical, and economic systems: how the interaction or cooperation of multiple organizations, substances, or other agents can produce an effect greater than the sum of their separate effects. Despite its ubiquity, however, a well-founded definition of synergy has remained elusive. Here, we consolidate the major attempts to tackle this problem, and present a new, domain-independent measure of synergy that not only analyzes the interactions of agents inside their group, but also outside it, thereby revealing otherwise-hidden information about how these individuals typically perform in various groups of the population. We show that this measure, based on cooperative game theory, is the only measure that satisfies a set of intuitive properties. We then investigate an alternative characterization of our measure, based on a new solution concept that reflects the average impact made by each individual.

2x2 Decomposition and Existence of vNM Stable Sets in the Assignment Game

Jun Wako

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This paper considers von Neumann-Morgenstern solutions (stable sets) in the TU assignment game first studied by Shapley and Shubik (1972). For this two-sided market model with sellers, each supplying a differentiated object, and buyers, each having a one-unit demand, it was proved that the core is non-empty and a seller's core payoff is a competitive price of his object, which is paid exclusively by his buyer assigned at an optimal matching that gives a maximum market surplus. To prove the existence of a stable set in the assignment game, Shubik (1985) considered a μ -compatible stable set with no third-party payments (μ -compatible stable set). This is a subclass of stable sets in which payments are made only within each buyer-seller pair formed at a given optimal matching μ . Although a complete proof was given by Núñez and Rafels (2013), he first showed that a μ -compatible stable set exists and coincides with the union of the cores of all μ -compatible subgames. A μ -compatible subgame is an assignment game played by the remaining agents after some agents left with all profits of the pairs they belong to under optimal matching μ .

In this paper, we present another characterization of a μ -compatible stable set for an $n \times n$ assignment game with n buyers and n sellers. Given an $n \times n$ assignment game G and an optimal matching μ , we consider a 2×2 assignment game that consists of two pairs from the pairs under optimal matching μ . We first prove that any 2×2 assignment game has a stable set (with no third-party payments). We then show that a μ -compatible stable set is represented as the intersection of the stable sets of all 2×2 assignment games under a condition on the valuation matrix of G . The condition is enough mild not to make a μ -compatible stable set degenerated to the stable core. Under the condition, we can easily see what bargaining outcome each buyer (or seller) can obtain against other sellers (or buyers) in a μ -compatible stable set by depicting the stable sets of 2×2 assignment games.

Duality and Anti-Duality in TU Games Applied to Solutions, Axioms, and Axiomatizations

Takayuki Oishi

Mikio Nakayama, Toru Hokari, Yukihiro Funaki

In this paper, for each solution for TU games, we define its 'dual' and 'anti-dual'. Then, we apply these notions to axioms: two axioms are (anti-)dual to each other if whenever a solution satisfies one of them, its (anti-)dual satisfies the other. It turns out that these simple definitions allow us not only to organize existing axiomatizations of various solutions but also to find new axiomatizations of certain solutions. As an illustration, we show that two well-known axiomatizations of the core are equivalent in the sense that one can be derived from the other, and derive new axiomatizations of the Shapley value and the Dutta-Ray solution.

On the Core, Prekernel, and Prenucleolus of Games with Communication Structures

Peter Sudholter

M. Josune Albizuri, Anna Khmelnitskaya

Consider a situation in which agents (banks, firms, organizations, individuals, etc.) have mutual financial claims on each other. A payment matrix in such a multilateral bankruptcy situation describes how much agents pay to each other, measured in the smallest monetary unit (cents, 5 cents, etc.). A clearing payment matrix satisfies limited liability and priority of creditors. Using Tarski's fixed point theorem we show that there exist a minimal and a maximal clearing payment matrix. We also describe a decentralized clearing procedure which is converging in finite steps to the minimal clearing payment matrix.

The Effects of Complexity and Information in Spatial Competition

Adam Jakubik

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This paper presents a model of spatial competition where the market structure is represented as a network. Two firms sharing a link represents a notion of proximity in the geographic or product space. A price setting game is played on this network, in which firms simultaneously set prices taking into account their information of the network structure. The question of interest is, how does the particular pattern of locations influence pricing? If the structure of the market is very complex or in constant flux, firms might then not be aware of the entire market. How would they behave when limited to observing only their closest competitors? If firms are limited in their information of the competition network, unsurprisingly equilibrium prices are decreasing in the intensity of local competition. Profits on the other hand will be non-monotonic in the intensity of local competition, thus both the opposing relocation incentives in the literature, Hotelling's law and product differentiation, are present. If firms have complete information about the competition network, the global network structure becomes relevant for pricing decisions. In equilibrium a firm has to account for the cumulative effect of all externalities exerted on it through its neighbours, those exerted on its neighbours by their neighbours, and so on. The equilibrium effect of these bilateral externalities is captured by the relevant measure of centrality, and firms set prices in proportion to this.

Division of a Resource in a Network

Chiu Yu Ko

Ruben Juarez, Jingyi Xue

A problem consists of a finite group of agents and a finite rectangular grid network with non-negative value attached to every link in the grid. A solution selects, for every problem, a non-decreasing path that connects the origin with the opposite corner of the grid, and split the sum of the values of the links in the selected paths among the agents.

A solution is path-consistent if for any given point in the path selected by the solution, the path chosen in the sub-grid formed by that point and the opposite corner of the grid is the remaining of the path selected by the solution. A solution is consistent if it is path-consistent and the value given to an agent is independent on whether the distribution is made at any point in the middle of the path.

There is a large class of path-consistent solutions, including: the maximalist path (the selects the path with the largest sum), the minimalist path (that selects the path with the smallest sum) or the myopic path (which selects the link with the largest value among the next two).

The paper characterizes the entire class of path-consistent solutions. A description of a large subset of consistent solutions as the maximization of an additively separable function is provided. We also provide a description of the consistent solutions. They require to pick a path-consistent solution and splits the value of a path using an arbitrary function that depends on the value of every link and the direction in which the path is moving.

Finally, the paper considers the problem of implementation. We ask which solutions provide agents the incentives to pick the efficient path as a Subgame Perfect Nash equilibrium of the game where they alternatively pick the direction of the path. Surprisingly, only a very small class of solutions meet this requirement. They must pick the efficient path and split the value using an arbitrary monotonic function that depends on the aggregate value of a path.

The proportional sharing solutions, where the value of every selected link is split in the same proportion to the agents, are the only consistent solutions that implement the efficient path. The equal sharing solution, where the value of every selected link is split equally among the agents, is the only symmetric method in the class.

Coordination Games on Graphs

Krzysztof Apt

Mona Rahn, Guido Schaefer, Sunil Simon

We introduce natural strategic games on graphs, which capture the idea of coordination in a local setting. We show that these games have an exact potential and have strong equilibria when the graph is a pseudoforest. We also exhibit some other classes of graphs for which a strong equilibrium exists. However, in general strong equilibria do not need to exist. Further, we study the (strong) price of stability and anarchy. Finally, we consider the problems of computing strong equilibria and of determining whether a joint strategy is a strong equilibrium.

Group Rebate and Social Cooperation: An Experimental Study

Nobuyuki Uto

Yukihiko Funaki, Hiroko Okajima, Shigeharu Okajima

This study explores subsidy framing to motivate individual charitable donations using laboratory experiments. The results show that a majority of subjects made voluntary donations without any sub-sidies to motivate them. Donations increased by 77% when individual rebate subsidies were provided, and by 71% when a group performance threshold for rebates was implemented.

While our group rebate structure resembles a public goods game, we found interesting behavioral differences: contrary to the well-documented finding in the repeated public goods game, voluntary contribution did not significantly diminish over periods and free riding was not conspicuous in the context of donation.

Public-Goods Games with Endogenous Institution Formation: Experimental Evidence on the Effect of the Voting Rule

Jiawen Li
Yukihiko Funaki, Robert F. Veszteg

We report experimental results on voluntary contributions to public-goods provision with endogenous institution formation. We show that, compared to the unanimity rule, the plurality/majority rule significantly decreases the institution initiation rate, but at the same time also significantly increases the implementation rate of institutions. In the end, as the two effects cancel each other out, the choice of the voting rule does not significantly affect the average contribution level or efficiency.

Moreover, Institution formation greatly depends on whether the institution has enough potential members as compared to the theoretically minimum efficient institution size. The grand coalition does not form in relatively large groups.

We also show that experience increases the probability of institution implementation, but reduces the contribution level, especially that of players outside the institution.

Fairness and Storable Votes: the Tale of Blotto's Lieutenants

Antonin Mace

Alessandra Casella, Jean-Francois Laslier

We consider a committee taking several binary decisions, and we assume that it is divided in a systematic majority and minority. Under majority rule, the minority side would lose all the decisions, and be effectively disenfranchised. We thus consider an alternative mechanism, known as “storable votes”, which allows committee members to shift their votes across decisions. We investigate how this mechanism can help the minority to win some of the decisions, leading then to a potentially fairer outcome than the majority rule.

This strategic situation is formally equivalent to a decentralized version of the Colonel Blotto game (Borel, 1921). We provide theoretical results on the payoffs that can be guaranteed by each side of the committee, and on the equilibria of the game. We then perform laboratory experiments confirming our main theoretical predictions : (i) the game is different from the Colonel Blotto game, and in particular the pattern of equilibrium strategies is different (ii) as in the Colonel Blotto game, the minority wins a positive fraction of the decisions. Hence, we conclude that the storable votes mechanism can effectively solve the “tyranny of the majority” issue for the committee.

An Experimental Study of Multi-Object Simultaneous Ascending Bid Auctions: the Case of Unit Demand

Naoki Watanabe

Takehito Masuda, Shuhei Morimoto, Shigehiro Serizawa

This paper experimentally investigates whether simultaneous ascending bid (SA) auctions for multiple objects perform as expected in theory. Sessions for four treatments were conducted in the experiment: SA auction, first-price sealed-bid auction, first-price sequential auction, sequential ascending bid auction. In each session, two objects were auctioned off to three bidders. Each bidder can receive at most one object. The main findings are as follows. (1) Similarly to the observations in the sequential auctions, bid shading was observed in SA auctions, which induced the improvement in allocative efficiency as compared to first-price sealed-bid auction. (2) The average sellers' revenue in SA auction was not significantly different from that in first-price sealed-bid auction.

Non-Manipulability and Pareto-Efficiency of Daso Rules in Landing Slot Problems

Hyukjun Kwon

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We consider the landing slot problem formulated by Schummer and Vohra(2012), which is concerned with reallocating landing slots to airlines in inclement weather. Schummer and Abizada(2013) introduce Deferred Acceptance with Self-Optimization(DASO) rules and show that these rules are individually rational, non-wasteful, non-manipulable via weights, and non-manipulable by slot hiding. However, they are harmfully manipulable by intentional flight delay and not Pareto-efficient. We show that non-harmful manipulability by intentional flight delay of these rules can be recovered by restricting the priority structure. We also show that they are Pareto-efficient if and only if all flight weights are the same for all airlines.

Ex-Ante Versus Ex-Post Proportional Rules for State Contingent Claims

Sinan Ertemel
Rajnish Kumar

We consider the rationing problems in a two stage setting where the claims are state contingent. In stage one, each agent submits a claim for every possible state of the world. The realization of state happens in stage two. A rule must distribute the resources in the stage one i.e., before the realization of the state of the world. In our two-stage framework, two particularly natural approaches arise. The first one is to apply a rationing rule on the expectation of the claims, which we call ex-ante rationing rule. The other approach is to consider the expectation of the allocations (by a rule) corresponding to the various state contingent claims, which we call ex-post rationing rule. In this paper, we will focus our attention to proportional rules and characterize both ex-ante and ex-post proportional rules.

A Random Assignment of Indivisible Goods in Single-Peaked Economies with a Common Peak

Hee-In Chang
Youngsub Chun

Bogomolnaia and Moulin (2001) show that there is no rule satisfying equal treatment of equals, sd-efficiency and sd-strategyproofness for a random assignment problem of indivisible goods. Furthermore, Kasajima (2013) shows that the incompatibility result holds when agents have single-peaked preferences. In this paper, we restrict the domain by requiring that all agents have a common peak and investigate the existence of rules satisfying the three axioms. We show that the three axioms are still incompatible. As it turns out, the three axioms are still incompatible even though all agents have the same preferences except the three least-preferable objects.

Strategy-Proofness and the Random Dictatorship

Rules

Yoichi Kasajima
Hidekazu Anno

We study the problem of choosing a public lottery defined over a finite set of sure alternatives. Each agent is assumed to have a von-Neumann Morgenstern preference over the lotteries. We show that a rule satisfies non-degeneracy (the range of a rule should be contained in a simplex with at least 2-dimension and should contain its all vertices; this property can be interpreted as a very weak form of efficiency), finiteness (the range of a rule should be finite), and strategy-proofness (misreporting his preference should not make him better off) if and only if the rule is a “nondegenerate” random dictatorship rule. If we weaken the requirement of finiteness to closedness (for each coalition and each preference profile of the agents outside the coalition, the set of lotteries that can be attained by the coalition by reporting the same preferences is closed; this property does not require the range of the rule to be finite), we still obtain the same family of rules. The implication of our results is that even if we reconcile efficiency and allow the range of the rule to be infinite, there are not interesting rules other than the random dictatorship rules.

Consistencies of the Level Structure Value

Xun-Feng Hu

Deng-Feng Li

A level structure describes a hierarchy of cooperation between players. A transferable utility cooperative game with a level structure (Henceforth LS-TU cooperative game) describes a finite set of players who can generate certain payoffs from cooperation restricted by the level structure. The level structure value assigns to every player his average marginal contribution with respect to all the permutations of the player set that are consistent with the level structure.

We will propose two kinds of consistencies for the level structure value, where one relates to its multi-step allocation procedure and another internal stability.

Intuitively, the level structure value can also distribute the worth of the grand coalition level by level from top to down. That is, firstly the worth of the grand coalition is allocated to all the coalitions in the last but one level, then every such coalition distributes its gain among all its direct subordinates. This procedure proceeds till every singleton gets its payoff. The first kind of consistency claims that the level structure value is identical with the Shapley value of some appropriate TU games which are called induced games. Roughly, the induced game is defined for every coalition in the level structure. All direct subordinates of this coalition act as players, and the worth of every coalition in this induced game is interpreted as its relative power to its complement.

As a requirement of the internal stability of solutions, the second consistency claims that the level structure value gives the same payoffs to players in the original game as it does to players of a special LS-TU cooperative game. To be clear, this LS-TU cooperative game is a reduced game with the same level structure. Roughly, the reduced game is not a TU game in ordinary sense and serves only to determine the distribution of a coalition to the members of it. According to the second consistency, we will give an axiomatic characterization of the level structure value without efficiency and additivity.

The Tau-Value for Cooperative Games with Fuzzy Coalitions

Yang Dian Qing
Li Deng Feng

The aim of this paper is to study the solving method and properties of the tau-value for cooperative games with fuzzy coalitions, which can be regarded as the generalization of the classical tau-value proposed by Tijs. Using the Choquet integral, we define the tau-value for cooperative games with fuzzy coalitions and prove its existence. Then, we discuss that the tau-value satisfies some properties such as efficiency, individual rationality, symmetry, dummy and so on. The uniqueness of the tau-value is proved by efficiency, covariant under strategic equivalence and restricted proportionality property. The relation between the tau-value and the core for cooperative games with fuzzy coalitions is discussed. The computational formula of the tau-value for the convex cooperative games with fuzzy coalitions is given. Finally, the effectiveness and rationality of the tau-value is illustrated by a numerical example. The research result shows that the tau-value for cooperative games with fuzzy coalitions is an extension of the tau-value for cooperative games with crisp coalitions. Especially, for the convex cooperative games with fuzzy coalitions, the computational process of the tau-value can be simplified.

Full Additivity with Basic Division Imply the Shapley Value

Oskar Skibski

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The principle of additivity states the sum of payoffs in two separate games should equal the payoff in the combination of both games. We show that the Shapley value is the only value that is additive for arbitrary games and that equally divides the payoff in games in which only the grand coalition has a non-zero value. Then, we extend the notion of additivity to graph-restricted games and games with a priori given coalition structure. We prove that the Myerson and Owen values are the only additive solution concepts in these classes, respectively, that satisfy an analogous simple borderline case conditions.

A Characterization of Convex Combinations of Egalitarian Shapley Value and Consensus Value

Yukihiko Funaki
Koji Yokote

We deal with the problem of striking a balance between marginalism and egalitarianism in the class of TU cooperative games. We introduce a new axiom, Weak Surplus Monotonicity. It states that if the marginal contribution of a player increases, the worth of the grand coalition increases and the cooperative surplus increases, then the payoff of the player should also increase. We show that a solution satisfies Efficiency, Symmetry and Weak Surplus Monotonicity if and only if it is a convex combination of the egalitarian Shapley value and the consensus value. By replacing the new axiom with a stronger axiom and taking the dual, we obtain 11 characterizations of solutions, including the results of Young (1985) or Casajus and Huettner (2014).

On the Equivalence between Iterated Application of Choice Rules and Common Belief of Applying These Rules?

Michael Trost

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One central issue tackled in epistemic game theory is whether for a general class of strategic games the solution generated by iterated application of a choice rule gives exactly the strategy profiles that might be realized by players who follow this choice rule and commonly believe they follow this rule. For example, Brandenburger and Dekel (1987) and Tan and Werlang (1988) have established that this coincidence holds for the choice rule of strict undominance in mixtures in the class of finite strategic games, and Mariotti (2003) has established that this coincidence holds for Bernheim's (1984) choice rule of point rationality in the class of strategic games in which the strategy sets are compact Hausdorff and the payoff functions are continuous. In this paper, we aim at studying this coincidence in a general way. We seek to figure out general conditions of the choice rules ensuring it for a general class of strategic games. We state four substantial assumptions on choice rules. If the players' choices rules satisfy - besides the technical assumption of regularity - the properties of reflexivity, monotonicity, Aizerman's property, and the independence of payoff equivalent conditions, then this coincidence applies. This result proves to be strict in the following sense. None of the four substantial properties can be omitted without eliminating the coincidence.

Common Belief Revisited

Romeo Matthew Balanquit

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This brief study presents how selection of equilibrium in a game with many equilibria can be made possible when the common knowledge assumption (CKA) is replaced by the notion of common belief. Essentially, this idea of pinning down an equilibrium by weakening the CKA is the central feature of the global game approach which introduces a natural perturbation on games with complete information. We argue that since common belief is another form of departure from the CKA, it can also obtain the results attained by the global game framework in terms of selecting an equilibrium. We provide here necessary and sufficient conditions.

Following the program of weakening the CKA, we weaken the notion of common belief further to provide a less stringent and a more natural way of believing an event. We call this belief process as iterated quasi-common p -belief which is a generalization to many players of a two-person iterated p -belief. It is shown that this converges with the standard notion of common p -belief at a sufficiently large number of players. Moreover, the agreeing to disagree result in the case of beliefs (Monderer & Samet, 1989 and Neeman, 1996a) can also be given a generalized form, parameterized by the number of players.

Common p-Beliefs and Puzzling Social Behaviors

Moshe Hoffman

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We ask: when is it possible for an event that doesn't directly affect payoffs to nevertheless influence play in a coordination game. We formalize this question using the game theoretic tools of information structures, common p-beliefs, and Bayesian Nash equilibrium. We then show how this result can shed light on many puzzling social behaviors, using four toy models of games with incomplete information: a model that contrasts transgressions of omission vs transgressions of commission, a model of innuendos, a model of categorical norms like the norm against chemical weapons, and a model that contrasts word of mouth vs public announcements.

Small Infinitary Logic, and Fixed Point Logic for Game Theory

Nobu-Yuki Suzuki

M. Kaneko and T.-W. Hu

This talk presents a series of small infinitary epistemic propositional logics $\{ GL(L_{\forall\alpha}) : \forall\alpha \text{ is an ordinal up to } \forall\omega \}$ so that $GL(L_0)$ is a KD^n (finitary multimodal KD) and $GL(L_{\forall\alpha})$ allows countably infinite conjunctions of formulae for $\forall\alpha \geq 1$ in a specific form constructed using germinal forms.

Those conjunctions are constructed in a recursive manner for each $\forall\alpha$ with the guidance of the germinal form, where $\forall\alpha$ is the upper limit for the depth of nested occurrences of such infinitary conjunctions.

Logic $GL(L_{\forall\omega})$ is proved to be large enough for many purposes to discuss the infinitary concepts such as positive introspective beliefs, common knowledge and infinite regresses arising in game theory, while $GL(L_{\forall\omega})$ remains still quite small as an infinitary logic.

In this talk, we focus on the logic $GL(L_{\forall\omega})$ corresponding to the common knowledge logic, which is formulated as a finitary fixed-point extension of KD^n .

Decentralized Clearing in Financial Networks

Peter Csoka

P. Jean-Jacques Herings

It is well-known that the core on several domains of cooperative transferable utility (TU) games is characterized by various combinations of axioms containing some versions of the reduced game property (RGP), of its converse (CRGP), or of the reconfirmation property (RCP) with respect to the Davis-Maschler reduced game. The prekernel and prenucleolus satisfy these consistency properties except RCP or CRGP, respectively, and possess characterizations that employ RGP, CRGP, or RCP. We show that these characterizations are still valid for games with communication structures a la Myerson when using the notion of the reduced communication structure that establishes a new link between two inside players if they can communicate via outside players. Just for the prenucleolus the additional axiom “independence of irrelevant connections” is needed. This property requires that any element of the solution to a game with communication structure is an element of the solution to the game that allows unrestricted cooperation in all connected components, provided that each newly connected coalition is sufficiently charged, i.e., receives a sufficiently small worth. Moreover, we show that the characterizations of the core on several interesting domains of nontransferable utility (NTU) games may be generalized to NTU games with coalition structures. As a byproduct we construct, for any NTU game with communication structure, a certain traditional NTU game with the same core that may be regarded as its Myerson restricted NTU game.

Market Discipline under Financial Contagion

Takeshi Nakata

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Theory analyzing market discipline suggests that bankers become more "creditor friendly" by holding demand deposit or short-term debt (e.g. Calomiris and Kahn 1991; Diamond and Rajan 2012). We reconsider the accepted notion in an environment where a financial contagion occurs by using a global game technique. When a contagion between bank and financial market occurs, an alternative effect arises: namely, a banker's incentive to make an effort is affected by the state of a financial market as well as the bank's own state. We show that, when speculators in the financial market have much more precise information about fundamentals of the economy than that of creditors in the bank, demand deposit or short-term debt induces the bankers to act "against creditors' interests".

Pollution Permit Sharing Game

Yuntong Wang
Sang-Chul Suh

We consider a pollution permit sharing problem in which a finite number of firms each with a technology and a given amount of pollution permit jointly share their technologies and permits. We define two different games for the problem. The Pollution Permit Sharing (PPS) game assigns to each coalition of firms the maximal value they can generate collectively given their technologies and permits. The Aspiration Upper Bounds (AUB) game, on the other hand, assigns to each coalition of firms the maximal value they can generate by using the technologies of all firms but only with the permits owned by the firms in the coalition. We show that for any problem, these two games each have a nonempty core. As expected, the competitive equilibrium allocation is in the core of the PPS game. However, it is unexpected that the competitive equilibrium is not in the core of the AUB game. This observation raises question about how well the pollution permit market functions when the participating polluting firms are not numerous. We argue that the cooperative game theory approach might be appropriate in this case. We propose some Shapley-value type solutions to the problem.

Identifying Groups with Boolean Algebra

Wonki Jo Cho
Biung-Ghi Ju

We study the problem of determining membership for groups based on individual opinions (known as group identification problems). The one-vote rules are defined and characterized in the binary and multinary models (Miller, 2008; Cho and Ju, 2014). However, because the two results are obtained in different models and involve different axioms, it is difficult to compare them properly. We propose an extended model of group identification that subsumes both the binary and multinary models. Using the extended setup, we show that the axioms that characterize the one-vote rules in the multinary setup characterize a family of rules that contains the one-vote rules in the binary setup as a special case. We also find that in the binary setup, an independence axiom is implicitly assumed, playing a more important role than consistency, and that a weaker set of axioms suffices for Miller's (2008) characterization.

Interpersonal Comparison Necessary for Arrovian Aggregation

Hirofumi Yamamura

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While studies of social welfare functionals have shown that some interpersonal comparability such as ordinal and level comparability and cardinal and unit comparability resolves Arrow's impossibility theorem, the kind of information necessary to solve this issue remains unclear. To address this shortcoming in the body of knowledge on this topic, the present study captures and then characterizes the features of informational structures that make available social welfare functionals satisfying Strong Pareto, Anonymity, and Independence of Irrelevant Alternatives. We know from this characterization that if utility levels are not interpersonally comparable, then transformed utility functions by a certain transformation need to be cardinal and unit comparable.

Bounded Response and Arrow's Impossibility

Nozomu Muto
Shin Sato

We propose a new axiom called bounded response, which says that the smallest change in an agent's preference leads to the smallest or no change in the aggregated preference in the society. This axiom is weaker than independence of irrelevant alternatives a la Arrow. We show that bounded response together with a weak axiom imply dictatorship whenever there are four or more alternatives. Our result offers a new perspective on Arrow's theorem: neither independence property nor informational efficiency in independence of irrelevant alternatives is necessary for the impossibility. A new technique is employed in the proof.

The Extended Stable Sets for Abstract Decision Problem

Weibin Han
Adrian van Deemen, Ary Samsura

We study abstract decision problems by introducing an extended dominance relation with respect to the set of alternatives. This extension is in between the traditional dominance relation R as formulated by Von Neumann and Morgenstan (1944) and the transitive closure of it. The motivation for introducing this new relation is that R is so strict that stable sets defined by it do not solve for every abstract decision problem, while the transitive closure of R is so weak that the generalized stable sets defined by it fail to turn out to be stable sets even though when R is acyclic. Subsequently, stable sets are defined and studied for this extended relation. We provide a characterization of stable sets for this relation and an existence theorem. Finally, we discuss its relation with stable sets and with generalized stable sets. We will prove that stable sets for the extended relation is in between stable sets for dominance R and generalized stable sets for transitive closure of R .

Polyequilibrium

Igal Milchtaich

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Polyequilibrium is a generalization of Nash equilibrium that is applicable to any strategic game, whether finite or otherwise, and to dynamic games, with perfect or imperfect information. It differs from equilibrium in specifying strategies that players do not choose and by requiring an after-the-fact justification for the exclusion of these strategies rather than the retainment of the non-excluded ones. Specifically, for each excluded strategy of each player there must be a non-excluded one that responds to every profile of non-excluded strategies of the other players at least as well as the first strategy does. A polyequilibrium's description of the outcome of the game may be more or less specific, depending on the number and the identities of the non-excluded strategy profiles. A particular property of the outcome is said to hold in a polyequilibrium if it holds for all non-excluded profiles. Such a property does not necessarily hold in any Nash equilibrium in the game. In this sense, the generalization proposed in this work extends the set of justifiable predictions concerning a game's results.

A perfect Bayesian polyequilibrium is a dynamic-game refinement of polyequilibrium that incorporates the requirement of Bayesian perfection. Unlike in a perfect Bayesian or sequential equilibrium, players are not restricted to a single system of beliefs. The special case of singleton perfect Bayesian polyequilibrium is equivalent to a strategy profile that constitutes a sequential equilibrium with every system of consistent beliefs.

Belief Distorted Nash Equilibrium - When Beliefs about Future Create Future

Agnieszka Wiszniewska-Matyszek

This paper presents new concepts of equilibria which can be applicable in dynamic game theoretic problems in which players do not have perfect information about the game they play.

The questions that are designed to answer to are as follows.

---Can beliefs of players about future values of some parameters being results of players choices cause this future values behave according to those beliefs?

---Can it happen if it is against the objective knowledge about e.g. the dynamics of the system?

---Can such players' behaviour be sustainable even if it does not lead to Nash or correlated equilibrium?

---What is the mechanism?

--- Can such beliefs be self-verifying? Is it possible that rational players believe they play a Nash equilibrium?

The class of games under consideration are discrete time dynamic games in which players have imperfect information about the game they play.

Players can observe the global state variable and a statistic of players' decisions influencing it, and form expectations about their future values based on their observations and best respond to their expectations. Expectations may have various forms: e.g. a probability distribution or sets of scenarios regarded as possible.

The concept of pre-belief-distorted Nash equilibrium (pre-BDNE) in which players best respond to their observations, belief-distorted Nash equilibrium (BDNE) being a pre-BDNE at which the beliefs cannot be falsified during the play.

The general idea behind BDNE is similar to all the imperfect information concepts in game theory: players form some beliefs, they best respond to those beliefs and if their beliefs are not falsified, there is no need to update them.

It is also the idea behind scientific research in the case when players use research results for their optimization which, in turn, influences data considered in research.

Implementation of Optimal Schedules in Outsourcing with Identical Suppliers

Flip Klijn
Herbert Hamers, Marco Slikker

This paper deals with decentralized decision-making situations in which firms outsource production orders to multiple identical suppliers. Each firm aims to minimize the sum of its completion times. We study whether a central authority can install a mechanism such that strategic interaction leads to a socially optimal schedule. For the case of single demand the shortest-first mechanism implements optimal schedules in Nash equilibrium. We show that for the general case there exists no such an anonymous mechanism.

Optimal Insurance Contract for an Ambiguity-Averse Insurer

Chong Wang
Mingli Zheng, Chaozheng Li

In this paper, we consider a monopolistic insurance market where an ambiguity-averse monopolistic insurer holds an α -contaminated prior about the distribution of the consumers. We consider a case with two types of consumers who hold private information about their types. We find that high-risk consumers are fully insured, whereas low-risk consumers are only partially insured. Compared to the case without ambiguity, if an insurer's prior belief is that the proportion of low risk consumers is high, an ambiguity-averse insurer will adjust downward the proportion of the low-type consumers and reduce the coverage of a low-risk consumer. If an insurer's prior belief is that this proportion is low, she will increase the coverage of a low-risk consumer when ambiguity exists. As ambiguity increases, the optimal menu of contracts moves toward the one that equalizes the profit earned by the insurer from the two types of consumers. Under information ambiguity, an ambiguity-averse insurer may offer the same menu of contracts even if her prior belief changes.

Sharing the Proceeds from a Hierarchical Venture

Lars Peter Osterdal

Jens Leth Hougaard, Juan D. Moreno-Ternero, Mich Tvede

We consider the problem of distributing the proceeds generated from a joint venture in which the participating agents are hierarchically organized. We characterize a family of allocation rules ranging from the so-called zero-transfer rule (which awards agents in the hierarchy their individually generated revenues) and the full-transfer rule (which awards all the proceeds to the agent at the top of the hierarchy). The intermediate rule of the family imposes a sequence of transfers along the hierarchy consistent with the so-called MIT strategy, recently singled out as an optimal social mobilization mechanism. Our benchmark model refers to the case of linear hierarchies, but we also extend the analysis to the case in which hierarchies convey a general tree structure.

Consistent Representation and Electoral Systems

Yoko Kawada

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This paper studies electoral systems in representative democracy by axiomatic approach. An electoral system is a function that maps each preference profile to distribution of seats in the congress. We show a paradox of single-member district systems: a political party that is the strong minority in the nation becomes the dominant party in the congress and a party that is the strong majority in the nation becomes the weakest party in the congress if we use the plurality rule, scoring rules, or Condorcet consistent voting rules in single-member electoral systems under weak conditions. This paradox motivates us to focus on not only voting rules but also electoral systems such as single-member district systems, multi-member district systems, and proportional representation systems. We define a consistency property for electoral systems, called representative consistency, and search for electoral systems complying with the property. This property requires that the majority in the nation should not be the minority in the congress. We first show incompatibility of representative consistency and desirable voting rules in single-member electoral systems. We next show that a simple proportional representation system with some desirable properties does not satisfy representative consistency. We finally show a possibility theorem: a characterization of a class of electoral systems satisfying representative consistency and other standard properties.

Choosing When to Delegate: Endogenous Cooperation and Optimal Voting Rules

Rafael Treibich
Antonin Mace

We develop a model of collective decision making in which a group of countries may choose to cooperate on specific areas, i.e. take decisions collectively on every proposal related to that particular area. Examples include environmental regulation, monetary and fiscal policy, foreign military intervention or space exploration. Cooperation is desirable because it generates positive externalities (economies of scale, coordination efficiency), but also comes at a cost since countries may sometimes disagree with the collective decision. The democratic process follows a two stage procedure. In a first stage, countries decide whether they want to cooperate or remain sovereign (for any given domain). In a second stage, repeated binary decisions, whether to accept or reject different proposals, are taken at a possibly qualified majority among cooperating countries. Two different forms of constitutional design are considered. Under rigid constitution, cooperation is adopted only if all countries agree to do so. Under flexible constitution, a strict subset of participating countries is allowed to cooperate while the others remain sovereign. When the externality is fully excludable, we show that flexible constitution always performs better than rigid constitution. If externalities are not fully excludable, rigid constitution may actually be optimal because flexible constitution generates a free riding problem. Under rigid constitution, we show the optimal majority rule is given by the lowest threshold for which cooperation is accepted by all countries. The optimal threshold may be strictly larger under flexible than under rigid constitution, as it is sometimes more efficient to induce a strict subset of the grand coalition as the stable outcome. The rest of the paper extends some of these results to the case of unequally sized countries.

An Evolutionary Approach to Social Choice Problems with q -Quota Rules

Ryoji Sawa
Akira Okada

This paper examines a dynamic process of n -person social choice problems, in which people choose one from a set of alternatives by q -quota voting. We characterize stochastically stable alternatives of these settings. The static settings are embedded into a dynamic process, in which players select an alternative as a proposal and vote on it over time. A pairwise q -quota rule determines the social choice of the next period; The proposal will be implemented if it receives at least q votes, and the status quo will remain otherwise. The evolution of social conventions is studied with the presence of stochastic noise which leads players to cast a suboptimal vote. A Condorcet winner is stochastically stable for all q -quota rules under the best response with mutations rule. While, the logit choice rule is in favor of a winner of the Borda rule under certain conditions.