

Book of SING17 (European Meeting on Game Theory)

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Foreword

Dear Colleagues,

we want to welcome you all to the 17'th European Meeting on Game Theory (formerly Spain-Italy-Netherlands Meeting of Game Theory – SING15). The conference, organized by the Department of Economics of the University of Padova (Italy), takes place on July 11th – July 13th, 2022 and it held on line. The scientific program consists of 109 talks and 4 plenary lectures. We would like to thank the authors and the invited speakers for their contributions, and all the participants for taking part in this event. We are grateful to the communication office of the Department of Economics of University of Padova for its help in organizing this conference. We would also like to acknowledge the financial support of the University of Padova under STARS grant. Besides we announced a call for papers on the journal Socio-Economic Planning Sciences (SEPS). We encourage the participants of SING17 conference to submit their papers to the advertised special issue, if the domain of the contribution fits with the call. Please, if you have any questions on this special issue, contact one of the guest editors. Link to the special issue can be found in the conference website.

Sincerely yours,

The Organizing Committee:

Michela Chessa
Francesco Ciardiello
Riccardo Saulle (Chair)

Abstracts

Nonempty core of minimum cost spanning tree games with revenues

José-Manuel Giménez-Gómez¹, Josep E. Peris² and Begoña Subiza²

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A minimum cost spanning tree problem analyzes the way to efficiently connect agents to a source when they are located at different places. Once the efficient tree is obtained, the total cost should be allocated among the involved agents in a fair and stable manner. It is well known that there always exist allocations in the core of the cooperative game associated to the minimum cost spanning tree problem (Bird, 1976; Granot and Huberman, 1981). Estévez-Fernandez and Reijnierse (2014) investigate minimum cost spanning tree problems with revenues and show that the cost-revenue game may have empty core. They provide a sufficient condition to ensure the non-emptiness of the r-core for elementary cost problems; that is, minimum cost spanning tree problems in which every connection cost can take only two values (low or high cost). We show that this condition is not necessary and obtain a family of cost-revenue games (simple problems, Subiza et al. (2016)) in which the non-emptiness of the r-core is ensured. Keywords: Minimum cost spanning tree problem, Elementary cost problem, Simple minimum cost spanning tree problem, Cost-revenue game, Core.

The Group-wise Egalitarian Owen Values

Takaaki Abe¹ and Satoshi Nakada²

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Different principles of distributive justice may result in different allocations of economic resources and surpluses across members of groups. This paper proposes a new class of allocation rules, called the group-wise egalitarian Owen values that integrates two seemingly conflicting principles—marginalism and egalitarianism—in the framework of cooperative games with coalition structures. These allocation rules facilitate the use of different principles of allocation in different layers of a social structure such as allocation across coalitions and within a coalition. Thus, each coalition can employ its specific distributive principle for intra-coalition distribution. Our main results provide axiomatic foundations for the class of allocation

rules and highlight the importance of monotonicity properties. We also show that various monotonicity properties generate various allocation rules, where the Owen value and the group-wise egalitarian division are the special cases. These results extend the egalitarian Shapley values to the games with coalition structures and offer a rationale for monotonic allocation rules in the presence of social structures.

A generalized implementation problem

Hector Hermida-Rivera

University of East Anglia, United Kingdom

In this paper, we generalise the classical implementation problem by introducing an exogenous set of social choice functions whose realisations determine the set of feasible outcomes in every state. In Remarks 1 to 3, we provide a set of simple yet dire conclusions regarding the (weak) implementability of rules by means of feasible (and exhaustive) mechanisms. We then introduce the notion of support, and show in Theorems 1 & 2 that a rule is (weakly) supportable if and only if there exists an ‘equivalent’ problem whose set of feasible outcomes is the original exogenous set of social choice functions.

Safe Equilibrium

Sam Ganzfried

Ganzfried Research, United States

The standard game-theoretic solution concept, Nash equilibrium, assumes that all players behave rationally. If we follow a Nash equilibrium and opponents are irrational (or follow strategies from a different Nash equilibrium), then we may obtain an extremely low payoff. On the other hand, a maximin strategy assumes that all opposing agents are playing to minimize our payoff (even if it is not in their best interest), and ensures the maximal possible worst-case payoff, but results in exceedingly conservative play. We propose a new solution concept called safe equilibrium that models opponents as behaving rationally with a specified probability and behaving potentially arbitrarily with the remaining probability. We prove that a safe equilibrium exists in all strategic-form games (for all possible values of the rationality parameters), and prove that its computation is PPAD-hard. We present exact algorithms for computing a safe equilibrium in both 2 and n-player games, as well as scalable approximation algorithms.

A dynamic model for native advertising

Chiara Brambilla, Alessandra Buratto and Luca Grosseto

University of Padova, Italy

We consider a communication media where different messages and content appear. In such a channel, advertising may take two different forms: the traditional and the native one. Native advertising is a widely used marketing tool that aims to mimic the regular topics of the media on which it is placed. The striking resemblance between native advertising and media content makes this advertising quite effective because consumers might not recognize it as a sponsored message. Nevertheless, once the consumers realize the real commercial scope of the native advertising, they may feel deceived and react by losing their trust in the media's credibility. Our model considers a firm that invests both in traditional and native advertising on a medium characterized by high-quality content. The editor of the media gains profit by publishing advertising and, at the same time, has to consider the loss of credibility that native advertising may cause. To avoid the negative effects of excessive native advertising, the editor can limit the amount of native advertising allowed. We formalize the problem over an infinite time horizon as a linear state differential game played à la Stackelberg, where the editor acts as the leader and the firm as the follower. With the main objective of studying whether native advertising is long-term sustainable for the editor, we determine a time-consistent open-loop Stackelberg equilibrium.

A Lexicographic Public Good Ranking

Michele Aleandri¹ Vito Fragnelli² and Stefano Moretti³

¹ Luiss University, Italy; ² University of Eastern Piedmont, Italy; ³ LAMSADE-CNRS-Université Paris-Dauphine PSL, France.

In this paper, we consider the consistency of the desirability relation with the ranking of the players in a simple game provided by some well-known solutions, in particular the Public Good Index and the criticality-based ranking. We define a new ranking solution, the lexicographic Public Good ranking (LPGR), strongly related to the Public Good Index being rooted in the minimal winning coalitions of the simple game, proving that it is mono-tonic with respect to the desirability relation, when it holds. A suitable characterization of the LPGR solution is provided. Finally, we investigate the relation among the LPGR solution and the criticality-based ranking, referring to the dual game.

Mutual insurance for uninsurable income

Michiko Ogaku

Nagasaki University, Japan

An infinite-period contract between a firm and individuals whose incomes are private information is said to provide an immiseration result: individuals' utilities on consumption converge to the negative infinity and welfare inequality rises without bound (e.g. Green, in v1 of *Minnesota Studies in Macroeconomics*, 1987; Thomas and Warrall, *Journal of Economic Theory*, 51(2), 1990). It occurs because incentives are needed for truth telling. It is Pareto optimal to provide only the highest income individuals with full insurance. Because by false reporting, the highest income individuals can receive transfers for lower income individuals. While lower income individuals are risk averse. It makes them prefer debts tomorrow to limited consumption today. Consequently, the average contract value becomes a decreasing sequence and welfare inequality keeps rising. The extant literature concludes that efficient allocations are achieved only at the expense of invoking inequality without full information Atkeson and Lucas (*Review of Economic Studies*, 59(3), 1992) or preferences that almost do not discount future values Carrasco et al. (*Journal of Economic Review*, 182, 2019). This paper shows a counter result: an efficient contract can solve the immiseration problems. (i) Such a contract provides optimal (full insurance) transfers in each period with varying inter-period allocation weights; (ii) the lifetime utility is higher than that in autarky; (iii) it does not invoke inequality and sustainable. This paper's key departure from prior work is the use of a mechanism adapted from the λ -mechanism by Marcet and Marimon (*Journal of Economic Review*, 58(2), 1992), which induces truth telling by varying future allocation weight λ . An efficient mutual contract achieves full insurance by shifting risks to future periods. The result sheds some light on efficient resource allocation in which rankings are not the sole solution.

Group Public Goods Game with Position Uncertainty

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We model a public goods game with sequential uncertainty and observational learning, and show that in a one shot public goods game with finite players, cooperation is still possible. To fix ideas, imagine a public goods game where a finite number of players are divided into groups. Each group is exogenously placed in a sequence. Players in each group are unaware of their position in the sequence. Decisions within the groups are made simultaneously, but decisions across the groups are made sequentially. Before players make their decisions, they observe total contributions of their predecessor group(s). We characterize the sequential equilibrium for the following cases: (i) when players observe at least two of their immediate group's total contribution, and (ii) when players observe only their immediate predecessor's total

contribution. We find full contribution can occur in the first case if the rate of return from the public goods is high enough. In the second case we show contributions can occur in two concurrent equilibrium- pure and mixed. In the mixed equilibrium we show that a player can become pivotal and can induce others to contribute.

The Price of Anarchy in the Bargaining Game

Huizhen Peng, Heyin Hou and Qian Jiang

China Southeast University, China

Based on the Bayesian game model under incomplete information, this paper studies the bargaining game which has one buyer and one seller, and take the risk attitude into consideration. We calculate the equilibrium quotation under centralized decision-making and decentralized decision-making respectively, and use PoA to measure the efficiency of decentralized decision-making.

Information Design for Weighted Voting: A Cooperative Game Theory Approach

Toygar T. Kerman and Anastas P. Tenev

Corvinus University of Budapest, Hungary

We consider a sender who wishes to persuade multiple receivers to vote in favor of a proposal and sends them correlated messages that are conditional on the true state of the world. The receivers share a common prior and have homogenous preferences, but are heterogeneous in their voting weights and wish to implement the outcome that matches the true state. With general weight profiles, finding the sender's optimal signal can be represented by a linear programming problem. In order to find a closed form solution for an optimal signal, we borrow terminology from cooperative game theory and interpret the voting problem as a simple game. For centralized policy games and ones that are not proper, we provide a lower bound for the sender's gain from persuasion, which is higher than under the optimal public signal. Moreover, we characterize optimal communication for specific types of simple games and we show that it is public under weak, oligarchic, and dictatorial games, while under apex-like games it is private and improves upon public communication.

Influential News and Policy-making

Federico Vaccari

Laboratory for the Analysis of Complex Economic Systems, IMT School of Advanced Studies, Lucca, Italy

This paper analyzes the implications of those types of interventions that affect misreporting costs. I study a model of communication between an uninformed voter and a media outlet that knows the quality of two competing candidates. The alternatives available to the voter are endogenously championed by the two candidates. I show that higher costs may lead to more misreporting and persuasion, whereas low costs result in full revelation. Yet, interventions that increase misreporting costs never directly harm the voter, but those that do so slightly can be wasteful of public resources. Regulation produced by politicians leads to suboptimal interventions.

Coexistence of Centralized and Decentralized Markets

Berk Idem

Penn State University, United States

In this paper, I introduce a profit-maximizing centralized marketplace into a decentralized market with frictions. I analyze the equilibria of a market choice game where agents choose between the centralized marketplace and decentralized bilateral trade. I use a mechanism design approach to characterize the optimal rules of the profit-maximizing marketplace in this game. In the unique equilibrium, the centralized marketplace and decentralized trade coexist. The thickness of the centralized marketplace is not affected by the decentralized trade. The equilibrium profit of the marketplace is at least half of the baseline profit, independent of the distribution of valuations. The decrease in the profit as a result of decentralized trade only depends on the efficiency of the decentralized market and not on the distribution. Under some conditions, this equilibrium results in higher welfare than either institution on its own.

The Gatekeeper's Effect

Moran Koren

Tel Aviv University, Israel

Many selection processes contain a “gatekeeper”. The gatekeeper’s goal is to examine an applicant’s suitability for a position before both parties incur substantial costs. Intuitively, a gatekeeper should reduce selection costs by sifting unlikely applicants. However, as we show, this is not always the case since the gatekeeper’s introduction inadvertently interferes with the candidate’s self-selection. We study the conditions under which a gate-keeper improves the system’s efficiency and those under which it induces inefficiency. Additionally, we show that selection correctness can, at times, be improved by allowing for strategic gatekeeping.

A Mouse-Tracking Bandit Experiment on Meaningful Learning in Weighted Voting

Naoki Watanabe

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In this experiment, subjects were asked to choose one of two weighted voting games (options) repeatedly. The payoff distributions realized by subjects' choices as well as the vote apportionments and quotas of those games were hidden from them in windows on their computer screens. Each subject needed to open a window which hid the information he or she wanted to view by clicking on it with a computer mouse. The window closes when the subject moves the cursor to another window and click on it for viewing other information. The payoffs for subjects were determined by a stochastic payoff-generating function which was also hidden from subjects throughout the session. After subjects had experienced a binary choice problem in the first 40 rounds, we examined whether those subjects increased the number of choosing the answer which would give a higher expected payoff (subjects meaningfully learned) in a similar but different binary choice problem in the subsequent 20 rounds. The information on subjects' cumulative payoffs might promote their meaningful learning of the latent feature of weighted voting, whereas the information on their current payoffs did not, or even hindered it. It was also confirmed in a binary choice problem that the subjects who took the win-stay-lose-shift strategy (Nowak and Sigmund, 1993) paid more attention to the current payoffs and that those subjects failed in meaningful learning. The same things were confirmed when the subjects chose the runs of options randomly.

Market-Minded Informational Intermediary and Unintended Welfare Loss

Wenji Xu¹ and Kai Hao Yang²

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This paper examines the welfare effects of informational intermediation. A (short-lived) seller sets the price of a product that is sold through a (long-lived) informational intermediary. The intermediary can disclose information about the product to consumers, earns a fixed percentage of the sales revenue in each period, and has concerns about its prominence—the market size it faces in the future, which in turn is increasing in past consumer surplus. We characterize the Markov perfect equilibria and the set of subgame perfect equilibrium payoffs of this game and show that when the market feedback (i.e., how much past consumer surplus affects future market sizes) increases, welfare may decrease in the Pareto sense.

Two-bound core games and the nucleolus

Dudou Gong¹, Bas Dietzenbacher² and Hans Peters²

¹ School of Mathematics and Statistics, Northwestern Polytechnical University, Xi'an, China; ² Maastricht University, The Netherlands

This paper introduces the new class of two-bound core games, where the core can be described by a lower bound and an upper bound on the payoffs of the players. Many classes of games turn out to be two-bound core games. We show that the core of each two-bound core game can be described equivalently by the pair of exact core bounds, and study to what extent the exact core bounds can be stretched while retaining the core description. We provide explicit expressions of the nucleolus for two-bound core games in terms of all pairs of bounds describing the core, using the Talmud rule for bankruptcy problems, and study to what extent these expressions are robust against game changes.

Stochastic adaptive learning with committed players in games with strict Nash equilibria

Naoki Funai

Shiga University, Japan

In this paper, we investigate the condition under which players of an adaptive learning model, including the one of stochastic fictitious play learning, learn to follow a logit quantal response equilibrium corresponding to a strict Nash equilibrium, the one which approaches the Nash equilibrium as the noise term approaches zero. In particular, we consider the situation in which adaptive players face a fixed normal form game repeatedly and may interact with committed players, who do not revise their behaviour and follow a specific strategy in each period. When committed players follow a logit quantal response equilibrium corresponding to a strict Nash equilibrium and the probability of each adaptive player interacting with committed players is large enough, we show that adaptive players learn to follow the equilibrium that committed players follow almost surely; we also show that any strict Nash equilibrium can be logit quantal response equilibrium approachable so that we can pick any strict Nash equilibrium for committed players to follow. Also, we show that when the probability of interacting with committed players is small, players of a more general adaptive learning model, including the ones of payoff assessment learning and delta learning, may learn to follow an equilibrium different from the one committed players follow with positive probability. Lastly, we also consider the case in which there do not exist committed players and show that when players of the general adaptive learning model have enough experience and their behaviour is close enough to a logit quantal response equilibrium corresponding to a strict Nash equilibrium, then their behaviour converges to the equilibrium with probability close to one.

Location Games on Trees

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In Voronoi location games on graphs [1], k players simultaneously choose a vertex of a given graph $G = (V, E)$. Of course, different players may choose the same vertex. The payoff of each player is the number of vertices closest to the vertex (location) chosen by that player. In case of ties, where a vertex is closest to the locations of m players, it contributes $m/2$ to the payoff of each of these m players. We will investigate Voronoi location games on trees for $k \geq 3$ players. The two-player case $k = 2$ has been discussed in [3]. We will discuss the questions whether such a game has a pure Nash equilibrium, and how such Nash equilibria will look like. We will also explore the relationship between such Nash equilibria and the graph-theoretical concept of branch-weight in trees. The social cost of a selection of k vertices in a graph is the sum of all distances to the closest selected vertex, summed over all vertices. It turns out that for paths and $k = 2$ players, the social cost of a Nash equilibrium is about twice the minimum possible social cost—this discrepancy was already discussed by Hotelling [2] in the continuous version of paths, as a possible problem of market solutions. Things get worse for trees: we show that for every $k \geq 2$, and every number m there is a tree such that the ratio between social cost of a Nash equilibrium and the minimum social cost exceeds m . We will also provide some data based on simulations on randomly generated trees of up to 100 vertices and up to 8 players. How often do we get Nash equilibria, how often do the different types of Nash equilibria occur, what is the average unfairness (ratio between highest and lowest payoff in a Nash equilibrium), and what is the average ratio of social cost of a Nash equilibrium and the minimum possible social cost?

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How Bankruptcy Rules Influences Investors' Behavior

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This study explores the investment implication of bankruptcy rules in a new setting different from Kıbrıs, ö and Kıbrıs, A. (2013) and Karagözoğlu, E. (2014). We consider two agents a risk-neutral and a risk-averse, both owning the same wealth, facing two investment alternatives, risky and safe assets. In the case of success, the risky asset leads to higher profit than the safe one. In the case of failure, it does lower. We set up three strategic games corresponding to three bankruptcy rules applied for the failure case: the proportional, the constrained equal awards, and the constrained equal losses rules. Generally, finding the equilibrium investment strategies requires numerical computations. We do that for a parameter set of size 37800. Our results reveal that against previous studies maximum equilibrium investment is not absolutely achieved under any of the rules. The most share belongs to the CEL(%66). The proportional and CEA rules have equal shares(%17).

Fear of communism: a political theory of land reform in democracies

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Why is so hard to find successful large-scale land reforms in democratic societies? Economic and political power of rural elites? High complexity of legislative processes? I provide an alternative explanation: the combination of electoral incentives and high uncertainty about politicians' types make the incumbent distance herself from the image of the one who carries too extensive land reforms (who I call communist). I build the argument through a Bayesian Game, wherein the three types of citizens, namely landowners, landless (rural), and urban citizens must decide whether to reelect the incumbent without observing her actual type (whether communist or not). Citizens' payoffs depend on the amount of land they will own in case of reform and on the social value of land – and, therefore, there is a preference for redistribution –, whose valuation varies across individuals. The incumbent can signal her type by implementing the land reform of a given extent. I show that, under quite general conditions, there is a unique Bayesian Perfect Equilibrium wherein both types redistribute less land than they would do if there is no electoral incentives. More interestingly, the magnitude of the equilibrium land reforms might be inferior to the one preferred by the median voter regardless of the incumbent's type (whether benevolent or communist). This result corroborates the empirical evidence on the weak correlation between politicians' ideology and the magnitude of the implemented land reforms. Comparative statics reinforces the role of electoral incentives: the higher the benefits from winning the lower the amount of land redistributed.

Water pricing and its allocation among heterogeneous end users in high and low seasons: a game theoretic approach

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The problem of water resource management has been widely debated, both by the public and by policy makers, due to the impact that the efficiency of such management (related to the scarcity of the resource) can have on both domestic uses and industrial activities. According to the actors mentioned above, the solution to the water problem lies in the regulation of water withdrawal, depending on the type of end user. This resource management problem, coupled with the inability to treat general natural resources as capital, has made it essential to research and develop rules for the efficient allocation of water between competing uses in time and space (Koundouri and Xepapadeas, 2004).

Recalling the seminal work of Gisser and Sanchez (1980) and the more recent contributions of Kogan and Tapiero (2010), Sechi et. al (2013) and Xiao et. al (2016), our work proposes a repeated game between an industrial firm, a domestic user and a regulator to determine the socially optimal solutions, both in terms of pumping levels and water resource prices. Specifically, the model assumes that (i) each period is composed of two seasons, high season (hs) and low season (ls) respectively, differentiated in terms of the amount of extractable (and therefore purchasable); (ii) agricultural and domestic pumping levels are determined in order to maximise the firms' profits and domestic users' preferences (water is assumed to be a commodity of first necessity for the latter) and (iii) the two differentiated prices for pumping the resource are established, according to an extraction cost (assumed as quadratic) and a hydro-damage caused to social welfare by excessive pumping.

The main outcome of the analysis is that both the marginal cost of extraction and the magnitude of hydro-damage can induce the inter-temporal choices of end-users along three different paths: (a) a hydro-catastrophic scenario, caused by excessively low prices and excessive pumping of the resource, resulting in a reduction (in the long run) of the base aquifer; (b) an anthropo-catastrophic scenario, with excessively high prices and consequent reduction in both the spending capacity of the domestic user and industrial production; (c) a virtuous scenario in which the combination of costs and damages leads to a balanced inter-temporal use of the resource and water levels that are never harmful to the ecosystem.

Improving cooperation using incomplete fractional punishment

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In a public goods game, when a sanctioning system is defined, typically every defector in the population is punished [3]. However, in real-world situations, punishing every free-rider is not the norm. On one hand, sanctioning is expensive and resource-consuming [4, 2], on the other hand, it may be impossible to catch all the defectors in the population. Therefore, the group must decide between accepting the sanctioning cost or assuming the financial loss. Often, an intermediate solution is applied. To sanction a reduced group expecting that, as a consequence, defectors are persuaded to change their strategy. In this work, we consider a compulsory public goods game where only a percentage of the free-riders are sanctioned. We call this mechanism fractional punishment [1]. The punished fraction of defectors has their payoff reduced by a fine. We analyze the interplay between both parameters: the fraction of sanctioned defectors and the amount of the fine applied to improve cooperation in the group. Using replicator dynamics we study the evolution of the system. The results show that it is not necessary to sanction every defector in order to improve cooperation in the population. Furthermore, due to the relation between the parameters, depending on the circumstances, it can be more advisable to sanction more defectors and apply a small fine or, on the contrary, to apply a large fine to fewer defectors. Thus, cooperation can be achieved with a moderate effort in chasing the free-riders and reasonable fines.

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How to Delegate the Choice of a Project

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We study a dynamic Principal-Agent problem where they jointly choose a project to implement. A project is a pair of payoffs for the players and the set of available projects is the private information of Agent. The preferences of Principal and Agent over the possible projects are in perfect conflict. In this sequential delegation game, in each period, Agent can propose an available project or stay silent. Following the proposal of a project, Principal can accept or reject but he cannot commit to his future responses. Acceptance ends the game and rejection takes the game into the next period. We first establish a benchmark in which Principal has commitment power and we compare it to the equilibria of the dynamic game. When there are two possible projects, there is always an equilibrium in which Principal attains his commitment payoff when the players are sufficiently patient. The reason why Coasian dynamics are not always present here is because Principal lacks proposal power. In addition to his limited actions, with the use of extremal off-path beliefs, Principal is able to override his sequential rationality and obtain his commitment payoff. When there are more than two possible projects, we identify a condition on the parameters under which Principal can still attain his commitment payoff.

Matching and Labour Contracts under the New Normal

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This paper proposes a matching model between pairs of employers and employees that assumes ambiguity about the disadvantages of working in an unknown environment. We assume that there are two possible states of nature, the familiar state and the unfamiliar state or New Normal, the latter is such that the unfamiliar work environment needs extra costly efforts, potentially compounded by the employee's adaptation ability to the new environment. We analyse the model considering alternative wage contracts with complete and incomplete information, and under two alternative scenarios: (1) with costly adaptation effort by both the employer and the employee but no adaptation utility suffered by either of them, and (2) costly adaptation effort and adaptation disutility. Our results suggest that the labour matching is positive assortative. The larger the difference between the adaptation ability of the employer and the employee, the harder it would be for them to be matched.

Testing Mixed-Strategy Nash Equilibria in penalty kicks: Literature review and case study on Italian amateur soccer leagues

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The literature on Game Theory applied to sporting data is very wide. Data from penalty kicks in professional soccer have been recently used to test if and to what extent the assumptions and implications of the Minimax theorem are met under natural conditions. In particular, it has been questioned whether professional soccer players play accordingly to the Mixed-Strategy Nash Equilibrium (MSNE). We first perform a critical review of the literature to highlight limits and potentialities of the MSNE predictions in explaining the strategic behaviour of professional soccer players. We then present an empirical study on penalty kicks in Italian amateur soccer leagues. To this end, we collected a quite large data set by watching original videos available on the web. The main research question is to verify whether non-professional soccer players play accordingly to the MSNE of the game, similarly to what has been proved for professional players. Selection bias and data heterogeneity problems are addressed and the main assumptions considered in the literature are discussed. In order to obtain the MSNE predictions, we use a simple linear programming optimization approach. Various alternative hypotheses to the MSNE predictions, including equal probabilities and probability matching, are explored and compared. Although probability matching seems to be a valid alternative to describe goalkeepers' behaviour, the results seem quite consistent with the MSNE play.

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Who to Listen to?: A Model of Endogenous Delegation

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Two privately-informed agents must take a joint action without resorting to side-payments. Size and location of the support of each agent's private types (their preferred action) determine the degree of conflict. Under high conflict, it is too costly to elicit agents' information, which leads to an optimal constant allocation. Delegation arises endogenously when there is conflict and asymmetry in the amount of private information. The agent with more private information dictates the allocation within some bounds. When supports overlap information is shared and sometimes ex-post inefficient actions are optimally taken. Welfare relative to the first-best is non-monotone in conflict.

Computing the per-capita nucleolus in assignment games

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We present a strongly polynomial algorithm that computes the per-capita nucleolus in assignment games. It rests on the following known results: (i) in the dual game of a balanced game the family of anti-essential coalitions is sufficient to determine the per-capita nucleolus (Solymosi, 2019); (ii) in the dual game of an assignment game all anti-essential coalitions are either single-player or mixed-pair coalitions, moreover, these dual game values can be computed by a polynomial time elementary method from the pairwise profit matrix that generates the assignment game (Núñez and Solymosi, 2017). The proposed algorithm shares the following features with the standard nucleolus algorithm for assignment games (Solymosi and Raghavan, 1994): (i) starting from the seller optimal corner of the core, we generate the corresponding special vertices of the iterated per-capita least cores; (ii) the sub-sequent points in this (polynomial size) series are found by solving a longest path problem on an associated arc-weighted directed network.

A payment scheme for sustaining cooperation in multistage games of renewable resource extraction

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We consider a competitive model of renewable resource extraction as a multistage game with feedback information structure. This model, in particular, could be interpreted as a fishery-management model with asymmetric players (see, e.g., [1]). We adopt a rather general assumption that each player's stage performance criterion is log of the current extraction level and focus on the finite-horizon game when the players value differently the resource residual stock after the extraction process ends. This is the only source for asymmetry of the players accepted in the paper (see, e.g., [1, 2] for other reasons of the players' asymmetry).

As it is known, the non-cooperative (selfish) behavior in dynamic models of renewable resource extraction under fairly general assumptions leads to worse results (in particular, more extensive resource exploitation) than the cooperative behavior (see, e.g. [5, 9, 1]). Hence, a problem how to guarantee the sustainability of cooperation (especially, from the long-term perspective) arises. We assume that the payoffs are transferable (between the players, but not between the stages of a game) and explore the payoff distribution procedure (PDP) based approach to reach and implement the cooperative agreement. Such approach was firstly introduced in [7] for differential games and then was successfully applied to different classes of dynamic games (see, e.g., [8, 5, 9, 2]).

To derive non-cooperative and cooperative feedback strategies we use standard dynamic programming technique. Then we extend the novel subgame perfect core (S-P Core) concept (see [3, 4, 6]) to the class of multistage games under consideration. Further, we introduce a refinement of the S-P Core based on maximization of the relative benefit from cooperation and constructing a specific PDP meeting several advantageous properties. Finally, we provide a numerical example of the two-person multistage game to demonstrate the properties of the obtained payment scheme. The contribution of the paper is twofold:

- we derive analytical solution for specific finite-horizon multistage game of renewable resource extraction with asymmetric players;
- we extend the S-P Core concept to multistage games of renewable resource extraction and provide an algorithm for the constructing of quasi proportional payment scheme which belongs to non-empty S-P Core of the two-player game.

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Core and stability notions in many-to-one matching markets with indifferences

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In a many-to-one matching model with responsive preferences in which indifferences are allowed, we study three notions of core, three notions of stability, and their relationships. We show that (i) the core contains the stable set, (ii) the strong core coincides with the strongly stable set, and (iii) the super core coincides with the super stable set. We also show how the core and the strong core in markets with indifferences relate to the stable matchings of their associated tie-breaking strict markets.

Formation of coalition structures from non-cooperative actions of agents

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We study coalition structure formation with intra and inter-coalition externalities in the introduced family of nested non-cooperative simultaneous finite games. A non-cooperative game embeds a coalition structure formation mechanism, and has two outcomes: an allocation of players over coalitions and a payoff for every player. Coalition structures of a game are described by the Young diagrams. They serve to enumerate coalition structures and allocations of players over them. For every coalition structure a player has a set of finite strategies. A player chooses a coalition structure and a strategy for it. A (social) mechanism eliminates conflicts in

individual choices and produces final coalition structure(s). Every resulting coalition structure is itself a non-cooperative game. Mixed equilibrium always exists and consists of a mixed strategy profile, payoffs and equilibrium coalition structures. We use a maximum coalition size to parametrize the family of the games. The non-cooperative game of Nash is a partial case of the model. Our equilibrium results are different from the Shapley value, a strong Nash, coalition-proof equilibria, core solutions, and other equilibrium concepts. We supply few non-cooperative coalition structure stability criteria, and apply the toolkit to construct a non-cooperative fundamental for the strong Nash equilibrium

Mixed Duopoly under Product Differentiation and Political Connections

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A private firm competes with a public-owned one in a game of endogenous product differentiation. The public firm cares about the median voter's utility and could be partially private. The model show that: (i) depending on the degree of privatization, the public firm could earn negative profits, but could also gain more profits than the private competitor; (ii) the socially optimal degree of privatization is interior; (iii) the public firm prefers to produce the low quality good. I also introduce several extensions to study how the optimal degree of privatization depends on the market context.

A cooperative game approach to integrated health care

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This article focuses on the implementation of a bundled payment for integrated health care. We model this problem by means of cooperative game theory. Various approaches are considered and make it possible to take the chronology of medical events into account. The Shapley value is used to (partially) refund the healthcare professionals on the basis of the fee paid by the patient and we establish some properties. Depending on which game the allocation rules are applied, that highlights a better refunding for healthcare professionals who act in the beginning of the process, or a refunding depending on the order of the turnover that each healthcare professionals can claim to treat the patient.

Equity in centralized school choice

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In this paper, we investigate the possibility of integrating a notion of fairness, inspired by the equality of opportunity (EOp) literature, into school allocation algorithms that satisfy the standard stability requirement. We enrich the standard school choice setting with the notion of educational outcome (match quality), which is a measure of students' benefit from attending each school. In this framework, we assume that fairness considerations are made by a social evaluator on the basis of the educational outcome distribution. A school allocation realizes EOp if the expected educational outcome of each student is independent of his circumstances, out of individual control. We investigate the compatibility between this notion of fairness, a new notion of efficiency based on aggregate educational outcomes, and the standard notion of stability. To overcome some of the identified incompatibilities, we set stability as the fundamental requirement for a school allocation, and we define a class of social evaluation function to rank allocations in terms of fairness and efficiency. Therefore, we propose an algorithm that produces the best stable matching, over all stable matching, for our social evaluation functions.

False-name-proof and strategy-proof voting rules under separable preferences

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We consider the problem of a society that uses a voting rule to select a subset from a given set of objects (candidates, issues or alike). We assume that voters' preferences over subsets of objects are separable. A voting rule is strategy-proof if no voter benefits by not revealing its preferences truthfully and it is false-name-proof if no voter gains by submitting several votes under other identities. We characterize all voting rules that verify strategy-proofness, false-name-proofness, anonymity, unanimity and neutrality as either the class of voting by quota one (all voters can be decisive for all objects) or the class of voting by full quota (all voters can veto all objects).

Undergraduate Course Allocation through Pseudo-Markets

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We consider a many-to-many matching problem with a priority structure such as the one in undergraduate course allocation. In order to incorporate course priorities, we develop a deterministic pseudo-market mechanism with priority-specific prices that is based on the approximate competitive equilibrium from equal incomes. This novel mechanism, the Pseudo-Market with Priorities mechanism, prevents justified course envy, prevents Pareto improvements among students respecting the priority structure, is strategy-proof in the large, bounds envy by a single course among students at the same level of priority, and maintains a small upper bound on the market-clearing error. In a simulated environment, we show that this mechanism increases student utility and outcome fairness when compared to the commonly used in practice Random Serial Dictatorship.

Transfer Market - a Contest Theory Approach

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We study Transfer Market in a Contest Theory approach. In our model, the clubs exert two forms of effort to sign a talented player. The first form is the "monetary effort", whose cost is paid in the case where a club signs a contract with a player. The second form of effort is the "persuading effort", which is paid regardless of the result of the contest. We assume two effects of the persuading effort. The first is a win-maximization effect that increases the probability of winning. The second is the profit-maximization effect that decreases the marginal cost of the monetary effort. We derived the conditions under which the persuading effort will not be exerted and examined its impact on monetary efforts and on the contestant's utility.

Broadcasting revenue sharing after cancelling sports competitions

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The COVID-19 pandemic forced the partial or total cancellation of most sports competitions worldwide. Sports organizations crucially rely on revenues raised from broadcasting. How should the allocation of these revenues be modified when sports leagues are cancelled? We aim to answer that question in this paper by means of the axiomatic approach. Two operators will play a major role in our analysis.

Quality investments and competition under limited attention to quality differences

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I analyze the incentives of firms to invest in quality when consumers pay limited attention to quality differences between goods. Consumers who are inattentive to quality differences are willing to pay the same price for two goods even if the goods differ in qualities. Thus quality investments are less profitable. I show that two types of equilibria exist: Equilibria with indistinguishable qualities as well as equilibria with distinguishable qualities. The existence of the equilibria depends on the extent of limited attention, the costs for quality, and on firms' market power.

Biased Mediators in Conflict Resolution

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One of the most important and disputed questions within the field of international mediation concerns the issue of bias. Should mediators be biased—supportive of one but not both of the main disputants— or should mediators always be neutral? This paper contributes to this debate by comparing the effectiveness of mediation, with regard to the role of mediator bias. We study a model in which an agent possesses private information that is relevant for a principal in order to make a decision that affects the welfare of both parties. Individuals disagree about what everyone considers should be the final decision. Consequently, a conflict of interests arises. This in turn leads to a misrepresentation problem, as the informational advantage of the agent gives reasons to the principal to be skeptical about the truthfulness of the information transmitted by the agent. The mediator controls the flow of information between the disputants, which helps alleviate the conflict of interests by mitigating the commitment problems they face. Within this setup, we compare the two scenarios where the mediator caters to the specific interests of each party. We show that an optimal mediation plan implemented by a biased mediator depends on two parameters: (i) the relative degree of conflict, and (ii) the likelihood of a misrepresentation problem. For most parameter configurations, mediator bias is inconsequential—mediation yields the same outcome regardless of the bias. A necessary (but not always sufficient) condition for the success of any mediation process is a sufficiently low likelihood of misrepresentation: When the principal has a strong belief that the agent will use her private information to manipulate the agreement, the mediator is unable to build trust between the parties. Provided that the likelihood of misrepresentation is low enough, mediation is effective regardless of the bias only when the relative degree of conflict is sufficiently low. Otherwise, only a principal-biased mediator will be effective. That is, the direction of the bias is only relevant for mediation success whenever the relative extent of the conflict is large but a misrepresentation problem remains unlikely. This occurs because

a strong conflict of interests makes any information disclosure detrimental for the agent. Thus, seeking to protect his protégé, an agent-biased mediator will make sure not to convey any information to the principal. The consequence is that agent-biased mediation hinders communication, even if reaching a settlement would be preferred by any of the agent's types.

Analysis of the cooperation in covert networks using games in partition function form

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Covert network analysis has gained increasing attention in recent years because of its usefulness in tackling such sensitive problems as terrorism. In this sense, classic techniques in social network analysis are usually used with the aim of identifying the most relevant members. However, such approaches do not consider the natural cooperation of their members. As an alternative, several papers used cooperative game theory to model the possible links between them (see, for instance, Lindelauf et al., 2013). In this work, we analyse the impact of the cooperation of the members of a covert network on the overall effectiveness. The main novelty lies in the fact of that the outsiders of each possible merger naturally influences the effectiveness of the joint operations of the network. This motivates the innovative use of games in partition function form (Thrall and Lucas, 1963) and specific ranking indices for the individuals. Finally, we apply this proposal to analyse the effectiveness of the hijackers of the covert network supporting the 9/11 attacks.

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Hybrid evolutionary games in industrial organization

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The paper provides a new methodological framework of "hybrid evolutionary games", in which the purely evolutionary aspect of the system evolves with a different time scale than that of other system states. The approach here proposed allows generalizing some evolutionary models recently proposed in the specialized economic literature for studying the dynamic interaction of heterogeneous agents. In this paper, we present an application for the dynamic selection of behavioral rules in

oligopolistic competition. In detail, interacting boundedly-rational firms choose dynamically their objective function, which can incorporate prosocial behavior of firms thus implementing forms of Corporate Social Responsibility (CSR). This choice is modeled in a hybrid setup, to include short and long-term decisions of these interacting heterogeneous agents. The paper analytically studies the main features of the proposed model through their global analysis in order to understand the economic implications of embedding different time scales in the system and how, as a consequence, complex dynamics arise.

Counterintuitive Comparative Statics in Legislative Bargaining

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This note shows that a very weak monotonicity property may fail to hold in legislative bargaining with weighted voting. Under the leading (noncooperative) model of legislative bargaining due to Baron and Ferejohn (1989), an increase in a party's voting weight, holding everything else constant, may result in a reduction of the party's expected equilibrium payoff. This is what Felsenthal and Machover (1998) call the fattening paradox for power indices. Coalitional monotonicity in the sense of Young (1985) may also be violated by the equilibrium of the noncooperative game.

Generalised Gately values for cooperative games

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We consider generalisations of the Gately point or value for the class of cooperative games with transferable utilities. The class of generalised Gately values form a subclass of the surplus sharing values for cooperative games. Furthermore, the class of generalised Gately values include the original Gately point (Gately, 1974) as well as the CIS value. We investigate the relationship between these generalised Gately values with other solution concepts such as the Shapley value, the Core, the nucleolus, the ENSC value, and the kernel. We provide a full characterisation under which conditions a generalised Gately value is in the Core of the cooperative game, which is akin to the convexity conditions that are well-established in the literature. Finally, we investigate and characterise the class of generalised Gately values for 3-player games. More generally, we investigate their properties and characterisation for n-player games.

A Little Knowledge is a Dangerous Thing: Intentional Disregard under Sequential Persuasion

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This paper considers the possibility that an information receiver will intentionally disregard some piece of information even if information acquisition is costless. To this end, I construct a sequential Bayesian persuasion model where two senders send information to a single receiver sequentially and the receiver can choose whether to select each sender's information or not. Results indicate that there is an equilibrium such that the receiver only selects the second sender's information. A novel mechanism behind the result is that information acquisition can be endogenously costly through a bad decision: The first sender's information can be detrimental if it makes the receiver biased and such bias cannot be removed by the second sender, which causes the receiver's unwise decision.

Pareto efficiency in affective interactions

Aviad Heifetz¹, Enrico Minelli² and Herakles Polemarchakis³

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In games of interactive affect, players derive utility from their own actions and from others' utility levels (rather than from their actions). We investigate such a setting with smooth utility functions that only partially overlaps with that of Ray and Vohra ("Games of love and hate", *Journal of Political Economy* 128(5): 1789–1825, 2020). We define a notion of a static equilibrium that does not hinge on the existence of a derived standard game. We prove that equilibrium strategies are locally dominant, and that equilibria of two-player games with moderate reciprocal affection are Pareto efficient.

If, moreover, utility functions are concave in one's own action and linearly separable, some weighted average of the players' utility functions is concave, and can therefore serve a social planner as a welfare function, of which the Pareto efficient static equilibrium is a global maximum.

In a sequential setting, the derived standard game is irrelevant even when it exists, because past players' moods cannot be influenced any more by the current player's choice. We define a notion of a dynamic equilibrium that simplifies considerably that of Pearce ("Nonpaternalistic Sympathy and the Inefficiency of Consistent Intertemporal Plans", 1983). At equilibrium, for each given history of actions and utility levels, the current player anticipates correctly future players' choices and utility levels given each potential utility level of her own, and chooses an action that maximizes her utility function subject to these correct anticipations. We prove that even though the setting is dynamic, two-player dynamic equilibria of games with moderate reciprocal affection nevertheless coincide with the static equilibria of the simultaneous-move game, and are hence Pareto-efficient.

Dealing with competing goals in the reduction of pollutant emissions

María Ángeles Caraballo, Asunción Zapata, Luisa Monroy and Amparo M. Mármol
University of Seville, Spain

The mitigation of pollutant emissions has increasingly become a pressing goal for Governments around the world. However, it is a difficult goal to achieve since, in turn, it involves two often conflicting objectives for countries: to maximize their monetary benefits and to minimize the perception of environmental damages, both depending on the pollution emitted by all the countries. Taking into account these two objectives, this situation is analysed by a bicriteria game where each country has a tolerance threshold with respect to the global emissions. The approach considered allows us to deal with the fact that it is not possible to compare in monetary terms the results obtained when the countries act strategically in pursuit of their objectives, a key issue in the analysis. Depending on the relationships between the thresholds of each country, different sets of equilibria are obtained. A meaningful consequence of this proposal is that all these equilibria provide strategies with a positive effect in the reduction of emissions and may play a major role to reverse climate change

Proportional methods for certification

Stéphane Gonzalez¹, Susumu Cato², Eric Remila¹ and Philippe Solal¹

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This paper examines a method that aggregates individuals' opinions when individuals express their yes-no opinions on each option. We examine what we call a proportional method, for which there exists a threshold proportion such that an option is chosen/certificated if and only if the share of those who says yes to the opinion is larger than or equal to the threshold. We use consistency axioms for changes in agents and in opinions to characterize the class of proportional methods. To compare the proportional methods with the approval-voting method, we establish a new characterization result of the approval-voting method; this is parallel to the one for the proportional methods. Through the characterizations, the analytically essential differences or similarities between these methods are identified.

The Role of the Status-quo in Dynamic Bargaining

Francesca Flamini

University of Glasgow, United Kingdom

Negotiations have often a dynamic nature, from political parties who need to agree government budgets to countries negotiating over environmental issues. When agreements over such issues are reached, they are not everlasting, but revisited, as the state of the environment/economy/budget evolves over time (e.g., changes in global temperature/debt). We investigate a dynamic bargaining game where parties can agree to implement a policy change, which is costly (beneficial) in the short-run but beneficial (costly) in the long-run. We show that when the status-quo is endogenized (at least in some components), the more farsighted party can induce their rival to accept the short-run costs of policy changes designed to generate benefits in the long-run. This is more common when players' asymmetries are less pronounced, the status-quo is fully endogenized and the state declines more quickly.

Trade-off between Equality and Stability in Multi-group Voting Games

Takaaki Abe

Tokyo Institute of Technology, Japan

Our society presents a variety of voting systems, wherein, in some cases, votes are unevenly distributed over the voters. Voters in a weak position may wish to change the voting system; however, they may not be able to achieve the change because they are weak. Conversely, voters in a strong position are sufficiently powerful to change the voting system; however, they have no incentive to do so because they enjoy their strong position. To formulate this conflict, we introduce multi-group voting games. The voting in the United Nations Security Council (UNSC) is an example of a multi-group voting game. We define stability and equality concepts for multi-group voting games. We show that no multi-group voting game satisfies both stability and equality. The trade-off between these two concepts holds for a variety of power indices. We show that UNSC voting is neither stable nor equal.

Dealing with competing goals in the reduction of pollutant emissions

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Comparative analysis of the efficiency of information structure in the game theoretic models of Cournot oligopoly

Guennady Ougolnitsky
Southern Federal University, Russia

The problem of (in)efficiency of equilibria plays an important role in the game theoretic modeling of social-economic systems [Algorithmic Game Theory 2007; Johari and Tsitsiklis 2004; Roughgarden 2005]. However, it makes sense to formulate the problem of (in)efficiency of equilibria in a more general form. First, we should compare the payoffs received not only in the basic ways of organization of the economic agents (selfish behavior, hierarchy, and cooperation) but also with consideration of some additional effects such as structure of the interaction. Second, it is very important to make a comparison not only from the point of view of the social welfare but also from the point of view of each economic agent. It is not at all necessary that an outcome which is optimal for the whole society is also optimal for all individuals. For example, a payoff of the leader in a Stackelberg game can exceed the respective share in a distribution of the cooperative payoff. An interesting line of research in game theoretic modeling is connected with so-called green supply chain management where the participants make special efforts directed to the prevention of environmental damage caused by the production of some goods and their transportation [Sarkis et al. 2011, Ahi and Searcy 2013, Fahimnia et al. 2015, Gunasekaran et al. 2015]. We think that it makes sense to analyze it in other models, say, in Cournot oligopoly models. At last, we consider fairness concern: if an agent in a supply chain is not consent with revenues allocation then it can refuse to participate [Sharma and Nandi 2018; Nie and Du 2017; Katok et al. 2014; Sharma and Jain 2021]. We built

and analytically investigated models of Cournot oligopoly as games in normal form. Green effect and fairness concern are considered. For symmetrical models of Cournot oligopoly the coincident structures of social and individual preferences for different modes of organization of the economic agents and control methods are received. Also, a comparative analysis of the efficiency of different modes of organization of economic agents (information structures) in the differential game theoretic models of Cournot duopoly is conducted. For quantitative evaluation of the efficiency from the point of view of separate agents and the whole society we used individual and collective relative efficiency indices. Conditions of viability of the controlled system are studied.

Voting power in corporate networks: Public Good Index

Izabella Stach¹, Jacek Mercik², Cesarino Bertini³

¹ AGH University of Science and Technology, Poland ² WSB University in Wrocław, Poland ³ University of Bergamo, Italy

We propose a new game-theoretical method to measure the indirect control power of firms as elements of a whole corporate network. Our method considers voting rights attached to individual firms and indirect ownership relations. Our method builds upon the Karos and Peters method introduced in 2015. More precisely, instead of the Shapley and Shubik (1954) index used in the Karos and Peters framework, we propose the Public Good Index (PGI) introduced by Holler in 1982. In this way, we obtain a method based on minimal winning coalitions allowing us to measure the control power of all firms involved in complex shareholding structures. We also try to discuss the appropriateness of using the Public Good Index critically. Moreover, this method is used to estimate the indirect control power in a theoretical example of a shareholding structure and compared with the Karos and Peters approach for measuring the control power of firms.

Unraveling the Spreading Pattern of Collusively Effective Competition Clauses

Michael Markus Trost

University of Hohenheim, Germany

Meanwhile, the Industrial Organization literature gives several reasons why retailers adopt competition clauses (CCs) such as price matching or price beating guarantees. The motivations underlying the CCs might affect their forms and spread. In this paper, we unravel the spreading pattern of CCs in markets where they are used as a device to facilitate tacit collusion. It turns out that in homogeneous markets with capacity-constrained retailers, the retailers with the largest capacities are most inclined to adopt CCs. Our finding is in line with results of earlier studies on the formation of price leadership, which suggest that the retailers with the largest capacities take on the leadership position. On the other side, we find that in some

market instances, retailers have to resort to CCs of non-conventional forms (i.e., of forms uncommon in real commercial life) to induce the most robust collusion. However, it turns out that this peculiar finding can be resolved for markets with additional characteristics. For example, if there exist market dominant retailers or the residual market demand is specified by efficient rationing, the most robust collusion can also be enforced by CCs of conventional forms.

Social acceptability and the majoritarian compromise rule

Mostapha Diss¹, Clinton Gassi^{1,2}, Issouf Moyouyou²

¹ CRESE, France ² University of Yaoundé 1, Cameroon

We study relationships between two well-known social choice concepts, namely social acceptability introduced by Mahajne and Volij [Social Choice and Welfare 51(2), 2018], and the majoritarian compromise rule introduced by Sertel and Yilmaz [Social Choice and Welfare, 16(4), 1999]. The two concepts have separately been introduced in the literature with the spirit of satisfying most people's preferences in the Arrovian social choice framework. In this paper, we show that the majoritarian compromise rule always selects a socially acceptable alternative when the number of alternatives is even and we provide a necessary and sufficient condition so that the majoritarian compromise rule always selects a socially acceptable alternative when the number of alternatives is odd. Moreover, we show that when we restrict the set of preference profiles to the classes of single-peaked, single-caved and single-crossing preference profiles, the majoritarian compromise rule always picks a socially acceptable alternative.

Setting Interim Deadlines to Persuade

Maxim Senkov

CERGE-EI, Czech Republic

The paper studies the optimal design of self-reporting on the progress of the project by a rent-seeking agent reporting to the principal who is concerned with accomplishing the project before an exogenous deadline. The project has two stages: completing the first one signals a milestone and completing the second one accomplishes the project. The agent commits to a dynamic mechanism that provides obedient recommendations to stop funding the project for the principal. When the normalized cost-benefit ratio of the project is low, the optimal mechanism recommends stopping after the completion of the second stage and provides no information regarding the completion of the first stage. When the normalized cost-benefit ratio of the project is sufficiently high, the optimal mechanism combines stopping after the completion of the second stage and an interim deadline. At the interim deadline, the mechanism recommends stopping if the first stage has not been completed yet.

Efficient and linear values that satisfy the equal treatment and weak null player out properties for cooperative games

Takumi Kongo

Fukuoka University, Japan

In cooperative games with transferable utilities defined on a variable set of players, we characterize the set of solutions satisfying efficiency, linearity, the equal treatment property, and the weak null player out property. The characterized set of solutions includes well-known values in the literature, such as the Shapley value, equal division value, equal surplus division value, and the egalitarian non-separable contributions value, etc. In addition, each value in the characterized set is determined by an infinite sequence of real numbers. Together with the fact that efficiency, linearity, and the equal treatment property characterize the Shapley value along with the null player out property, our result reveals how weakening the null player out property can expand the possibilities of solutions. Furthermore, the equal treatment property in our characterization can be replaced by the balanced contributions property for symmetric players or the balanced cycle contributions property.

On the Duration of Affirmative Action Policies

Philippe Jehiel¹, Matthew V. Leduc²

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Successive decentralized policy makers must decide whether to implement an affirmative action policy aimed at improving the performance distribution of future generations of a targeted group in their district. Workers receive wages corresponding to their expected performance, suffer a feeling of injustice when getting less than their actual performance, and employers do not observe district by district whether workers benefited from affirmative action. We find that welfare-maximizing policy makers choose to implement affirmative action "perpetually", despite the resulting feeling of injustice that eventually dominates the purported beneficial effect on the targeted group's performance. This is in contrast with the first-best that requires affirmative action to be temporary.

Search Steering in Two-Sided Platforms

Gustavo Saraiva¹, Pedro Guinsburg²

¹ Pontificia Universidad Católica de Chile, Business School, Chile ²Paris University of São Paulo (USP), Brazil

We study the incentives from a two-sided platform to segment the market by providing personalized search results. In our environment, a monopolistic platform is in charge of matching sellers with buyers. Upon being matched, each pair of buyer and seller negotiate prices. If they choose to transact, the platform receives a commission fee proportional to the value of the transaction. The platform is assumed to have full information over customers' and sellers' outside options. We show that in this environment the platform may have incentives to prioritize finding feasible matches to more expensive products so as to inflate market prices and, thus, the commissions it receives from transactions. By doing this, the platform maximizes the number of transactions, which can generate excess liquidity.

The Influence of Parties' Influence

Jesus Sanchez-Ibrahim

Universität Hamburg, Germany

This paper presents a dynamic model of party competition where parties' policy choices influence citizens' future policy preferences, which at the same time influence parties' future payoffs. In equilibrium, parties' influence may distort their current choices and promote party confrontation. In particular, one party may support an unpopular policy because then the number of citizens preferring that policy increases, and so does the party's future payoff. When this happens, parties end up confronted at levels of public opinion that are associated to party consensus in the context of non-influence. This feedback effect gives an intuition of why U.S. parties look more polarized than U.S. citizens, a question that has surrounded the literature on U.S. politics for years.

Emergence of Specialization in a Simple Production Economy

Amarjyoti Mahanta

Indian Institute of Technology Guwahati, India

In this paper, we study the emergence of specialization in a simple production economy. We consider a very simple economy in the sense that the production technology is linear in nature. The aggregate dynamics are derived from individual decisions. The individuals revise their decision to specialize based on the comparison of returns. The derived dynamics are similar to replicator dynamics. We find that under certain conditions on the preferences of the individuals and distortion in the market, there exist interior equilibria. The interior equilibria are given by a straight line in the unit simplex. We also show that trajectories converge at this line. Thus, implying that there may not be complete specialization always. There is going to be complete specialization for certain initial points. When the coordination problem in the market is extreme in nature, the market may not function at all leading to production for their own consumption only.

Dissolving a bilateral partnership

Harshika Dalakoti

Indian statistical institute, India

We define loss averse agents as described by Koszegi and Rabin (2006) in the partnership model described in Cramton et al. (1987). In the bilateral partnership model for the loss averse agents, it is impossible to dissolve a partnership, for any share of property rights, through a mechanism which is efficient, dominant strategy incentive compatible, individually rational and feasible. We also try to maximize the expected total gains by dissolving the partnership.

Comparing notions of group criticality: differential vs. minimal essential ranks

Michele Aleandri¹, Marco Dall'Aglio²

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The classical notion of criticality of a player in simple games, i.e. the ability of that player to change the outcome of a coalition, has been recently extended to include the cases where a player is effective only in conjunction with other players, the cardinality of the group determining the order (or rank) of criticality. We compare the definitions given in Beisbart [1] and, more recently in Aleandri et al. [2]. We show that power indices based on the differing notions can be decomposed in several parts, with one part shared by both: that of the critical players that belong to minimal essential critical coalition with respect to any given coalition of players. Isolating this common component, enables us to define a new power index whose properties are analyzed.

- [1] C. Beisbart (2010), Groups can make a difference: voting power measures extended, *Theory and Decision*, 69:469488. [2] M. Aleandri, M. Dall’Aglia, V. Fragnelli and S. Moretti (2021). Minimal winning coalitions and orders of criticality., To appear in *Annals of Operations Research*.
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How to Win at Final Jeopardy

Louis Gosart

UCLA, Unites States

This poster analyzes the economic strategies in the game show Jeopardy, specifically its last round – “Final Jeopardy”. Contestants in Jeopardy usually focus on making sure they get the correct answer to the questions asked in order to win the show. However, the dollar amount that they choose to wager in each round is a critical element that is often overlooked. By modeling “Final Jeopardy”, we can come up with a framework that enables contestants to choose the best dollar amount to wager in the last round in order to maximize their chance of winning and taking home the largest amount of money. We focus on “Final Jeopardy” as it creates a unique 3-player game that can be solved using game theory. Trying to quantify utilities and actions in real-life scenarios is usually impossible, but “Final Jeopardy” is a game that is restricted enough, where payoffs are simple and the range of strategies is limited, that it allows for the use of basic game theory to solve for the best strategies of each player.

The economic problem: What is the main trade off? Contestants in “Final Jeopardy” have a two-fold goal. First, they seek to win by being the player with the highest dollar balance in the end. Second, given that they win, they seek to take home the largest amount of money. Only the winner of “Final Jeopardy” gets to take home their dollar balance. The second and third prize contestants leave with only 2000 and 1000 respectively. Therefore, there is no incentive to preserve your dollar balance if it is not high enough to beat those of the other contestants. Contestants increase their dollar balance by the amount they wager if they answer the question correctly and decrease their dollar balance by the amount they wager if they answer it incorrectly. Therefore, the contestant coming in with the highest dollar balance faces a trade off when wagering money: he/she can wager a large amount to preserve his/her ranking assuming everyone answers the question correctly or he/she can wager a small amount to preserve his/her ranking assuming he/she answers it incorrectly but the other contestants answers it correctly. There are similar trade offs for contestants coming into “Final Jeopardy” with lower dollar balances. We will consider a matrix of trade offs based on where each contestant is positioned and who answers the question correctly.

In conclusion, the best strategies for players participating in Final Jeopardy can be found for any scenario, with one rare exception (when the top two/three players come in with the same dollar balance). Most of the analysis could be simplified to a 2-player game, since the best strategies for the players in the first and third positions only depended on one other player. The best strategies for players are the wagers that maximize their chance at winning regardless of what their opponents

do, since winning is the number one priority. In nearly every scenario, a player's wagering strategies can be reduced down to a set of best responses, from which he/she can choose what amount to wager. Applying the methods we introduce in our project will maximize the probability of any player in nearly every of maximizing their winnings.

Asset Issuance Price and Networks of Secondary Markets

Gabriela Stockler

Universitat Autònoma de Barcelona and Barcelona School of Economics, Spain

This paper investigates how future decentralized trading affects the issuance price of an asset. It concerns, for example, dealers behaviour in fixed income markets who are the link between the Primary Market where the asset is issued by a firm or the government, and inter-dealer markets where the asset is re-traded for inventory management. In the two-period trading model, a single divisible asset is first available in a frictionless market, the Primary Market, and then can re-traded in a decentralized way, in the Secondary Market. Possible decentralized exchange flows among dealers are captured by an exogenous, fixed and known network and a random shock determines the endogenous, inelastic supply at period two. Thus, Secondary Market conditions are ex-ante uncertain and at each period dealers compete in demand to build up their optimal asset inventory level. I show that to infer asset issuance price in the Primary Market is enough to look at the structure of the trading network. That's because dealers use their position in the network to conjecture all decentralized trading outcomes and strategically decide their Primary Market demand taking those into account. In equilibrium, the issuance price is non-monotonic in network connectivity as it is a linear function of only the weighted adjacency matrix of the network graph with the endogenous weights capturing global network effects. Dealers' demands in the Primary Market are determined by their trading centrality and a dealer is more central as his connections are less central. Because of that, central dealers emerge as market makers by consuming relatively more in the Primary Market and having relatively higher prices in the Secondary Market. I show that the model boils down one-shot network game of strategic substitutes played in the Primary Market. The findings uncover a new effect of inter-dealer trades for debt-securities: apart from guaranteeing the well-functioning of over-the-counter markets, it is the key determinant of the issuer's cost of credit.

A Game of Second Opinions and The Humility Threshold

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France

A decision-maker sequentially approaches two experts who individually possess an informative private signal regarding an unknown state of the world. Each expert strives to provide an accurate recommendation regarding the true state, while preferring to be the only one to do so, either to obtain all the “glory” or to share the blame. This defines a Bayesian game between the two experts are non-symmetric, as the second observes the actions of the first but not vice versa. We characterize the equilibria of this game, depending on the experts’ order and expertise level, and deduce the correctness of the process (the probability to learn the correct state of the world) for each equilibrium.

Our analysis provides a mapping from the experts’ expertise levels to the equilibria of this game, showing that: (i) better-informed experts may generate worse recommendations in equilibrium; and (ii) ordering the experts so that the lower-level one provides the second opinion can typically improve the outcome. This contraries the common belief that the more skilled expert should be the one to provide the second opinion.

Moreover, if the decision-maker can influence the experts’ liability in case of an error, then he can ensure an equilibrium in which his correctness is maximized. This optimal liability is generally robust and remains the same, irrespective of either small changes in the experts’ quality, or the prior probability of the state of the world. Thus, although the DM is typically uninformed of the experts’ assessment processes and their quality, he can still facilitate cooperation between them and increase his probability of learning the true state of the world.

Cooperative Purchasing with General Discount: A Game Theoretical Approach

Jose A. Garcia-Martinez ¹ Ana Meca¹ G. Alexander Vergara ²

¹ Miguel Hernández University, Spain, ² University of San Buenaventura Cali, Colombia

In some situations, sellers of a certain commodity use to provide price discounts for large orders according to a decreasing unit price function. To take advantage of this pricing practice, buyers of this commodity can cooperate and form purchasing groups to obtain benefit from these price discounts. This situation can be analyzed as a cooperative game. A natural way to allocate the corresponding cost reductions is the equal price rule. We show that when the decreasing unit price function is linear, the equal price rule coincides with the Shapley value and the nucleolus. However, some buyers could argue that the equal price rule is not acceptable because it favors those buyers who buy just a few units of the product. This can be more problematic when the decreasing unit price function is nonlinear, in that case, the equal price loses some of their good properties, it does not match the Shapley value

or the nucleolus anymore. In this nonlinear case, Shapley value and nucleolus do not assign the same price to all agents unlike the linear case, thus, they are different price rules. However, they have a computability problem, both are very laborious to calculate for a large number of agents. To find an adequate alternative, we first study the properties that an allocation rule should have in this situation. Second, we propose a family of allocation rules that hold these properties and are easy to calculate for a large number of agents.

Sharing the Cost of a Gas Distribution Network.

David Lowing

GATE - Lyon Saint Etienne, France

A gas distribution network connects consumers to a source in gas. It is managed by a network operator, whose task incurs various costs, some of which may not be attributable to a particular consumer. Assuming that the operator wishes to recover these costs by charging for its services, the problem is then to determine how much each consumer should pay. In other words, how should these costs be shared among consumers. In this paper, we address this problem and propose cost sharing rules that depend on the network and the demands of the consumers. To that end, we adopt a normative approach and resort to three principles: (i) the independence of higher demands principle, (ii) the connection principle and (iii) the uniformity principle. Applying (i) and (ii), we derive the Connection rule and applying (i) and (iii), we derive the Uniform rule. It appears that (ii) and (iii) are incompatible. In order to make a trade-off between these two principles, we propose the Mixed rules, which compromise between the Connection rule and the Uniform rule. For each cost sharing rule, an axiomatic characterization is provided. Then, we show that the Connection rule coincides with the multi-choice Shapley value of a specific multi-choice game derived from the network and the demands of the consumers. Moreover, the Connection rule is in the Core of this specific multi-choice game. Similarly, we show that the Uniform rule coincides with the multi-choice Equal division value and the Mixed rules coincide with the multi-choice Egalitarian Shapley values.

Stable Competition with Increasing Returns-to-Scale

Harborne Stuart

Columbia Business School, United States

In the strategy literature, the core of many-to-one assignment games can be used to derive insight into firm profitability. For example, with increasing marginal costs and unitary demand, a core analysis shows that the foundation for firm profitability, both potential and guaranteed, is a firm's marginal value creation with each of its buyers.* With increasing returns-to-scale, this analysis does not hold. Moreover, the core can be empty. We show that the core will be non-empty if buyer preferences satisfy a critical-mass effect. Loosely, when buyers are matched optimally with firms, their preferences for their matched firm outweigh any coordination gains that would arise from joining with buyers of some other firm. We show how this condition provides insight into when increasing returns-to-scale will, and will not, lead to a 'winner-take-all' effect.

How to optimally allocate rapid-response teams?

Lotte van Aken, Loe Schlicher and Marco Slikker

Eindhoven University of Technology, Netherlands

Over the past five years, terrorism has claimed hundreds of innocent lives in Europe, and also affected the economy (e.g., by destruction of property, increased market uncertainty, and loss of tourism) resulting in monetary losses in the order of millions. Improving the protectability against terrorism is therefore an important societal concern.

To address this concern, several governmental agencies introduced, amongst others, the concept of rapid-response teams. These heavily-armed and highly-trained teams are located at high potential attack regions being capable to respond to attacks within minutes. The aim of the government is to carefully position these rapid-response teams.

Inspired by this setting, we investigate how a government should optimally allocate its rapid response teams, while taking into account the strategic behavior of terrorists. We do so by introducing and solving a Stackelberg game. In this game, the leader (i.e., government) decides where to allocate rapid-response teams on a line segment. The follower (i.e., terrorist) observes this allocation and attacks exactly at that location that maximizes the damage for the government. We model this damage as the product of the time it takes the closest rapid-response team to travel to the attack location and the damage that an attack causes per time unit per location. This last component is modelled as a damage function on the line segment that indicates the amount of damage of an attack per time unit (e.g., the amount of people that pass away or get injured per time unit).

In this talk, I will discuss (and characterize) how the leader should allocate its rapid-response teams on the line segment for various types of damage functions.

Priority relations and cooperation with multiple activity levels

Kevin Techer¹, David Lowing¹

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This paper analyzes cooperation situations between heterogeneous players. It considers two types of heterogeneity. First, the players are differentiated with respect to a priority structure. This structure captures asymmetries between players, which may reflect exogenous rights, different needs, merit, or hierarchical constraints. Second, each player may have different cooperation possibilities represented by a set of activity levels. To analyze these situations, we enrich the model of multi-choice games, which is a natural extension of transferable utility games, with a priority structure. A new value on the class of multi-choice games with a priority structure is introduced. To accommodate the different activity levels and the asymmetries between players, this value follows an allocation process based on a lexicographic procedure. New axioms for multi-choice games with a priority structure are introduced. These axioms endogenously determine the lexicographic procedure used to define the value. Two axiomatic characterizations of this value are provided.

Designing a Competitive Monotone Signaling Equilibrium

Seungjin Han

McMaster University, Canada

In this paper we consider a generalized competitive signaling model with two-sided matching. A decision maker (DM) sets the support of reactions that receivers can choose before senders and receivers sequentially choose their actions and reactions. Adopting the proposed methodology, the DM can build the optimal design of a unique stronger monotone signaling equilibrium, which maximizes the aggregate net surplus. Our analysis sheds light on how the trade-off between matching efficiency and signaling costs affects optimal equilibrium designing. We further clarify how the trade-off depends on the relative heterogeneity between receiver and sender types and on the (direct) productivity effect of the sender's action on generating gross match surplus. Specifically, the DM's equilibrium design is most effective (i) when the receiver type distribution has the smallest mean and variance; and (ii) when the sender's action has no productivity effect. The DM's equilibrium design quickly loses its effectiveness as the mean/variance of the receiver type distribution increases or the productivity effect of the sender's action increases.

Arbiter Assignment

Mustafa Oguz Afacan ¹, Nejat Anbarci ², Ozgur Kibris ¹

¹ Sabanci University, Turkey ² Durham University, United Kingdom

In dispute resolution, arbitrator assignments are decentralized and they incorporate parties' preferences, in total contrast to referee assignments in sports. We suggest that there can be gains (i) in dispute resolution from centralizing the allocation by bundling the newly arriving cases, and (ii) in sports from incorporating teams' preferences. To that end, we introduce a class of Arbiter Assignment Problems where a set of matches (e.g., disputes or games), each made up of two agents, are to be assigned arbiters (e.g., arbitrators or referees). On this domain, the question of how agents in a match should compromise becomes critical. To evaluate the value of an arbiter for a match, we introduce the (Rawlsian) notion of depth, defined as the arbiter's worst position in the two agents' rankings. Depth optimal assignments minimize depth over matches, and they are Pareto optimal. We first introduce and analyze depth optimal (and fair) mechanisms. We then propose and study strategy-proof mechanisms.

The Interaction of Consumer Learning and Competition Intensity in a Differentiated Duopoly

Maximilian Conze and Michael Kramm

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We introduce consumer learning in a model of differentiated duopoly, so that laggards can obtain information on the product's quality by observing the early adopters' behavior. This incentivizes firms to influence the consumers' updating via their quantity or price setting. Investments into product differentiation now have two effects. On the one hand, and as usual, they enhance the firm's "local" monopoly power. On the other hand, they can serve as a commitment device to soften competition, which is driven by consumer learning. However, depending on the amount invested into differentiation, this commitment may be detrimental for the firms if it is too large. For high costs of differentiation, firms invest more into differentiation in a model with consumer learning than in a model without consumer learning, since the commitment effect is not too large. The opposite holds for low costs. These observations have implications for a market platform deciding on whether to install a learning mechanism, such as a bestseller list: if the platform receives a share of the competing firms' profits, a learning mechanism will only be installed if costs of differentiation are high. The platform then uses consumer learning as a commitment device for the competing firms to soften their competition.

Tax and Subsidy Policies in a Two-sided Market with Heterogeneous Independent Products

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This paper develops a model to investigate the effects of tax and subsidy policies on agents' decisions and social welfare in a two-sided market. Focusing on e-commerce with heterogeneous and independent products, the model considers a fiscal-neutral environment, in which sellers receive a per-unit subsidy, and a monopoly platform pays a per-transaction tax for facilitating transactions between sellers and buyers. Employing a four-stage sub-game perfect equilibrium, the analysis derives conditions under which adopting a tax and subsidy policy system improves social welfare. In particular, it shows that an increase in the platform tax reduces the number of participating agents, the net gains of agents on both sides of the platform, and the profit of the monopoly platform. As the platform always chooses socially sub-optimal numbers of agents in the absence of policy intervention, after introducing a tax-subsidy policy system, increases in sellers' subsidy and decreases in platform tax lead to convergence of the numbers of agents toward the socially-optimal levels. The overall welfare effect of tax and subsidy policies is positive if the platform tax is sufficiently low and the number of participating buyers meets a minimum threshold. The latter explains the role of cross-group network externality and is satisfied when the sellers' subsidy is high. Finally, the paper highlights the role of participation surplus by examining a particular case in which adopting a set of tax and subsidy policies may improve welfare and comparing the outcomes to those without such policies.

An Options Game Approach to Value Broadband Projects in a Smart City Context

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Broadband projects nowadays represent a valid investment alternative to pursuing smart city goals, particularly considering the rapid development that has affected the telecommunications industry. However, for potential investors, the valuation of these projects is a demanding activity because they are characterized by the uncertainty of future user demands, the competition risk, and the sequential nature of investment. In this paper we propose an innovative methodology to value the broadband projects taking into account these three peculiarities. This model consists of combining the compound Real Options Approach (ROA), able to price the sequential uncertain projects, with the Options Game (OG) approach used in the literature to value uncertain investments affected by competition risk. This paper contributes to the existing literature by expanding the OG model to fit the broadband characteristics in discrete time. We also propose a case study to implement the

theoretical approach. Results show that, despite their uncertain nature and competition risks, broadband investments represent a profitable investment alternative when pursuing smart city goals.

Independence of Existence of Measurable Equilibrium Selection

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We study the problem of selecting, in a measurable manner, equilibria from a family of games. Typical equilibrium selection theorems assume compactness of and continuity in actions, while we merely assume equilibria exist for all games in the family, and payoffs are jointly Borel in parameter and actions. The existence of Lebesgue- or universally-measurable selectors turns out to be independent of ZFC; the result is robust to restriction to zero-sum games, as well as to allowing mixed strategies. We show however that the existence of analytically-measurable selections, well-known to exist for single decision makers, fails for two-player zero-sum games.

Impacts of Public Information on Flexible Information Acquisition

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Interacting agents receive public information at no cost and flexibly acquire private information at a cost proportional to entropy reduction. When a policymaker provides more public information, agents acquire less private information, thus lowering information costs. Does more public information raise or reduce uncertainty faced by agents? Is it beneficial or detrimental to welfare? To address these questions, we examine the impacts of public information on flexible information acquisition in a linear-quadratic-Gaussian game with arbitrary quadratic material welfare. More public information raises uncertainty if and only if the game exhibits strategic complementarity, so it can be harmful to welfare under strong strategic complementarity. However, when agents acquire a large amount of information, more provision of public information increases welfare through a substantial reduction in the cost of information. We give a necessary and sufficient condition for welfare to increase with public information and identify optimal public information disclosure, which is either full or partial disclosure depending upon the welfare function and the slope of the best response.

A Model of Repeated Collective Decisions

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The theory of repeated games offers a compelling rationale for cooperation in a variety of environments. Yet, its consequences for collective decision-making have been largely unexplored. In this paper, we propose a general model of repeated voting in committees and study equilibrium behavior under alternative majority rules. Our main characterization reveals a complex, non-monotonic, relationship between the majority threshold, the preference distribution, and the optimal equilibrium outcome. In contrast with the stage-game equilibrium, the optimal equilibrium of the repeated game involves a form of implicit logroll, individuals sometimes voting against their preference to achieve the efficient decision. In turn, this affects the optimal voting rule, which may significantly differ from the optimal rule under sincere voting. The model provides a rationale for the use of unanimity rule, while accounting for the prevalence of consensus in committees which use a lower majority threshold.

The Curse of Being Mediocre

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We study a signalling game with three types of sender in which his utility function depends not only on the sender's type but also on the distribution of types sending each message. In those games we study the conditions under which two types of equilibria arise: U-shaped and over-signalling equilibria. In the former, only high and low types of sender are signallers, whereas the medium type cannot imitate the others because choosing the same message would increase its cost too much. In the latter, all sender's types choose the highest value of the signal because the presence of low types among the signallers reduces the cost of the signal significantly and all types may afford to signal. We found that the U-shaped equilibrium arises when the cost of the signal increases sufficiently with the statistic representative of the types sending that signal for all sender's types, while the over-signalling equilibrium is obtained when the cost of the signal decreases sufficiently with that statistic of types among low and medium types. We use this class of signalling games in order to study the educational outcomes under direct and indirect spillovers caused by students.

Social stigma and status concerns can produce rational generosity

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Thanks to a three-type, two-market status signalling model, it is possible to identify conditions under which the rich support income redistribution. The more the social blame experienced by the poor when receiving government assistance, the easier is for those conditions to be satisfied. If status competition happens between contiguous social classes, a blaming-money transfer to the poor ignites the competition between the poor and middle class, letting the rich save some money. This approach allows for exploring preferences for redistribution across countries and history.

Knowledge revision and aggregation in heterogeneous groups

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Our goal is to understand how knowledge is revised and aggregated in a population in which different members may exhibit different levels of rationality. Specifically, we consider three types of agents. Fully sophisticated agents satisfy both positive and negative introspection. That is, if they know something, they know that they know it; and if they do not know something, they know that they do not know it. Less sophisticated agents satisfy only positive introspection, so that they know everything they know but may fail to know what they do not know. The third type of agents are even less sophisticated and they do not satisfy any type of introspection. We ask two main questions. First, how should an agent revise her knowledge when she receives information from an agent of a different type? We argue that, depending on the agent's type, the revision process can be defined in terms of three distinct operators on the set of feasible knowledge operators (or, equivalently, the set of feasible possibility correspondences). Each operator captures a distinct inference making ability: positive introspection, negative introspection and conjunction. We show that the resulting revision process is always well defined and consistent for each type. The second question we ask is: How can one define distributed knowledge for a group with at least two different types of agents? By distributed knowledge we mean knowledge that can be attained by pooling all the information that each group member has. We argue that the standard characterization, which amounts to taking the intersection of all the individual possibility correspondences, can only work when all agents are of the same type. We give a new and complete characterization of distributed knowledge for heterogeneous groups that overcomes the pitfalls of the standard one. Our characterization makes use of the three operators already introduced for individual knowledge revision.

Stackelberg versus Cournot. A risk dominance approach.

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We study a quantity duopoly in which firms with different marginal costs sell differentiated products. Based on this setting, we provide an interpretation of the Stackelberg versus Cournot question, using a risk dominance criterion and two classical endogenous timing frameworks: the Game with Observable Delay (GOD) and the Game with Action Commitment (GAC). We also exhibit that these two frameworks, GOD and GAC, are indeed intrinsically different, even when they are applied to the exact same basic interaction. Finally, we show that the differentiation parameter plays no role in the endogenous timing results. We interpret this fact as evidence that the influence of the reaction curves on the endogenous timing outcomes is only through their qualitative (and not quantitative) behaviour.

Minimax-regret in the 11-20 money request game

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Arad and Rubinstein (2012) rightly argued that the 11-20 money request game is a game that naturally triggers level-k reasoning. In this 2-player game, each player requests an amount of money, an integer between 11 and 20. Each player receives the amount he asks for. And a player gets a bonus, an additional amount of 20, if he requests exactly one unit less than the other player. In our paper we turn to the general 11-T money request game with bonus B (T and B being two integers in a given range of values) and we show two funny results. The main result is that minimax regret (Renou and Schlag, 2010, Halpern and Pass, 2012) leads to a behavior close to the one obtained with level-k reasoning, despite minimax regret and level-k reasoning convey a completely different philosophy. To put it more precisely, we prove that mixed-strategy minimax regret mimics level-k reasoning, at least if the number of players is supposed to decrease in the depth of reasoning. So we generalize the link observed by Garcia-Pola (2020) between level-1 reasoning and iterative pure-strategy minimax regret. We also show a strange link between minimax regret and Nash equilibrium. In the games under study, the mixed-strategy minimax regret distribution is the exact reverse of the mixed-strategy Nash equilibrium distribution, and it leads to a larger expected payoff. We show how these two rather surprising results are linked to the special structure of the money request games. To illustrate our results we add some behavioral comments out of a classroom experiment that was run at the University of Strasbourg. This experiment shows that Arad and Rubinstein's 11-20 money request game is, from a behavioral viewpoint, richer than expected by its authors.

Some properties for cycle-free communication networks

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We analyze the properties which characterize different communication networks. Namely, we pay special attention to the class of cycle-free communication networks. We focus on certain communication networks which are free of cycles, making a comparative in relationship to their properties.

Solutions for Global Games

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A global game is described by a real function on the set of partitions of the player set. Compared to a classic cooperative game with transferable utility, it does not specify what every coalition of players can obtain but rather what the whole society can obtain depending on what coalitions are formed. For instance, it can model carbon reduction agreements where the different coalitions represent the engagement that each country is willing to undertake, and the outcome represents the change in the mean global temperature at a given time.

The model of global games has many similarities with other cooperative games from a mathematical point of view. Even if it was introduced in 1991 it has hardly been studied to date. We build on previous research and propose new solutions to global games and study their properties. The final goal is to characterize the proposed solutions by means of properties.

On Two Voting systems that combine approval and preferences: Fallback Voting and Preference Approval Voting

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Preference Approval Voting (PAV) and Fallback Voting (FV) are two voting rules that combine approval and preferences. They were first introduced by Brams and Sanver (2009). Under PAV, voters rank the candidates and indicate which ones they approve of; with FV, they rank only those candidates they approve of. In this paper, we supplement the work of Brams and Sanver (2009) by exploring some other normative properties of FV and PAV. We show among other that FV and PAV satisfy and fail the same criteria; they possess two properties that AV does not: Pareto optimality and the fact of always electing the absolute Condorcet winner when he exists. For three-candidate elections and a very large electorate, we compare FV and PAV to other voting rules by evaluating the probabilities of satisfying the

Condorcet majority criteria. We find that PAV performs better than the Borda rule. We also find that in terms of agreement, FV and PAV are closer to scoring rules than to Approval voting. Our analysis is performed under the Impartial Anonymous Culture assumption.

The strategy of conflict and cooperation

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In this paper, I introduce (i) a novel and unified framework, called cooperative extensive form games, for the study of strategic competition and cooperation, and (ii) a novel solution concept, called cooperative equilibrium system. I show that non-cooperative extensive form games are a special case of cooperative extensive form games, in which players can strategically cooperate (e.g., by writing a possibly costly contract) or act non-cooperatively. To the best of my knowledge, I propose the first solution to the long-standing open problem of "strategic cooperation" first identified by von Neumann (1928). I have one main result to report: I prove that cooperative equilibrium system always exists in finite n-person cooperative strategic games with possibly imperfect information. The proof is constructive in the case of perfect information games.

“Greedy” Demand Adjustment in Cooperative Games

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This paper studies a simple process of demand adjustment in cooperative games. In the process, a randomly chosen player makes the highest possible demand subject to the demands of other coalition members being satisfied. This process converges to the aspiration set; in convex games, this implies convergence to the core. We further introduce perturbations into the process, where players sometimes make a higher demand than feasible. These perturbations make the set of separating aspirations, i.e., demand vectors in which no player is indispensable in order for other players to achieve their demands, the one most resistant to mutations. We fully analyze this process for 3-player games. We further look at weighted majority games with two types of players. In these games, if the coalition of all small players is winning, the process converges to the unique separating aspiration; otherwise, there are many separating aspirations and the process reaches a neighbourhood of a separating aspiration.

An experiment on Demand Commitment Bargaining

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In this paper we experimentally compare three implementations of Winter demand commitment bargaining mechanism: a one-period implementation, a two-period implementation with low and with high delay costs. Despite the different theoretical predictions, our results show that the three different implementations result in similar outcomes in all our domains of investigation, namely: coalition formation, alignment with the Shapley value prediction and axioms satisfaction.

Our results suggest that a lighter bargaining implementation with only one period is often sufficient in providing allocations that sustain the Shapley value as appropriate cooperative solution concept, while saving unnecessary costs in terms of time and resources.

Preference restrictions for simple and strategy-proof rules: local and weakly single-peaked domains

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We show that if a rule is strategy-proof, unanimous, anonymous and tops-only, then the preferences in its domain have to be local and weakly single-peaked, relative to a family of partial orders obtained from the rule by confronting at most three alternatives with distinct levels of support. Moreover, if this domain is enlarged by adding a non local and weakly single-peaked preference, then the rule becomes manipulable. We finally show that local and weak single-peakedness constitutes a weakening of known and well-studied restricted domains of preferences.

The Shapley value as a measure of nodes' centrality in networks of networks

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Many networks in modern real-life contexts are interconnected with each other. There is a substantial difference between links: some links join nodes that are in the same networks; other links join nodes that belong to distinct networks.

The communities and individuals present on social networks can be segmented through characteristics such as demographics, needs, priorities, common interests, social status also for marketing reasons. Information may be exchanged or transferred via such links. The literature on social networks highlights the emergence of

communities also in networks. These communities have a denser structure of links but there are few links between different communities.

We represent systems formed by segmented networks by an undirected graph whose nodes are partitioned into different groups. The dissemination of content on the networks has some similarities with outbreaks, the spread of epidemics. We distinguish between internal and external diffusion and introduce two characteristics for the contents. The first property of content is "embeddedness" and measures the rate of diffusion of content within the community that generates it. The second property for content is "pourability" and measures the rate of diffusion of content between communities.

We study the theoretical problem of assigning fair rewards to nodes for the relevance to social learning.

Adopting a cooperative approach for capturing the entity of social learning from contents, we find a closed formula of the Shapley value, we study its properties and those of its potential.

The first application provides solutions to the problem of ranking nodes versus their importance or relevance to social learning using the Shapley value as a game theoretical measure of nodes' centrality in networks of networks.

The second application is devoted to the phenomenon of formation of communities in complex networks. In fact, we discover sufficient conditions under which networks change the set of internal segments or, better, change the way they are internally organized.

Priority coalitional games and claims problems

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In this lecture, we analyze priority coalitional games as an extension of cooperative games with transferable utility. Here, conditions imposed by an allocation used in the past need to be respected when deciding on a new allocation of the revenues obtained by the grand coalition. On the one hand, benefit obtained by cooperation has to be shared without harming a protected group and, on the other hand, no agent outside the group should benefit to the detriment of the protected group. For example, rights obtained by the unions for a given group of workers have to be respected in future negotiations and employers should not benefit at the expense of the workers. For this aim, we define auxiliary cooperative games and analyze the corresponding core. Pulido et al. (2002) extend claims problems by adding a vector of references representing the agents' rights to the usual model description. Pulido et al.'s model can be embedded in our model when the references are given from a past allocation of the estate and the purpose is to benefit or harm a group of agents. Using claims problems as a tool, we define weak and strong priority games with respect to a given allocation and study their properties and their cores. Moreover, priority games can be used to analyze cooperation restricted by a hierarchical structure. First, we select a solution to the underlying game without hierarchy. Second, we consider the associated (weak and) strong priority game to establish an allocation respecting the

hierarchical structure where the priority is induced by this hierarchical structure. We focus on the class of games with a non-empty core and take as starting point a value satisfying core selection, such as the nucleolus. We then define the corresponding hierarchical value (like the nucleolus) that satisfies a weak or strong monotonicity property. Finally, we establish differences with the model of Fiestras-Janeiro et al. (2015) that use face games to define the hierarchical structure.

Vote swapping in irresolute two-tier voting procedures

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We investigate a specific type of group manipulation in two-tier elections, which involves pairs of voters agreeing to exchange their votes. Two-tier elections are modeled as a two-stage choice procedure. In the first stage, voters are distributed into districts, and district preferences result from aggregating voters' preferences district-wise through some aggregation rule. Final outcomes are obtained in the second stage by applying a social choice function that outputs one or several alternatives from the profile of district preferences. Combining an aggregation rule and a social choice function defines a constitution. Voter preferences, defined as linear orders, are extended to complete binary relations by means of some extension rule. A constitution is swap-proof w.r.t. a given extension rule if one cannot find pairs of voters who, by exchanging their preferences get better off (w.r.t. their extended preference over sets). We consider four specific extension rules: Kelly, strong Kelly, Fishburn, and Gärdenfors. We establish sufficient conditions for the swap-proofness of a constitution w.r.t. each extension rule. Special attention is paid to majority constitutions, where both the aggregation rule and the social choice function are based on simple majority voting. We characterize swap-proof majority constitutions w.r.t. each extension rule. Moreover, we show that no constitution based on scoring methods is swap-proof.

Does homophily impede human capital investments?

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We consider a game between multiple candidates and a decision-maker. Nature assigns each candidate a type (A or B); each candidate chooses his social group and skill (high or low). There are four kinds of tasks, and the decision-maker needs to assign each candidate to a task. Types are relevant for the decision-maker since type A fits particular tasks and type B fits others. Skills are relevant too since only high skilled candidates can do specific tasks. The decision-maker observes each candidate's social group but needs to pay to observe his type and skill. We find that when there is homophily, social groups are informative about candidates' skills and

types, and the decision-maker does not need to pay to know the candidates' types and skills. In such a case, the decision-maker never pays to see candidates' skills and types, and candidates never choose the high skill.

Efficient, fair, and strategy-proof allocation of discrete resources under weak preferences and constraints

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We consider the problem of allocating indivisible objects without monetary transfers. Each agent has a weak preference over the objects and there is a constraint on possible allocations. An illuminating example is the allocation of time slots for vaccination, where people have weak preferences over the slots and the government faces operational constraints. We introduce a new mechanism for this allocation problem. Our main theorem states that, if the constraints constitute a discrete structure called an integral polymatroid, then our new mechanism is efficient, respects priorities, is strategy-proof, and polynomial-time computable. We demonstrate practical relevance of an integral polymatroid.

Global convergence of affine relaxations of the best response algorithm in ratio-bounded games

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In a two-player non-cooperative game framework, we investigate the global convergence towards a Nash equilibrium of the affine relaxations of the best response algorithm (where a player's strategy is a best response to the other player's strategy that comes from the previous step). To be able to specify the convergence of any type of affine relaxation of the best response algorithm, we define a class of games, called ratio-bounded games, that relies on explicit assumptions on the data and that contains large classes of games broadly used in literature, both in finite- and in infinite-dimensional setting. We provide a classification of the ratio-bounded games in four subclasses such that, for each of them, the following issues are examined and answered when the strategy sets are real Hilbert spaces: existence and uniqueness of the Nash equilibria, global convergence of affine relaxations of the best response algorithm, estimation of related errors and determination of the algorithm with the highest speed of convergence.

The lattice of worker-quasi-stable matchings

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In a many-to-one matching model, we study the set of worker-quasi-stable matchings when firms' choice functions satisfy substitutability. Worker-quasi-stability is a relaxation of stability that allows blocking pairs involving a firm and an unemployed worker. We show that this set has a lattice structure and define a Tarski operator on this lattice that models a re-equilibration process and has the set of stable matchings as its fixed points.

Dynamic Programming for Computing Power Indices for Weighted Voting Games with Precoalitions

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We study the efficient computation of power indices for weighted voting games with precoalitions amongst subsets of players (reflecting, e.g., ideological proximity) using the paradigm of dynamic programming. Starting from the state-of-the-art algorithms for computing the Banzhaf and Shapley–Shubik indices for weighted voting games, we present a framework for fast algorithms for the three most common power indices with precoalitions, i.e., the Owen index, the Banzhaf–Owen index and the symmetric coalitional Banzhaf index, and point out why our new algorithms are applicable for large numbers of players. We discuss implementations of our algorithms for the three power indices with precoalitions in C++ and review computing times, as well as storage requirements. The presentation is based on a recent paper of the authors in *Games* (DOI: 10.3390/g13010006)

The Role of Confidence for Disputes

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I model dispute as a contest between two agents. Expected benefits from dispute depend on social interactions. More and stronger links increase agents' benefits from disputes. Moreover, agents grow confident in winning a dispute when their peers are opponents of their opponent. Agents have heterogeneous types and decide which types to tolerate. They are in dispute with everyone else. In equilibrium, society consists of cliques or neighborhoods overlap. Dispute intensity is non-monotonic in the socialization cost and how susceptible agents are to peer influence. Encouraging socialization dampens dispute intensity and increases overall socialization when overlaps in neighborhoods are small.

Fair and efficient matching under dichotomous preferences

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We study a many-to-one matching problem where agents are assigned to objects which have multiple capacities and priorities over the agents. There is a shortage of the objects, and agents care mostly about being assigned to an acceptable object rather than which object they are assigned to, while the designer is concerned about assigning as many agents to acceptable objects as possible. Such a problem arises with an increasing number of applicants to institutions such as daycares and public schools. For example, the government of Quebec is concerned that many children stay on the waiting lists of daycares for a long time, and thus parents face difficulties when returning to work after parental leave. Surprisingly, there are still vacant spots remaining in Quebec daycares. It is unlikely that the maximum possible number of children are placed at daycares using a decentralized daycare allocation system, and even in a centralized system if the parents were required to submit strict preferences over daycares, it is well known that fairness would conflict with maximizing the number of matches, where fairness means that the priorities of children at different daycares are respected by the matching.

If the shortage is significant, it would make sense in a centralized allocation mechanism to only require parents to report dichotomous preferences over daycares, splitting daycares into acceptable and unacceptable sets, where the reported acceptable daycares are treated as welfare-wise identical for children. This allows the designer to focus on the main goal of maximizing the number of children placed in daycare. We show that in a model with dichotomous preferences and strict priorities maximum matchings are the same as Pareto-efficient matchings and prove that a maximum and fair matching exists for each profile of dichotomous preferences. Moreover, we propose a strategyproof mechanism to allocate children to daycares that selects a maximum and fair matching for each preference and priority profile.

Allocation of greenhouse gases using bankruptcy methods

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Global warming and climate change, as a result of greenhouse gas emissions, pose a major threat to the international community; therefore, such emissions must be reduced by moving to clean energy resources. In this work, we follow an approach based on bankruptcy models using the proportional run-to-the-bank rule in order to propose a novel allocation protocol for sharing annual CO₂ equivalent emissions in Spain among a series of sectors including in Annex I to Decision No 406/2009/EC. Unlike the standard bankruptcy model, the current model deals with situations in which player's claims are multi-dimensional and the issues correspond to greenhouse gases contained in Annex II to Directive 2003/87/EC. Assuming that Spain or any

other Member State can limit the greenhouse gas emissions beyond their obligations under the European legislation, being able to establish national greenhouse gas emission reduction objectives in relation to 2005, the proportional and constrained equal awards rules for bankruptcy problems will be used to allocate the CO₂ equivalent emissions among greenhouse gases, sectors and sub-sectors. Two types of situations will be considered: when total emissions and removals from activities related to the land use, land-use change and forestry are excluded, we will make a first allocation among sectors to determine the amount of equivalent tonnes of CO₂ that they can emit for each greenhouse gas; and when land-use/forestry activities are taking into account for the distribution emissions reduction efforts, we will make a second allocation among sectors in order to determine which sub-sectors and sectors are compromised in each case.

Coalitional-weighted Shapley values

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The (symmetric) Shapley value of a coalitional game, introduced by Lloyd Shapley ([5]), can be viewed as the amount that a player may reasonably expect to get from playing the game. Different characterizations, generalizations, and adaptations of this value have been studied. Shapley himself also considered the possibility of treating players non-symmetrically. The positively weighted Shapley value is defined by introducing exogenous weights to players in order to cover the asymmetries that are not included in the underlying game. The positively weighted Shapley value does not allow zero-weight players. The weighted Shapley value (introduced by [5] and axiomatized by [3]), gets around this drawback by classifying the players into hierarchical classes so that players from a class have relative zero-weight with respect to players that belong to a higher class.

In this paper we introduce the coalitional-weighted Shapley values, a new class of values where weights are assigned to coalitions (not just to players). Zero-weight players (and zero-weight coalitions) are admissible for the new coalitional-weighted Shapley values, and hierarchical values for ordered partitions of players are also included in our model. We show that the coalitional-weighted Shapley values are random order values, Harsanyi values, and multiweighted Shapley values ([1]). Moreover, both the positively weighted Shapley value and the weighted Shapley value can be obtained by iterating coalitional-weighted Shapley values. Coalitional weighted Shapley values are closely related to face-games ([2] and [4]). Our main result provides an axiomatic characterization of this new class of values through properties that do not involve the weights.

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Punishments and sanctions for the International Environmental Agreements stability

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This paper is devoted to study the stability of international environmental agreements (IEAs) in a pollution abatement context. Countries can decide to cooperate or to defect. Defector countries decide on their abatement levels by minimizing their own total cost whereas, signatory countries decide on their abatement levels by minimizing the aggregate of all cooperators.

In the model, all countries have the same environmental damage instead, respect to the non-environmental cost, we assume that each signatory country has to punish a non-signatory for its behaviour, at some cost to itself (see Sethi and Somanathan, 1996). We propose two different cases in which we have that punishment is directly proportional to the level of pollution (see Breton et al., 2010) or not (see Bischi et al., 2004). Punishments can be in the form of trade sanctions or import tariffs, as a measure to encourage cooperation. We model a differential game in order to determine both the optimal path of the abatement levels and stock pollutant as results of feedback Nash equilibria. Stability conditions, such as internal and external stability, are applied showing that different answers about the size of a stable IEA can be obtained.

Implementation in vNM stable sets

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We examine the problem of implementation of social choice functions in stable set (von Neumann and Morgenstern, 1944) under complete information. The planner's exercise consists of designing a rights structure which formalize the idea of power distribution in a society. A rights structure is implementing if the stable outcomes coincides with socially optimal outcome at any preference profile. We fully characterize the implementation in stable set via rights structure under different specifications. Also, since the Harsanyi's critique (Harsanyi, 1974), we conduct an analysis of robustness with respect to farsighted reasoning.

Stable Sharing

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We propose a simple model of job sharing. Agents are matched in pairs in order to complete a job of unit size. The preferences of agents are single-peaked and continuous on the amount of time they work. Our model combines features of two models: assignment games (Shapley and Shubik (1971)) and the division problem (Sprumont (1991)). We provide an algorithm (Select-Allocate-Match) that generates a stable allocation. We show that stable allocations may fail to exist if either the single-peakedness or the continuity assumption fail.

Behavioral Strong Implementation

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A choice behavior is rational if it is made in accordance with the maximization of some context-independent preference relation. This paper re-examines the classical questions of implementation theory under complete information in a setting in which players' choices need not be rational and in which the game theoretic solution concept invoked is robust to coalitional deviations.

Communication and the Emergence of a Unidimensional World

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Individuals hold and exchange opinions over multiple issues. However, a unidimensional spectrum is often enough to represent all those. As our theoretical and experimental results indicate, opinion differences can reduce to disagreement on a single dimension when individuals communicate and update their opinions in a boundedly rational manner, even when communication patterns are not (very) structured. Nevertheless, while communication is enough for the prevalence of unidimensionality, the presence of structured social networks proves crucial in predicting whether individuals form relatively moderate or extreme views and the importance of different issues on the shape of disagreement.

On necessary conditions for implementation of functions without rational expectations

Giacomo Rubbini

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The Bayesian implementation literature has identified in Bayesian Incentive Compatibility (BIC) and Bayesian Monotonicity (BM) two key conditions that a social choice function has to satisfy to be fully implemented by a social planner. I characterize the class of solution concepts such that BIC is necessary for full implementation of functions, and I find we can not expect significantly more permissive results by dropping the rational expectations assumption and moving to non-equilibrium models. Preliminary results suggest the same may be true for a BM-like condition as well.

Monopolistic Competition and Products Quality

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In this paper we join together some of the features of a monopolistic competition model with those of a vertically differentiated products à la Mussa and Rosen (1978) and Gabszewicz and Thisse (1979). The purpose is to focus on the quality-variety trade-off and its effects on the behaviour of consumers and firms. We study the existence of a Nash equilibrium and show some unexpected comparative statics arising from the model.

Two-stage contests and choice of levels of difficulty

Yigal Gerchak

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Contests discussed in the literature typically assume that the contestant's action is the choice of level of EFFORT it exerts. There are, however, types of contests where the key choice is the LEVEL OF DIFFICULTY (LD, Gerchak and Kilgour 2014), rather than effort level. The outcome is then success or failure to attain the target level, the probability of which is decreasing in the LD chosen. Recently the effort-centered research has addressed strategy issues in TWO-STAGE contests, where the winner of the first stage receives a secondary prize, while the winner of the sum of achievements in both stages receives the primary prize (Iluz and Sela 2018). We consider two-stage LD contests, either as simultaneous games where a contestant commits to her LD's in both stages in advance, or as adaptive games where the the choice of second stage LD's is only made after the outcomes of the first are known. A contestant's goal is to maximize its expected total prize earnings net of LD costs.

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