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CORE DISCUSSION PAPERS 1997/1

- 9701 Financial transfers to ensure cooperative international optimality in stock pollutant abatement.
M. GERMAIN, P. TOINT and H. TULKENS.

It is well known that the transnational character of many environmental problems requires cooperation amongst the countries involved, if a social optimum is at all to be achieved. Most of the numerous contributions dealing with the problems raised by the cooperation issue bear only on pollutants that do not accumulate: they are thus only relevant in a static, or a-temporal, context. On the other hand, many contributions which deal with the dynamic dimension of the problem when the pollutant accumulates leave aside the issue of the voluntary implementation of the international optimum. The aim of the present contribution is to overtake the two above limitations. Using both cooperative and differential game theories, we design a scheme of financial transfers between countries such that aggregate abatement costs are covered in a way that makes cooperation both individually rational and strategically stable.

- 9702 Refinements of rationalizability for normal-form games.
J.J. HERINGS and V.J. VANNETELBOSCH.

In normal-form games, rationalizability (Bernheim [3], Pearce [11]) on its own fails to exclude some very implausible strategy choices. Three main refinements of rationalizability have been proposed in the literature: cautious, perfect, and proper rationalizability. Nevertheless, some of these refinements also fail to eliminate unreasonable outcomes and suffer from several drawbacks. Therefore, we introduce the trembling-hand rationalizability concept, where the players' actions have to be best responses also against perturbed conjectures. We also propose another refinement: weakly perfect rationalizability, where players' actions that are not best responses are only played with a very small probability.

We show the relationship between perfect rationalizability and weakly perfect rationalizability as well as the relationship between proper rationalizability and weakly perfect rationalizability: weakly perfect rationalizability is a weaker refinement than both perfect and proper rationalizability. Moreover, in two-player games it holds that weakly perfect rationalizability is a weaker refinement than trembling-hand rationalizability. The other relationships between the various refinements are illustrated by means of examples. For the relationship between any other two refinements we give examples showing that the remaining set of strategies corresponding to the first refinement can be either smaller or larger than the one corresponding to the second refinement.

Keywords: rationalizability, refinements.

JEL classification: C72

- 9703 Tax competition and revelation of preferences for public expenditure.
S. BUCOVETSKY, M. MARCHAND and P. PESTIEAU.

This paper considers a federal country composed of local jurisdictions which differ in their taste for public goods and finance public spending by a source-based tax on capital income. The taste for public goods is private information of jurisdictions. By transferring differential grants to jurisdictions the central government aims at both reducing the misallocation of capital due to the diverging jurisdictional tax rates on capital income and getting closer to the optimal balance between private and public consumption in every jurisdiction. The purpose of the paper is to characterize the optimal grant policy of the central government. It is shown that there persist at the optimum both some misallocation of capital and some violation of the Samuelson rule in every jurisdiction.

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CORE DISCUSSION PAPERS 1997/2

- 9704 Intertemporal equity and the extension of the Ramsey criterion.
M. FLEURBAEY and P. MICHEL.

We examine social orderings applied to infinite intergenerational consumption paths. Basic dilemmas between several reasonable axioms lead to a taxonomy and characterization of different kinds of orderings, some of which are well known extensions of the Ramsey criterion. We show how filters and ultrafilters can be used to understand the general structure of these extensions and to construct orderings which meet as many axioms as possible.

- 9705 Compensating wage differentials, workers' heterogeneity and imperfect competition in the labor market.
X. WAUTHY and Y. ZENOU.

In this paper, we explore a simple model which focuses on the joint role of workers' heterogeneity and imperfect competition in the endogeneous formation of labor market equilibria. We show that, compared to the competitive case, imperfect competition leads to a misallocation of workers and to an increase of the level of unemployment when the population is heterogeneous. When workers are all identical, competitive and Nash allocations become the same.

Keywords: labor market structures, workers' characteristics, wage setting.

- 9706 Loss aversion and bargaining.
J. SHALEV.

We consider bargaining situations where two players evaluate outcomes with reference-dependent utility functions, analyzing the effect of differing levels of loss aversion on bargaining outcomes. We find that as with risk aversion, increasing loss aversion for a player leads to worse outcomes for that player in bargaining situations.

An extension of Nash's axioms is used to define a solution for bargaining problems with exogenous reference points. Using this solution concept we endogenize the reference points into the model and find a unique solution giving reference points and outcomes that satisfy two reasonable properties, which we predict would be observed in a steady state.

The resulting solution also emerges in two other approaches, a strategic (non-cooperative) approach using Rubinstein's alternating offers model and a dynamic approach in which we find that even under weak assumptions, outcomes and reference points converge to the steady state solution from any non-equilibrium state.

Keywords: loss aversion, bargaining, reference dependence.

JEL classification: C78

- 9707 Human capital formation in an open economy with increasing wage differentials.
A. TURRINI.

Several developed countries are witnessing a trend towards an increasing gap in the earnings between skilled and unskilled workers. Though it is widely recognised that human capital formation programs through education and training should be strengthened in the presence of increasing wage differentials, it seems that this is not currently occurring to a satisfactory extent. We show an example where technology and terms of trade shocks that enhance the wage differential between high and low-skilled labour aggravate the underinvestment in public education arising from majority voting, thus leading to an undesirable outcome, both in terms of efficiency and equity.

Keywords: wage differentials, human capital, international trade, political economy.

JEL classification: J31, H52, D72, F10.

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CORE DISCUSSION PAPERS 1997/3

- 9708 Capacity and entry deterrence under demand uncertainty.
S. PODDAR.

I consider a two period model with an incumbent firm and a potential entrant each of whom produces a homogeneous good. There is a demand uncertainty: it can be high or low and it realizes in the second period. The question I ask: How by choosing capacity at an earlier period of actual production of output and *more importantly* not knowing which state of demand is going to realize *and* knowing that there is a potential entrant, the incumbent firm can influence the outcome of the game by changing its initial condition. To that end, I study how the impact of the distribution of uncertainty deeply affects the incumbent's decision regarding entry deterrence / accommodation. I compare the results with the case where there is no uncertainty.

JEL classification: D43, L13

- 9709 Capacity and entry deterrence under asymmetric information on demand.
S. PODDAR.

I consider a two period model with an incumbent firm and a potential entrant each of whom produces a homogeneous good. There is a demand uncertainty and the information regarding the demand is asymmetric: the incumbent possesses private information concerning the state of demand while the entrant only knows the probability distribution. I show that under certain cost structure of the incumbent (which is common knowledge), using capacity as a signalling device, the incumbent can reliably convey the information to the potential entrant regarding the state of demand; while in some other cost environment such a signalling has no effect. Outcomes are more desirable when signalling truly reveals and more importantly convinces the entrant about the true state of demand compared to those where signalling does not reveal.

JEL classification: D80, D82.

- 9710 Scheduling multiclass queueing networks on parallel servers: approximate and heavy-traffic optimality of Klimov's rule.
K. D. GLAZEBROOK and J. NIÑO-MORA.

We address the problem of scheduling a multiclass queueing network on M parallel servers to minimize the time-average holding cost. We analyze a heuristic index rule, based on Klimov's solution to the single-server model: when a server becomes free it selects a customer with largest Klimov's index. We present closed-form performance guarantees for this heuristic, with respect to (1) the optimal cost in the original parallel-servers network, and (2) the optimal cost in a "corresponding" single-server network, attended by a server working M times faster. Simpler expressions are derived for the special case that there is no customer feedback, where the heuristic becomes the $c\mu$ -rule. Our analysis is based on comparing the cost of the heuristic to the value of (the dual of) a strong linear programming relaxation, which equals the optimal cost for the "corresponding" single-server network. This relaxation follows from a set of approximate conservation laws satisfied by the network. Our proof of these laws relies on the first set of work decomposition laws known for this model, which we obtain from a classical flow conservation law.

Keywords: Multiclass queueing network, performance guarantee, heavy-traffic analysis, scheduling, performance region, priority index, work decomposition.

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CORE DISCUSSION PAPERS 1997/4

- 9711 Optimal selling mechanisms for multiproduct monopolists: incentive compatibility in the presence of budget constraints.

P. KLINGER MONTEIRO and F. H. PAGE Jr.

We demonstrate the existence of an optimal, individually rational, and incentive compatible selling mechanism for a multiproduct monopolist facing a market populated by consumers *with budget constraints*. Our main contribution is to show that, in general, when facing consumers with budget constraints the monopolist is able to maximize profits over the set of individually rational and incentive compatible selling mechanisms only if other goods are available and only if the monopolist's goods are nonessential relative to other goods.

- 9712 On Loeb measure spaces and their significance for non-cooperative game theory.

M. A. KHAN and Y. SUN.

In this expository paper, Loeb measure spaces are constructed on the basis of sequences, and shown to satisfy many useful properties, including some regularity properties of correspondences involving distribution and integration. It is argued that Loeb measure spaces can be effectively and systematically used for the analysis of game-theoretic situations in which "strategic negligibility" and/or "diffuseness" of information are substantive and essential issues. Positive results are presented, and the failure of analogous results for identical models based on Lebesgue measure spaces is illustrated by several examples. It is also pointed out that the requirement of Lebesgue measurability, by going against the non-cooperative element in the situation being modelled, is partly responsible for this failure.

- 9713 Estimating returns to scale using nonparametric deterministic technologies: a new method based on goodness-of-fit.

K. KERSTENS and P. VANDEN EECKAUT.

The purpose of this note is to define a new and more general method to obtain qualitative information about returns to scale for individual observations. In a second section the traditional methods developed for estimating returns to scale on nonparametric deterministic reference technologies (Data Envelopment Analysis (DEA) models) are reviewed. Section 3 provides a new and more general method that is suitable for all reference technologies. Its usefulness is illustrated by considering variations on an existing non-convex production model, known as the Free Disposal Hull (FDH). When different returns to scale assumptions are introduced into the FDH, then previous methods for determining returns to scale do no longer apply.

Keywords: returns to scale; FDH; DEA.

JEL classification: D24.

- 9714 The dual bounds for the Brownian games.

B. DE MEYER.

Let S denote $\{x \in \mathbb{R}^K \mid \exists k, k' : x_k \leq 0, x_{k'} \geq 0\}$. For a point $x \in S$, a subspace \mathcal{A} of $\mathbb{R}^{K \times I}$ and an I dimensional Brownian motion W , we denote by $\mathcal{Q}(S, \mathcal{A}, x)$ the set of the S -valued local martingales $Y := x + \int_0^\bullet A_t dW_t$ where A is an \mathcal{A} -valued progressively measurable process.

Our main results states that $\mathcal{Q}(S, \mathcal{A}, x)$ is uniformly bounded in L^α for an $\alpha \in (0, 1)$ under the additional hypothesis: $\forall A \in \mathcal{A}, \forall p \in \mathbb{R}_+^K - \{0\} : p^\top A = 0 \implies A = 0$.

These bounds are derived for their application to the analysis of the so called Brownian games (see [1] and [2]).

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CORE DISCUSSION PAPERS 1997/5

- 9715 Brownian games: uniqueness and regularity issues
B. DE MEYER.

This paper extends the analysis of the dual Brownian game $\Gamma^*(x, T)$ initiated in [2]. The existence of a value $\psi^*(x, T)$ for $\Gamma^*(x, T)$ as well as the existence of optimal strategies was proved there. In this paper we will prove successively that player 2's optimal strategy is unique, that it depends continuously (even in an Hölderian way) on x , and that, under a strict ellipticity condition, the mapping $\psi^*(\bullet, T)$ is C^2, α for a strictly positive α .

Brownian games were essentially introduced to prove the existence of a solution to a non linear elliptic PDE problem. The regularity of ψ^* proved here joint to the results proved in [2] indicates that ψ^* is the solution to this PDE problem.

- 9716 A Gibbs sampling approach to cointegration.
L. BAUWENS and P. GIOT.

This paper reviews the application of Gibbs sampling to a cointegrated VAR system. Aggregate imports and import prices for Belgium are modelled using two cointegrating relations. Gibbs sampling techniques are used to estimate from a Bayesian perspective the cointegrating relations and their weights in the VAR system. Extensive use of spectral analysis is made to get insight into convergence issues.

- 9717 Spatially oligopolistic model with opportunity cost pricing for transmission capacity reservation - A variational inequality approach.
Y. SMEERS and WEI J.-Y.

Two markets co-exist in a unbundled electricity supply industry: the one of the electricity supply and the one of transmission capacity reservations. The first one could be assumed as an oligopoly, and the second one, as a natural monopoly, is regulated. The prices in the first market are determined by an oligopolistic equilibrium. The prices in the second market are set equal to the opportunity costs. The strong interaction of the behavior of the two markets requires a new concept of equilibrium. In this equilibrium, the two markets must be simultaneously in their own equilibrium: Nash equilibrium in the first market and market-clearing equilibrium in the second. An equilibrium of the market is defined and variational inequality approach is used to solve the problem. A simulation using this model is done for an electricity supply market organized across 4 European countries.

- 9718 An iterative process for international negotiations on acid rain in Northern Europe using a general convex formulation.
M. GERMAIN and Ph.L. TOINT.

This paper proposes a dynamic game theoretical approach of international negotiations on transboundary pollution. This approach is distinguished by a discrete time formulation and by a suitable formulation of the local information assumption on cost and damage functions: at each stage of the negotiation, the parties assign the best possible cooperative state, given the available information, as an objective for the next stage. It is shown that the resulting sequences of states converges from a non-cooperative situation to a Pareto optimum in a finite number of stages. Furthermore, a financial transfer structure is also presented, which guarantees that the desired sequence of states is individually rational and strategically stable if one starts from a Nash equilibrium. The concepts are applied in a numerical simulation of the SO_2 transboundary pollution problem related to acid rain in Northern Europe. This simulation shows the need for an improved formulation of the financial transfers if one starts from another initial state. Such a formula is proposed and tested numerically.

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CORE DISCUSSION PAPERS 1997/6

- 9719 Quality of semidefinite relaxation for nonconvex quadratic optimization.
Yu. NESTEROV.
In this paper we prove that the semidefinite relaxation of boolean quadratic maximization problem with indefinite matrix provides us with a fixed absolute accuracy estimate for the exact solution.
- 9720 The 0-1 knapsack problem with a single continuous variable.
H. MARCHAND and L.A. WOLSEY.
Constraints arising in practice often contain many 0-1 variables and one or a small number of continuous variables. Existing knapsack separation routines cannot be used on such constraints. Here we study such constraint sets, and derive valid inequalities that can be used as cuts for such sets, as well for more general mixed 0-1 constraints.
Specifically we investigate the polyhedral structure of the knapsack problem with a single continuous variable, called the *continuous 0-1 knapsack* problem. First different classes of facet-defining inequalities are derived based on projection and lifting. The order of lifting, particularly of the continuous variable, plays an important role. Secondly we show that the flow cover inequalities derived for the single node flow set, consisting of arc flows into and out of a single node with binary variable lower and upper bounds on each arc, can be obtained from valid inequalities for the continuous 0-1 knapsack problem. Thus the separation heuristic we derive for continuous knapsack sets can also be used to derive cuts for more general mixed 0-1 constraints. Initial computational results on a variety of problems are presented.
- 9721 Estimation of a latent linear model based on the rank statistics of the dependent variable.
L. BROZE and F. JOUINEAU.
In this paper we study a new type of latent model in which only the rank statistics of the dependent variable is observed. This problem appears naturally in the microeconomic literature, in particular in the case of the parametric estimation of a production function when the output is poorly observed. A full information approach seems difficult. So we consider another model which describes part of the information of the first one. This second model is Probit model with serial correlations. The inferential problems (test and estimation) have been studied in the literature but not from this viewpoint. We show by simulations that the proposed estimators behave nicely even in relatively small samples. We also perform the estimation of a production function on a real data set.
Keywords: Limited dependent variables, Probit Analysis, Robust Production Function Estimation.
- 9722 Skill acquisition and wage competition with heterogeneous workers and firms.
J. HAMILTON, J.-F. THISSE and Y. ZENOU.
We study labor market competition with heterogeneous firms and consumers. Worker types are continuously distributed within the population and a finite number of firms have specific skill requirements. Specific human capital investment is the cost of training a worker to be able to work for a particular firm and depends on the difference between the worker's skill type and the firm's skill requirement. A firm's profit equals its output minus wages, its share of training costs, and a fixed cost. We solve for symmetric free-entry Nash equilibria of the wage offer game under two different information structures. When firms can identify worker types before employment, firms can pay different net wages to workers with different training costs. When firms cannot identify worker training costs in advance, firms pay workers equal wages, but workers absorb training costs. The level of fixed costs, the size of the labor market, and the cost of investment in human capital all affect the equilibrium settings. We also consider different tax instruments to increase allocative efficiency and to finance investment in general human capital.
Keywords: endogenous wage setting, education financing, median voter, information structure.
JEL classification: J41, I22.

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CORE DISCUSSION PAPERS 1997/7

- 9723 Loss aversion equilibrium.
J. SHALEV.

The Nash equilibrium solution concept for strategic form games is based on the assumption of expected utility maximization. Reference dependent utility functions (in which utility is determined not only by an outcome, but also by the relationship of the outcome to a reference point) are a better predictor of behavior than expected utility. In particular, loss aversion is an important element of such utility functions.

We extend strategic form games to include loss aversion characteristics of the players. We define loss-aversion equilibrium, a solution concept endogenizing reference points. Reference points emerge as expressions of anticipation which are fulfilled in equilibrium.

We show existence of loss-aversion equilibrium for any extended game, and compare it to Nash equilibrium. Comparative statics show that an increase in loss aversion of one player can affect his and other players' payoffs in different directions.

Keywords: loss aversion, reference dependence, equilibrium.

JEL classification: C72

- 9724 Local public funding of higher education when skilled labor is mobile.
M. JUSTMAN and J.-F. THISSE.

Inter-jurisdictional labor mobility when public funding of higher education is sub-federal leads to a disparity between the centralized output-maximizing allocation of resources to education and decentralized equilibria. We show that when local governments choose their level of spending on higher education at a Nash equilibrium, the size and direction of this disparity depend strongly on the political balance of forces at the sub-federal level. The more common case of under-investment can be alleviated through inter-jurisdictional subsidies of local education expenditures based on net migration flows.

JEL classification: H77, I121.

- 9725 Orienting matroids representable over both $GF[3]$ and $GF[5]$.
J. LEE.

For matroids representable over both $GF[3]$ and $GF[5]$, we provide a recipe for constructing an orientation.

- 9726 Spatially oligopolistic model with nodal opportunity cost pricing for transmission capacity reservations.
Y. SMEERS and WEI J.-Y.

Two markets co-exist in a unbundled electricity supply industry: the one of the electricity supply and the one of transmission capacity reservations. The first one could be assumed as an oligopoly, and the second one, as a natural monopoly, is regulated. The prices in the first market is determined by an oligopolistic equilibrium. The prices in the second market are set equal to opportunity costs. The strong interaction of the behavior of the two markets requires a new concept of equilibrium. In this equilibrium, the two markets must be simultaneously in their own equilibrium: Nash equilibrium in the first and market-clearing equilibrium in the second. A 3-bus example is presented to show the main result of the model.

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CORE DISCUSSION PAPERS 1997/8

- 9727 One-way spillovers, endogenous innovator/imitator roles and research joint ventures.
R. AMIR and J. WOODERS.
We consider a two-period duopoly characterized by a one-way spillover structure in process R&D and a very broad specification of product market competition. We show that *a priori* identical firms always engage in different levels of R&D, at equilibrium, thus giving rise to an innovator/imitator configuration and ending up with different sizes. We also provide a general analysis of the social benefits of, and firms' incentive for, forming research joint ventures. The key properties of the game are submodularity (R&D decisions are strategic substitutes) and lack of global concavity.
Keywords and phrases: oligopolistic R&D, one-way spillovers, research joint ventures, submodularity.
JEL classification: C72, L13, O31.
- 9728 Moral hazard and overlapping generations with endogenous occupational choice.
M. GHATAK, M. MORELLI and T. SJÖSTRÖM.
This paper introduces a general equilibrium, overlapping generations model of the principal-agent problem. Bargaining power, occupational choice, and the returns to each occupation are endogenous. Individuals live for two periods and must work when young. When old, they have a choice between becoming principals or remaining agents. Successful workers are paid high wages and may become *self financed* principals when old; unsuccessful workers are paid low wages and can become principals only by borrowing money. In a "high wage" equilibrium, an *imperfect* credit market (which makes it costly to borrow money due to, for example, moral hazard between lender and borrower) mitigates the moral hazard problem on the labor market: young workers work harder than in the static model (for a given wage) in order to succeed and become *self-financed* principals (the "American Dream" effect). The extra effort makes it possible for principals to pay high wages. However, there is a coordination problem. For the same parameter values that give rise to the "high wage" equilibrium, there also exist equilibria where wages are so low that even successful agents need to borrow money if they are to become principals. Effort is then low because wages are low, and because there is no "American Dream".
Keywords: Moral Hazard, Overlapping Generations, Occupational Choice, Bargaining Power, Credit Market Imperfections, American Dream.
JEL classification: D41, D82, J24.
- 9729 Using continuous nonlinear relaxations to solve constrained maximum-entropy sampling problems.
K. M. ANSTREICHER, M. FAMPA, J. LEE and J. WILLIAMS.
We consider a new nonlinear relaxation for the Constrained Maximum-Entropy Sampling Problem - the problem of choosing the $s \times s$ principal submatrix with maximal determinant from a given $n \times n$ positive definite matrix, subject to linear constraints. We implement a branch-and-bound algorithm for the problem, using the new relaxation. The performance on test problems is far superior to a previous implementation using an eigenvalue-based relaxation. A parallel implementation of the algorithm exhibits approximately linear speed-up for up to 8 processors, and has successfully solved problem instances which were heretofore intractable.

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CORE DISCUSSION PAPERS 1997/9

- 9730 The APOS linear programming solver: an implementation of the homogeneous algorithm.
E. D. ANDERSEN and K. D. ANDERSEN.

The purpose of this work is to present the APOS linear programming (LP) solver intended for solution of large-scale sparse LP problems. The solver is based on the homogeneous interior-point algorithm which in contrast to the primal-dual algorithm detects a possible primal or dual infeasibility reliably. It employs advanced (parallelized) linear algebra, it handles dense columns in the constraint matrix efficiently, and it has a basis identification procedure. Moreover, recently the solver has been incorporated into the commercially available XPRESS-MP¹ software.

This paper discusses in details the algorithm and linear algebra employed by the APOS LP solver. In particular the homogeneous algorithm is emphasized. Furthermore, extensive computational results are reported. These results include comparative results for the XPRESS-MP simplex and barrier code and the freely available BPMPD code developed by Cs. Mészáros. Finally, computational results are presented to demonstrate the possible speed-up, when using a parallelized version of the APOS LP solver on a Silicon Graphics Challenge computer.

- 9731 On estimation of monotone and concave frontier functions.
I. GIJBELS, E. MAMMEN, B.U. PARK and L. SIMAR.

A way for measuring the efficiency of enterprises is via the estimation of the so-called production frontier, which is the upper boundary of the support of the population density in the input and output space. It is reasonable to assume that the production frontier is a concave monotone function. Then, a famous estimator is the data envelopment analysis (DEA) estimator, which is the lowest concave monotone increasing function covering all sample points. This estimator is biased downwards since it never exceeds the true production frontier. In this paper we derive the asymptotic distribution of the DEA estimator, which enables us to assess the asymptotic bias and hence to propose an improved bias corrected estimator. This bias corrected estimator involves consistent estimation of the density function as well as of the second derivative of the production frontier. We also discuss briefly the construction of asymptotic confidence intervals. The finite sample performance of the bias corrected estimator is investigated via a simulation study and the procedure is illustrated for a real data example.

Keywords: Asymptotic distribution, bias correction, confidence interval, data envelopment analysis, density support, frontier function.

AMS 1991 subject classification: Primary 62G20; secondary 60E20, 60Gxx.

¹Available from Dash Associates, see <http://www.dash.co.uk/>

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CORE DISCUSSION PAPERS 1997/10

- 9732 Price competition when consumer behavior is characterized by conformity or vanity.
I. GRILO, O. SHY and J. - F. THISSE.

It has long been recognized that the pleasure of consuming a good may be affected by the consumption choice of other consumers. At least two types of motivations may explain such a behavior. In some cases social pressures may lead to conformity; while in some other cases individuals may feel the need of exclusiveness under the form of vanity. Such externalities have proven to be important in several markets where the decision to buy a product is positively or negatively affected by the number of consumers purchasing the same product. However, the market and welfare implication of these effects are still unclear. To investigate them, we propose to graft the consumption externality model onto the spatial duopoly model.

When conformity is present but not too strong, both firms remain in business but price competition is fiercer and results in lower prices. The market share of the large firm increases with the population size; as the population keeps rising, the large firm serves the entire market and sets a price which has the nature of a limit price. When conformity is strong enough, different equilibria may exist. These equilibria are such that only one firm has a positive market share or both firms split the market. At the other extreme, when vanity is at work, price competition is relaxed.

Keywords: Price competition, network, consumption externality.

JEL Classification: L13, D11.

- 9733 Demand uncertainty, mismatch, and (un)employment.
M. JELLAL, J. - F. THISSE and Y. ZENOU.

We consider a finite number of firms which compete imperfectly for heterogeneous workers. Firms produce a homogeneous good sold on a competitive market and face demand-induced price fluctuations. It is then shown that unemployment may arise in equilibrium because of uncertainty on product demand and job mismatch. However, unemployment does not arise when the variance of the demand shock is small enough and/or the cost of mismatch is sufficiently low. Full employment always prevails when there is free entry. Hence, unemployment may persist as long as the incumbent firms choose their skill requirements to protect their supranormal profits.

Keywords: workers and heterogeneity, job matching, demand shock, unemployment.

JEL Classification: I28, J41, L13.

- 9734 On the declining price anomaly in wine auctions.
V. GINSBURGH.

The anomaly is concerned with the observation that in multiple-item auctions of identical objects, prices tend to decline over time. We show that in the case of wine auctions which have been analyzed frequently, the anomaly is likely to be caused by the fact that most bids are entered by absentees. If only absentees are interested in a multiple-lot auction and have sent different written valuations for the various lots, it is obvious that the auctioneer will sell the lots to satisfy bids in decreasing order of valuation.

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CORE DISCUSSION PAPERS 1997/11

- 9735 Coalition formation and payoff distribution in majority games.
M. MORELLI.

In this paper we provide a cooperative solution as well as a non-cooperative analysis to study coalition formation and payoff distribution in weighted majority games. The cooperative solution concept proposed here, the **Anonymous Core**, keeps the spirit of Core-like competition (reflecting individual rationality as well as group rationality), but it is non-empty and it is precisely characterized for every vector of weights. Agents of the same type must receive equal treatment within the winning coalitions, and some consistency is required on blocking coalitions, following a similar logic to that underlying the Von-Neumann and Morgenstern's Stable Set. We show that in any weighted majority game every agent within the winning coalition is expected to obtain a payoff share proportional to her bargaining power. The latter is what defines the different types, and it is obtained endogenously. We introduce a non-cooperative coalitional bargaining game which resembles the rules of the game describing the formation of coalitional governments. We obtain an algorithm for the computation of all the Symmetric Markov Subgame Perfect Equilibria of such game, and show that the set of such equilibria has a one-to-one correspondence with the Anonymous Core for homogeneous weighted majority games.

- 9736 Antitrust policy and price collusion: public agencies versus delegation?
G.M. MARTINI and C. ROVESTI.

In a simple economic setting with asymmetric information we compare different social institutions which fight against industry cartels on prices. Firstly, we analyse the case where an Antitrust Authority is created and we distinguish two situations depending whether the agency has the possibility to commit itself to a policy or not. Secondly, we develop an alternative framework in which consumers can act legally against price collusion practices. Then, we compare the results in terms of social welfare associated to the three schemes. Even if a general result in favour to a "delegated" antitrust action to consumers cannot be established, we show that in many instances private suits can be more effective than interventions of an Antitrust Authority.

- 9737 A monopolistic market for certification.
G. L. ALBANO and A. LIZZERI.

If buyers do not observe the quality of a product and production of quality is costly, market allocations can be very inefficient. Certification intermediaries are institutions that provide information about quality to buyers. The amount of information in the market determines the incentives that producers have to provide high quality goods. In this paper, we model information revelation as a strategic variable of intermediaries. The amount of disclosed information is shown to deeply influence both the intermediary's profits and the distribution of quality produced in equilibrium. We show that a monopoly intermediary will provide noisy signals of quality and that the quality produced in equilibrium is the same as the one that would be chosen by a monopsonistic buyer who optimally designs a mechanism. Efficiency is increased by the intermediary but less quality is produced in equilibrium than under complete information. **Keywords:** Information revelation, Disclosure rule, Certification. **J.E.L. classification:** C72, D82, L15

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CORE DISCUSSION PAPERS 1997/12

- 9738 On the decomposition and characterization of risk.
A. KHAN and Y. SUN.
We show that the main theorem in Al-Najjar's 1995 *Econometrica* paper is false. We provide additional references for the residual implications that are valid, but point out that these standard implications are incapable of bearing the interpretative weight that Al-Najjar places on them.
JEL classification: C60, D80
- 9739 Competition in both quantity and quality: spatial competition models with regulated transportation prices.
Y. SMEERS and WEI J.-Y.
An oligopoly with spatially dispersed producers and consumers and with multi-period demands is modeled in the paper. Generation firms compete both in quantity and in quality for electricity supply. That is, they compete in generation capacity and electric energy supply as well as in reserved capacity demanded by consumers for reliability.
Two models are formulated under the following underlying assumptions on oligopolistic competition: (1) Ramsey model; (2) the producers are assumed to behave in the Cournot manner with regulated transportation prices. Variational inequality approach is used for computing equilibria of the model. These models are applied to simulate the long run electricity market.
- 9740 Towards a practical volumetric cutting plane method for convex programming.
K. M. ANSTREICHER.
We consider the volumetric cutting plane method for finding a point in a convex set that is characterized by a $\mathcal{C} \subset \mathbb{R}^n$ separation oracle. We prove polynomiality of the algorithm with each added cut placed directly through the current point, and show that this "central cut" version of the method can be implemented using no more than $25n$ constraints at any time.
- 9741 Intergenerational altruism and the environment.
P.-A. JOUVET, P. MICHEL and J.-P. VIDAL.
This paper constructs an overlapping generations model of pollution externality wherein individuals are altruistically linked to their offspring as in Barro (1974). It is shown that steady-state consumption can be a decreasing function of the intergenerational degree of altruism. Despite individuals' altruism, the competitive equilibrium is not optimal. We thus study the social optimum and prove that it can be decentralised.
Keywords: altruism, environment, overlapping generations.
- 9742 Optimal all-pay auction when signals are correlated.
P. KLINGER MONTEIRO.
In this note I prove the existence of the optimal-pay auction when signals are correlated.
JEL: D44
- 9743 Discreteness of equilibria in incomplete markets with a continuum of states.
P. KLINGER MONTEIRO and M. R. PÁSCOA.
We discuss the issue, raised by Mas-Colell (1991) whether the local uniqueness (relative to the L^∞ topology) may be a generic property of equilibria in incomplete markets economies with a continuum of states.
JEL: D52

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CORE DISCUSSION PAPERS 1997/13

- 9744 Semidefinite relaxation and nonconvex quadratic optimization.
Yu. NESTEROV.
In this paper we consider the semidefinite relaxation of some global optimization problems. We prove that in some cases this relaxation provides us with a constant relative accuracy estimate for the exact solution.
- 9745 Ellipsoidal approximations of convex sets based on the volumetric barrier.
K. M. ANSTREICHER.
Let $\mathcal{C} \subset \mathbf{R}^n$ be a convex set. We assume that $\|x\|_\infty \leq 1$ for all $x \in \mathcal{C}$, and that \mathcal{C} contains a ball of radius $1/R$. For $x \in \mathbf{R}^n$, $r \in \mathbf{R}$, and B an $n \times n$ positive definite matrix, let $E(x, B, r) = \{y | (y-x)^T B (y-x) \leq r^2\}$. A β -rounding of \mathcal{C} is an ellipsoid $E(x, B, r/\beta) \subset \mathcal{C} \subset E(x, B, r)$. In the case that \mathcal{C} is characterized by a separation oracle, it is well known that an $O(n^{3/2})$ -rounding of \mathcal{C} can be obtained using the shallow cut ellipsoid method in $O(n^3 \ln(nR))$ oracle calls. We show that a modification of the volumetric cutting plane method obtains an $O(n^{3/2})$ -rounding of \mathcal{C} in $O(n^2 \ln(nR))$ oracle calls. We also consider the problem of obtaining an $O(n)$ -rounding of \mathcal{C} when \mathcal{C} has an explicit polyhedral description. Our analysis uses a new characterization of circumscribing ellipsoids centered at, or near, the volumetric center of a polyhedral set.
- 9746 Linear programming in $O(\frac{n^3}{\ln n} L)$ operations.
K. M. ANSTREICHER.
We show that the complexity to solve linear programming problems, using standard linear algebra, can be reduced to $O([n^3/\ln n]L)$ operations, where n is the number of variables in a standard form problem with integer data of bit size L . Our technique combines partial updating with a preconditioned conjugate gradient method, in a scheme first suggested by Nesterov and Nemirovskii.
- 9747 Discrete time option pricing with flexible volatility estimation.
W. HÄRDLE and C. HAFNER.
By extending the GARCH option pricing model of Duan (1995) to more flexible volatility estimation it is shown that the prices of out-of-the-money options strongly depend on volatility features such as asymmetry. Results are provided for the properties of the stationary pricing distribution in the case of a threshold GARCH model. For a stock index series with a pronounced leverage effect, simulated threshold GARCH option prices are substantially closer to observed market prices than the Black/Scholes and simulated GARCH prices.
- 9748 “Cav u ” and the dual game
B. De MEYER and D. ROSENBERG.
We give an alternative proof of a theorem of Aumann and Maschler [1] that characterizes the limit of the values of finitely repeated games with lack of information on one side as the concavification of the value of the game where none of the players has any information.
- 9749 Structure of non-negative polynomials and optimization problems
Yu. NESTEROV.
In this paper we give an explicit description of the cone of univariate non-negative polynomials in terms of the cone of positive semidefinite matrices. As a consequence of that result, we get a description of the cones of polynomials, which are non-negative on a ray and on an interval, and the description of non-negative trigonometric polynomials. We present some extension of these results on multi-dimensional case.

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CORE DISCUSSION PAPERS 1997/14

- 9750 Competing with second-hand products when consumers differ in risk aversion.
Isabel Grilo and Xavier Wauthy.
When consumers differ in their attitude towards risk, price competition between products of uncertain characteristics may be analyzed using address-models of product differentiation. These models provide a natural set-up for analyzing industries in which products of different reliability may coexist. This is in particular the case of second-hand markets. For such industries, we characterize the Nash equilibrium in prices and the associated market outcomes. They are shown to depend mainly on the distribution of risk aversion in the population. When the degree of reliability is chosen before price competition takes place, maximal differentiation results, yielding either horizontal or vertical differentiation configurations.
JEL Classification: L13
- 9751 Walras-Keynes equilibria coordination and macroeconomics.
Jacques H. Drèze
In decentralised market economies, supply-constrained equilibria may persist as coordination failures, sustained but not caused by price rigidities. This feature may be arbitrarily severe, even at prices compatible with competitive equilibrium. The supply-constraints may originate in rational expectations. Some implications for macroeconomics are drawn. The possibility of coordination failures explains why organised labour may resist wage flexibility. These features are illustrated in elementary macroeconomic prototypes, like RBC or Barro-Grossman-Malinvaud prototypes.
Keywords: coordination failures, supply constraints, price rigidities, macroeconomics.
JEL Classification: E00
- 9752 Cooperation vs. free riding in international environmental affairs: two approaches.
H. Tulkens
Two theses on the likelihood of international cooperation for achieving international optimality in transboundary pollution problems are being confronted: a pessimistic one and an optimistic one. On the one hand a “Small Stable Coalitions” (SSC) thesis — based on the stability of coalitions literature and put forward in several papers by Barrett, Carraro and Siniscalco — holds the view that only small subsets of the countries involved in a transfrontier pollution problem can ever emerge as a group and sign a treaty among themselves; on the other hand a “Grand Stable Coalition” (GSC) thesis — inspired by classical cooperative game theory and proposed by Chander and Tulkens — presents the contents of a feasible treaty which the authors show to enjoy some “core property”, that is, to be more beneficial not only for all countries taken individually, as compared to a no treaty situation, but also more beneficial for all subgroups of them, for any partial treaty they might sign among themselves.
The two views are formally developed in Section III, after that a presentation is given in Section II of the common underlying economic model of international environmental externalities. Section IV then identifies and discusses several game theoretic differences and similarities between the two approaches, namely those bearing on the notion of “coalition”, on the phenomenon of “free riding” in its relation with “threats” in games with externalities, on the uses of the concept of “characteristic function” in cooperative games (with a suggested extension, designed towards reconciling the two approaches), and finally on the rôle of transfers and “side payments” in the international pollution problem under consideration. The concluding section stresses the fact that essentially two different notions of group stability lie at the root of these diverging views.
Keywords: bifurcations, sunspots, endogenous fluctuations.
JEL Classification: E32.

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CORE DISCUSSION PAPERS 1997/15

- 9753 Competition in multi-characteristics spaces: Hotelling was almost right.
A. Irmen and J.-F. Thisse.
Lancasterian models of product differentiation typically assume a one-dimensional characteristics space. We show that standard results on prices and locations no longer hold when firms compete in a multi-characteristics space. In the location game with n characteristics, firms choose to maximize differentiation in the dominant characteristic and to minimize differentiation in the others when the salience coefficient of the former is sufficiently large. Thus, the principle of minimum differentiation holds for all but one characteristic. Furthermore, prices do not necessarily fall when products get closer in the characteristics space because price competition is relaxed when products are differentiated enough in the dominant characteristic.
Keywords: product positioning, multi-characteristics space.
JEL Classification: L1, M3, R3.
- 9754 Tax harmonisation and political competition.
L. Grazzini and T. van Ypersele.
In this paper, we analyse tax harmonisation in the framework of two countries asymmetric in their capital-labour endowment. In the first part, countries play a non-cooperative game and we examine how national fiscal policies are decided according to majority voting. At the Nash equilibrium, inefficiency arises because of the corresponding misallocation of resources. In the second part, we analyse fiscal policy coordination within the institutional framework of the European Union, where policy reforms are decided by unanimity rule. In most cases, we show that the imposition of a minimum capital tax rate is refused.
Keywords: Fiscal competition, Mobility of factors of production, International policy coordination, Political economy
JEL Classification: F20, F42, H87, D72
- 9755 Worker's skills, product quality and industry equilibrium.
J. J. Gabszewicz and A. Turrini.
In this paper we develop a model of a vertically differentiated industry where the production of higher quality goods needs a higher fraction of specialized labour. In the first stage, firms choose the quality of their products, in the second, both good prices and skilled workers' wages are determined. We show that in duopoly, though supplying different variants of the product, firms tend to cluster either at the bottom or at the top of the quality ladder, depending on skilled labour availability. This switch in equilibrium qualities creates a discontinuous behaviour for the wage rate of skilled workers. When the supply of skilled labour is made endogenous, two equilibria are simultaneously possible: one with low-skill, low quality, the other with high-skill, high-quality.
Keywords: Quality competition, strategic effects, endogenous market structure, skills investments, multiple equilibria.
JEL Classification: D4, J24, L13, L15.
- 9756 Vertically differentiated goods and labour markets. A note on quality, quantity and welfare.
A. Turrini.
In a vertically differentiated oligopoly where the high quality variant of the good requires the use of the high quality labour (available in fixed supply) firms may either all supply the same quality or differentiate their product. Only differentiated outcomes can be optimal, but the number of firms choosing the high quality variant is generally above the optimal number.
Keywords: Quality competition, product differentiation, strategic effects, cost externalities.
JEL Classification: D4, J24, L13, L15.

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CORE DISCUSSION PAPERS 1997/16

- 9757 Robustness of the coordinating role of a redundant security.
Chiaki HARA.
The coordinating role of a redundant security is its role in markets with transaction costs to coordinate different consumers' security demands so as to clear all security markets and, simultaneously, attain a given commodity allocation. The purpose of this paper is to prove that, under some conditions, the coordinating role of a redundant security is a robust property with respect to perturbations in utility functions, initial endowments, and transaction costs.
Keywords: Security markets, transaction costs, redundant securities, general equilibrium theory, robustness.
JEL Classification: D52, G11, G12
- 9758 The coordinating role of a redundant security in frictional markets.
Chiaki HARA.
In this paper, we show that even if a redundant security does not have the cost-saving role in markets with transaction costs, it may still be relevant to risk-sharing at equilibrium. We call this the coordinating role of the redundant security. We prove that at least five securities and three states are necessary for one of the securities to have the coordinating role. We also show that even if a redundant security requires a lower transaction cost and actively traded at an equilibrium, it need not be relevant to risk-sharing.
Keywords: Security markets, transaction costs, redundant securities, general equilibrium theory, financial innovation.
- 9759 Bayesian option pricing using asymmetric GARCH.
Luc BAUWENS and Michel LUBRANO.
This paper shows how one can compute option prices from a Bayesian inference viewpoint, using an econometric model for the dynamics of the return and of the volatility of the underlying asset. The proposed evaluation of an option is the predictive expectation of its payoff function. The predictive distribution of this function provides a natural metric with respect to which the predictive option price, or other option evaluations, can be gauged. The proposed method is compared to the Black and Scholes evaluation, in which a predictive mean volatility is plugged, but which does not provide a natural metric. The methods are illustrated using an asymmetric GARCH model with a data set on a stock index in Brussels. The persistence of the volatility process is linked to the prediction horizon and to the option maturity.
Keywords: Bayesian, GARCH, option pricing, simulation
JEL Classification: C11, C15, C22, G13
- 9760 Do we need a power exchange if there are enough power marketers?
Yves SMEERS and WEI Jing-Yuan.
Decentralization in electricity restructuring is a growing trend that Power Marketers are expected to take advantage of. We consider a market composed of Power Marketers, an Independent System Operator, generators and retailers. Power Marketers behave à la Cournot-Nash and the ISO implements a Transmission Capacity Reservation market à la FERC. Retailers are price taker. Generators' behavior is only reflected in the purchase costs of the Power Marketers. Their behavior is thus not really modeled. We define equilibrium of this market and show that it is efficient when the number of the Power Marketers is large enough.

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CORE DISCUSSION PAPERS 1997/17

- 9761 Computable equilibrium models and the restructuring of the European electricity and gas markets.
Yves SMEERS.

More regulation, not less, is temporarily necessary, if effective competition is to be established in network industries. This paradox places new requirements on computable models: they should provide realistic descriptions of technologies but also of market and institutions. Industrial economics and computation of economic equilibrium can help achieve this dual requirement. The paper discusses their potential in the context of the deregulation of the European gas and electricity sectors. Some key elements of the European legislative process are first presented in order to point to the diversity of institutions that can emerge and to the need to model institutions. Perfect competition equilibrium models although institutionally poor are argued to be useful for ex post analysis. Applications of the standard Cournot and Bertrand paradigms in ex ante analysis of gas and electricity markets are reviewed next. Models combining market power and externalities are then discussed with reference to electricity restructuring. Finally multistage equilibrium models are introduced in the context of investment in gas and electricity. Computation remarks conclude the paper.

JEL Classification: C6, D43, L 94, L95

- 9762 Some problems with the Ferrier/Hirschberg bootstrap idea.
Léopold SIMAR and Paul W. WILSON.

This paper demonstrates that the bootstrap procedure suggested by Ferrier and Hirschberg (1997) gives inconsistent estimates. A very simple example is given to illustrate the statistical issues underlying nonparametric efficiency measurement and the problems with the Ferrier/Hirschberg approach, and may serve as a primer on bootstrapping in nonparametric models of production processes.

- 9763 A welfarist version of Harsanyi's aggregation theorem
Claude d'ASPREMONT and Philippe MONGIN.

Harsanyi's Aggregation Theorem has often been dismissed as being irrelevant to utilitarianism, and thus void of ethical content. Some of these objections can be met by reformulating Harsanyi's theorem in the *multi-profile* context of Social Welfare Functionals theory. The present paper aims at showing that appropriately formulated *single-profile* variants of the theorem also meet the objections, and thus arguably make sense in terms of utilitarianism. More precisely, using an "enlarged" single-profile approach, we derive a Harsanyi-like representation which is both anonymous and compatible with meaningful comparisons of cardinal utility functions. These results depend on reformulating Harsanyi's aggregation theorem in the social-choice theoretic framework of welfarism.

JEL Classification: D60, D63

- 9764 A linear programming approach to stability, optimization and performance analysis for Markovian multiclass queueing networks.

Kevin GLAZEBROOK and José NIÑO MORA.

Our object of study is a multiclass queueing network (MQNET) which consists of a collection of (connected) single server stations. Exogenous arrivals into the system form independent Poisson streams, service times are exponential and we have Markovian routing of customers between stations. Recent results concerning linear programming (LP) based approaches enable us to establish a simple and intuitive stability condition. This is of interest in its own right, but also enables us to progress with a study of optimal scheduling and performance analysis. Our methodology here is also based on LP. A primal-dual approach exploits the fact that the system satisfies (approximate) conservation laws to yield performance guarantees for a natural index-based scheduling heuristic. We are also able to analyse the performance of an arbitrary priority policy.

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CORE DISCUSSION PAPERS 1997/18

- 9765 Niche search: an application to the Manhattan newspaper problem.
João Pedro PEDROSO.
In this paper we describe a hybrid strategy for solving combinatorial optimisation problems, obtained by coupling a local search method to an evolutionary algorithm, and we provide an application to the Manhattan newspaper problem.
The local search method has been devised specifically for this class of problems. It is based on a composite neighbourhood, which is searched iteratively up to the point where no further improvements can be made.
The evolutionary structure is the niche search, an algorithm based on the evolution of several independent niches. Niches whose individuals' fitness is good remain, and the others tend to be replaced. The separation of the population into niches allows for a good compromise between intensive search (inside each niche) and diversification (through the separation between the niches).
Keywords: Hybrid Evolutionary Algorithms, Vehicle Routing.
- 9766 Cournot-Nash equilibria in limit exchange economies with complete markets: a comparison between two models.
Giulio CODOGNATO.
In this paper, we compare, in the framework of exchange economies with an atomless continuum of traders, two models of noncooperative exchange "à la Cournot-Nash" with consistent prices which belong to a line of research initiated by Shapley and Shubik (1977).
JEL Classification: C72, D51.
- 9767 Homogeneous analytic center cutting plane methods for convex problems and variational inequalities.
Yurii NESTEROV and Jean-Philippe VIAL.
In this paper we consider a new analytic center cutting plane method in a projective space. We prove the efficiency estimates for the general scheme and show that these results can be used in the analysis of a feasibility problem, the variational inequality problem and the problem of constrained minimization. Our analysis is valid even for the problems whose solution belongs to the boundary of the domain.
Keywords: Cutting plane, analytic centers.
- 9768 Exact geometry of explosive autoregressive models.
Kees van GARDEREN
This paper derives exact expressions for statistical curvature and related geometric quantities in the first order autoregressive models with stable and unit roots, as well as explosive roots larger than unity. We develop a method for deriving exact moments of arbitrary order in general autoregressive models. The covariance of the minimal sufficient statistic is an application of this method. Of particular interest is the Efron curvature which is continuous and bounded in finite samples, but increases rapidly when the autoregressive parameter changes from stable to explosive values, which has important inferential consequences. The initial value effect is also quantified exactly. We also include results for the Efron curvature in the pure stationary case with stochastic initial value for comparison, extending and correcting results from a previous discussion paper.
Keywords: Differential geometry, statistical curvature, exact distribution theory, exact mgf, unit root, explosive time series, conditional inference, curved exponential models.

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CORE DISCUSSION PAPERS 1997/19

- 9769 Endogenous business cycles: capital-labor substitution and liquidity constraint with increasing returns to scale.
Stefano BOSI and Francesco MAGRIS.
It is well known from the literature that the introduction of financial constraints in economies with infinite-lived agents can be responsible for the occurrence of multiple equilibria and endogenous fluctuations. However, the question of the persistence of such phenomena when the constraints are progressively relaxed remains open. By departing from Cazzavillan, Lloyd-Braga and Pintus (1996) framework with heterogeneous agents and positive externalities in aggregate capital and labor, we show that endogenous fluctuations can persist for a wide range of the financial constraint.
Keywords: bifurcations, sunspots, endogenous fluctuations.
JEL Classification: E32
- 9770 Redistribution with unobservable bequests: a case for taxing capital income.
Robin BOADWAY, Maurice MARCHAND and Pierre PESTIEAU.
This paper addresses the question of the optimal taxation of labour and interest income in an overlapping generations model with two unobservable characteristics, ability and inheritance. We assume realistically that saving can only be taxed anonymously, whereas the tax on labour earnings can be individualized and made non-linear. In such a setting, we show that a withholding tax on interest income along with a non-linear tax on labour income is desirable. The role of interest income taxation is to indirectly tax inherited wealth.
Keywords: Capital income taxation, tax evasion, bequest.
JEL Classification: H21, H24, H26.
- 9771 Subsidies versus public provision of private goods as instruments for redistribution.
Robin BOADWAY, Maurice MARCHAND and Motohiro SATO.
The literature on the use of differential commodity taxes/subsidies and that on quantity controls to supplement income taxation have developed separately from each other. The purpose of this paper is to combine these two strands in the standard framework of optimal non-linear income taxation. We start from a simple model in which there are two types of households, the government has access to both subsidy policy and public provision of a good substitutable with leisure, and households can supplement the publicly provided good from the market. We present conditions when optimal policy should involve a mix of these two instruments alongside income taxation or only one of them. We also consider alternative settings, including the extension to many types of households and the inability of households to supplement in-kind transfers.
Keywords: in-kind transfers, subsidies, optimal income tax
JEL Classification: H2, H4
- 9772 Efficiency wages, labor heterogeneity and the financing of the training cost.
Xavier WAUTHY and Yves ZENOU.
We consider a dual labor market with a continuum of heterogeneous workers differentiated by their ability of acquiring a specific skill. In the primary sector, jobs require firm-specific training and firms set efficiency wages. In the secondary sector, wages are competitive and no training is required. Given workers' heterogeneity, firms in the primary sector face an elastic labor supply, so that they can be labor constrained at the efficiency wage. When this is the case, we show that firms may optimally choose to bear all the training cost in order to relax the labor supply constraint.
Keywords: J31, J41
JEL Classification: dual labor markets, efficiency wages, training costs, workers' heterogeneity, labor supply constraint.

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CORE DISCUSSION PAPERS 1997/20

- 9773 Contestability and the indeterminacy of free entry equilibria.
Claude d'ASPREMONT, Rodolphe DOS SANTOS FERREIRA and Louis-André GÉRARD-VARET.
A general notion of market perfect contestability is introduced. It coincides with the definition given by Baumol *et al.* under Bertrand competition, but is compatible with other forms of competition : Cournot competition as well as monopolistic competition. Using this notion, we illustrate the fact that the number of active firms in free entry equilibrium may be largely indeterminate and different levels of positive profits may in many cases be sustained. This is shown to be true, in spite of market perfect contestability, either under Cournot competition or under product differentiation. Examples are given for both cases. Appropriate conditions of increasing returns are required.
JEL Classification: D5, D43.
- 9774 Loss aversion equilibrium. Revised.
Jonathan SHALEV.
The Nash equilibrium solution concept for games is based on the assumption of expected utility maximization. Reference dependent utility functions (in which utility is determined not only by an outcome, but also by the relationship of the outcome to a reference point) are a better predictor of behavior than expected utility. In particular, loss aversion is an important element of such utility functions. We extend games to include loss aversion characteristics of the players. We define two types of loss-aversion equilibrium, a solution concept endogenizing reference points. The two types reflect different procedures of updating reference points during the game. Reference points emerge as expressions of anticipation which are fulfilled. We show existence of myopic loss-aversion equilibrium for any extended game, and compare it to Nash equilibrium. Comparative statics show that an increase in loss aversion of one player can affect her and other players' payoffs in different directions.
Keywords: loss aversion, reference dependence, equilibrium.
JEL Classification: C72
- 9775 Nonparametric methods and option pricing.
Eric GHYSELS, Valentin PATILEA, Eric RENAULT and Olivier TORRES.
In this paper, we survey some of the recent nonparametric estimation methods which were developed to price derivative contracts. We focus on equity options and start with a so-called model-free approach which involves very little financial theory. Next we discuss nonparametric and semi-parametric methods of option pricing and illustrate the different approaches.
- 9776 Continuously updated extremum estimators.
Valentin PATILEA and Eric RENAULT.
An important class of structural econometric models (nonlinear rational expectations, option pricing, auction models, ...) characterize observable variables as highly nonlinear transformations of some latent variables. These transformations are one-to-one, but they depend on the unknown distribution of the latent variables through the equilibrium of the game and/or the learning process. Therefore numerical complexity of the equilibrium definition generates substantial obstacles for the direct implementation of maximum likelihood inference. This is a particular case of argmax estimators based on a untractable sample based criterion $Q_T[\theta, \lambda(\theta)]$ contaminated by the occurrences of θ in a 'nuisance function' $\lambda(\theta)$ to which corresponds a simple criterion $Q_T[\theta, \lambda(\theta^0)]$ with θ^0 the true, unknown value of the parameter. The natural idea is to replace the unknown value $\lambda(\theta^0)$ by some 'good proxy', say $\lambda(\theta^1)$, to maximize $Q_T[\theta, \lambda(\theta^1)]$ with respect to θ and to get a new, updated estimate which, in turn, can be used for approximating $\lambda(\theta^0)$,... Such steps can be considered for a fixed sample size (iterative M -estimators), or each time new data arrive (recursive estimators). In this paper we present and analyze several iterative and recursive (Robbins-Monro type) estimation procedures of this kind which, at the end, are applied to the class of structural econometric models which motivated this work.
Keywords: Iterative procedures, M -estimators, Robbins-Monro procedures, structural models, latent variables.

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CORE DISCUSSION PAPERS 1997/21

- 9777 Auctioning public goods to groups of agents.
Dirk ALBOTH, Anat LERNER and Jonathan SHALEV.
A profit-maximizing auctioneer can provide a public good to at most one of a number of groups of agents. The groups may have non-empty intersections. Each group member has a private value for the good being provided to the group. We investigate an auction mechanism where the auctioneer provides the good to the group with the highest sum of the agents' bids, only if this sum exceeds a minimum price declared previously by the auctioneer. For the one-group two-bidder case with private values drawn from a uniform distribution we characterize the continuously differentiable symmetric equilibrium bidding functions for the agents, and find the optimal minimum price for the auctioneer when such functions are used by the bidders. We also examine another interesting family of equilibrium bidding functions for this case, with a discrete number of possible bids, and show the relation (in the limit) to the differentiable bidding functions.
Keywords: public goods, auctions, externalities.
JEL Classification: C00, C72, D44, D82, H41
- 9778 *bc - opt*: a branch-and-cut code for mixed integer programs.
Cécile CORDIER, Hugues MARCHAND, Richard LAUNDY and Laurence A. WOLSEY.
A branch-and-cut mixed integer programming system, called *bc-opt*, is described, incorporating most of the valid inequalities that have been used or suggested for such systems, namely lifted 0-1 knapsack inequalities, 0-1 gub knapsack and integer knapsack inequalities, flowcover and continuous knapsack inequalities, path inequalities for fixed charge network flow structure and Gomory mixed integer cuts. The principal development is a set of interface routines allowing these cut routines to generate cuts for new subsets or aggregations of constraints. The system is built using the XPRESS Optimisation Subroutine Library (XOSL) which includes a cut manager that handles the tree and cut management, so that the user only essentially needs to develop the cut separation routines. Results for the MIPLIB3.0 library are presented - 37 of the instances are solved very easily, optimal or near optimal solution are produced for 18 other instances, and of the 4 remaining instances, 3 have 0, +1, -1 matrices for which *bc-opt* contains no special features.
Keywords: mixed integer programming, branch-and-cut, cutting planes.
- 9779 Second order pseudo-maximum likelihood estimation and conditional variance misspecification.
Bernard LEJEUNE.
In this paper, we study the behavior of second order pseudo-maximum likelihood estimators under conditional variance misspecification. We first determine sufficient and essentially necessary conditions for such an estimator to be, regardless of the conditional variance (mis)specification, consistent for the mean parameters when the conditional mean is correctly specified. These conditions imply that, even if mean and variance parameters vary independently, standard PML2 estimators are generally not robust to conditional variance misspecification. Further, we outline sufficient and essentially necessary conditions for a second order pseudo-maximum likelihood estimator to be consistent for both mean and variance parameters when the conditional mean and the conditional variance are jointly correctly specified, and to remain consistent for the mean parameters when the conditional mean is correctly specified but the conditional variance is not jointly correctly specified. Finally, we provide limiting distribution results for this latter robust to conditional variance misspecification class of estimators under different assumptions regarding the degree of misspecification present in the model, show that its asymptotic covariance matrix is bounded and outline its similarities with QGPML1.
Keywords: Pseudo-maximum likelihood methods, misspecified models.
JEL Classification: C13, C30.

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CORE DISCUSSION PAPERS 1997/22

- 9780 Modelling interest rates with a cointegrated VAR-GARCH model.
Luc BAUWENS, Dominique DEPRINS and Jean-Pierre VANDEUREN
We use a bivariate VAR model to model and predict the joint evolution of short term and long term interest rates. We introduce a GARCH effect on the innovations of the model in order to account for the changing volatility of the series. We test the cointegration of the two interest rates, which is implied by a present value relation between the rates. The cointegration test is done both with and without taking account of the GARCH effect. The empirical results for five countries (Belgium, Germany, France, Great Britain and the USA) point to the same conclusions: i) the incorporation of the GARCH part allows to conclude more clearly that a cointegration relation exists; ii) GARCH effects are quite present; and iii) the models are useful for short term predictions of interest rates.
- 9781 A Bayesian approach to dynamic Tobit models.
Steven X. WEI
This paper develops a posterior simulation method for a dynamic Tobit model. The major obstacle rooted in such a problem lies in high dimensional integrals, induced by dependence among censored observations, in the likelihood function. The primary contribution of this research is to develop a practical and efficient sampling scheme for the conditional posterior distributions of the censored (*i.e.* unobserved) data, so that the Gibbs sampler with data augmentation algorithm is successfully applied. The substantial differences between this approach and some existing methods are highlighted. The proposed simulation method is investigated by means of a Monte Carlo study and applied to a regression model of Japanese exports of passenger cars to the U.S. subject to a non-tariff trade barrier.
Keywords: Bayesian inference, dynamic Tobit model, Gibbs sampler with data augmentation, Monte Carlo simulation, truncated normal.
- 9782 Export restraints and horizontal product differentiation.
Nicolas BOCCARD and Xavier WAUTHY.
We consider the effects of export restraints on price competition in the Hotelling model of horizontal product differentiation. We characterise the Nash equilibrium for all possible values of the quota and compare our results with those of Krishna [89]. We show that a foreign producer would choose a Voluntary Export Restraint in the vicinity of the Free Trade Equilibrium. In order to maximise domestic welfare, a government would not necessarily choose complete protectionism nor free trade.
Keywords: Hotelling, optimal quota, price competition.
JEL Classification: D43, F13, L13.
- 9783 Capacity precommitment in Hotelling's model.
Nicolas BOCCARD and Xavier WAUTHY.
We consider the two-stage game proposed by Kreps and Scheinkman [83] in the address model of horizontal differentiation developed by Hotelling. Firms choose capacities in the first stage and then compete in price. We show that capacity precommitment softens price competition drastically. In almost all subgame perfect equilibrium, firms behave as if they were an integrated monopoly *i.e.*, choose capacities which exactly cover the market, so that there is no room for price competition at all. The foundation of this result is that capacity precommitment enables firms to take advantage of the local monopoly structure inherent to the Hotelling model. If furthermore the installation cost for capacity is one fourth of the transportation cost, then this result stands for all SPE. We also provide an interesting treatment of mixed strategies equilibria which is quite new in this literature.

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CORE DISCUSSION PAPERS 1997/23

- 9784 Privatizing social security: a critical assessment.
Pascal BELAN and Pierre PESTIEAU.

The purpose of this paper is to provide a critical evaluation of theoretical models showing that shifting from pay-as-you-go to funded social security schemes can be made Pareto-improving. Further, it argues that what often makes a reform toward funded schemes attractive is a number of additional features that could have been introduced as well in the unfunded social security system. The paper is organized in three main sections. The first presents a taxonomy of social security systems; this allows for showing that in privatization programs the issue is not just moving from unfunded to fully funded techniques, but also, and above all, individualizing the system in such a way that there is no more redistribution. The second shows that funded and pay-as-you-go schemes are perfectly equivalent as long as the payroll taxes paid during the period of inception of the pay-as-you-go scheme are duly invested. Finally, the third section presents two models of Pareto-improving social security reforms and discusses the assumptions on which they rely.

Keywords: social security, privatization, retirement.

JEL Classification: H55, O41, D9, J1.

- 9785 Economic integration as a partition function game.
Massimo MORELLI and Philippe PENELLE.

This paper provides a methodology to study coalition formation problems with externalities and heterogeneous players, when some subset of the players can act as “coalition developers” over time.

The framework provided here allows to explicitly predict the timing of admission to coalitions, the equilibrium coalition structure and payoff distribution, as well as the equilibrium length of the admission game. We derive conditions on the availability of side-payments under which a union chooses to delay the admission of admissible countries. We show that the observed sequencing of admissions to the European Union is not consistent with the existence of perfectly competitive markets to price the admission of candidate countries. Welfare implications are derived.

Keywords: C7, F15.

JEL Classification: Admission paths, partition function, side-payments, European integration.

- 9786 Redistributive taxation and migration under uncertainty.
Manuel LEITE-MONTEIRO.

Redistributive taxation under uncertainty has two functions: not only the redistribution of income across individuals who are *ex ante* different but also the sharing of risk between them. The economic integration of factor markets changes the distribution of income within each country, and so the redistributive policies must be changed to account for those changes. In this paper we show that, when mobile individuals are subject to a residence-based linear income tax, the optimal redistributive policy is dependent not only on the relative size of the economies but also on the timing of the migration process: under the small country hypothesis, there is no redistribution in equilibrium if workers' migration decisions are taken with complete knowledge of incomes. If uncertainty is only solved after mobility has occurred, then it is possible to have redistributive taxation. In this latter case, the magnitude of the tax parameters depends on the size of the countries, i.e., on whether or not the home taxing authorities take foreign utilities as given.

Keywords: Tax competition, Income redistribution, Uncertainty, Labour migration.

JEL Classification: H21, H71, F22

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CORE DISCUSSION PAPERS 1997/24

- 9787 Capital-labor substitution and competitive nonlinear endogenous business cycles.
Jean-Michel GRANDMONT, Patrick PINTUS and Robin de VILDER.

We develop in this paper simple geometrical methods to study local indeterminacy, bifurcations and stochastic (sunspot) equilibria near a steady state, in nonlinear two dimensional economic models. We present stochastic sunspot equilibria, which allows a constructive description of local bifurcations. The latter analysis is relevant when some eigenvalues of the linearized dynamics, near the steady state, have a modulus close to one (“unit root(s)”), as taking into account small nonlinearities generates linear local approximation. These methods are applied to a simple aggregative model (Woodford (JET, 1986)), to study in particular the influence of capital-labor substitution and of the aggregate labor supply wage elasticity, on the occurrence of competitive endogenous deterministic or stochastic fluctuations.

Keywords: Endogenous business cycles, sunspots, indeterminacy of equilibrium, nonlinear dynamics, bifurcations, unit roots.

JEL Classification: E32, C62.

- 9788 Expectations formation and stability of large socioeconomic systems.
Jean-Michel GRANDMONT

This paper attempts to identify, in a framework deliberately stripped of unnecessary technicalities, some of the basic reasons why adaptive learning may or may not lead to stability and convergence to self-fulfilling expectations in large socioeconomic systems where no agent, or collection of agents, can act to manipulate macroeconomic outcomes. It is shown that if agents are somewhat uncertain about the local stability of the system, and are accordingly ready to extrapolate a large range of regularities (trends) that may show up in past small deviations from equilibrium, including divergent ones, the learning dynamics is locally divergent. On the other hand, if agents are fairly sure of the local stability of the system, and extrapolate only convergent trends out of small past deviations from equilibrium, one may get local stability. This “uncertainty principle” does show up in a wide variety of contexts: smooth or discontinuous, finite or infinite memory learning rules, error learning, recursive least squares, Bayesian learning.

Keywords: Learning dynamics, convergence to rational expectations, error learning, least squares learning, Bayesian learning.

JEL Classification: E10, E32, D83, D84.

- 9789 The logarithmic ACD model: an application to market microstructure and NASDAQ.
Luc BAUWENS and Pierre GIOT

This paper introduces the logarithmic autoregressive conditional duration model (Log-ACD model). The logarithmic version allows for more flexibility than the ACD model of Engle and Russel (1995), when additional variables are included in the model. We apply the Log-ACD model to bid/ask prices relative to securities listed on the NASDAQ and investigate the way market makers revise their beliefs on these bid and ask prices. The updating behavior of the market makers is closely linked to the evolution of the liquidity of the market over the trading day.

Keywords: Duration, High frequency data, Liquidity, Market microstructure, NASDAQ.

JEL Classification: C10, C41, G10.

CORE DISCUSSION PAPERS 1997/25

- 9790 Subscription as a price discrimination device.
Jean J. GABSZEWICZ and Nathalie SONNAC
- We propose a model representing a newspaper producer supplying a product which can be acquired by the readers either every day per one unit at a time, or by subscription. The population of potential buyers is differentiated according to the frequency at which they want to read the newspaper. First we identify the optimal pricing policy, namely, the optimal price for issues sold per unit at the newspaper-stall, as well as the optimal subscription fee. Then we show that it is always more profitable to supply the market with both possibilities, — free sale purchase and subscription —, than to concentrate the sales on either of these alternatives.
- Keywords:** Subscription, price discrimination, press industry.
- 9791 Comparison of information structures. device.
Olivier GOSSNER
- Several authors have observed that in interactive decision frameworks, welfare is not monotonic with information in the sense that more information can make agents worse off. This contrasts with Blackwell's comparison of statistical experiments in which more information can only make the statistician better off.
- We introduce the notion of an information structure \mathcal{L} as being richer than another \mathcal{J} when for every game G , all correlated equilibrium distributions of G induced by \mathcal{J} are also induced by \mathcal{L} . If \mathcal{L} is richer than \mathcal{J} , \mathcal{L} can always make all agents as well off than \mathcal{J} .
- We also define \mathcal{J} to be faithfully reproducible from \mathcal{L} when all the players can compute from their information in \mathcal{L} "new information" that reproduces what they could have received from \mathcal{J} . Our main result is that \mathcal{L} is richer than \mathcal{J} if and only if \mathcal{J} is faithfully reproducible from \mathcal{L} .
- Keywords:** Information structure, correlated equilibrium, statistical experiment, value of information.
- JEL Classification:* C72
- 9792 Secure protocols or how communication generates correlation.
Olivier GOSSNER
- Correlated equilibria and communication equilibria are useful notions to understand the strategic effects of information and communication. Between these two models, a protocol generates information through communication. We define a secure protocol as a protocol from which no individual may have strategic incentives to deviate and characterize these protocols.
- Keywords:** Information structure, communication mechanism, correlated equilibrium, communication equilibrium, protocol.
- 9793 Core-theoretic and political stability of international agreements on transfrontier pollution.
Sergio CURRARINI and Henry TULKENS.
- International agreements on transfrontier pollution issues require approval by domestic political institutions. In this paper we employ a voting game theoretic model to characterize the stability of such agreements when each country's participation is conditioned upon a domestic ratification vote. To describe pre-treaty or no treaty situations, we propose a concept of (noncooperative) political equilibrium, and prove its existence. Then, we show that the set of cooperative joint policies (yielding a treaty) that are ratified by all countries is nonempty. Moreover, in our model, the unique agreement so ratified corresponds to the ratio equilibrium allocation of the international economy with the noncooperative equilibrium allocation as initial endowment.
- Keywords:** voting games, core, international cooperation, pollution, political equilibrium.