

- 2000/1 The importance of being small: size effects in international trade.
Joe THARAKAN and Jacques-François THISSE.

Market size and transport costs are important ingredients of international trade. We propose to look at these issues from a different perspective. Using a Hotelling duopoly model with quadratic transport costs, we analyze the welfare effects of international trade between two countries which differ only in size. Our results indicate that in most cases free trade will lead to a decrease in prices. Furthermore, the firm of the small country will benefit from market expansion. Finally, the model predicts that the small country benefits from a move towards free trade whereas the large country may be hurt by the opening to trade.

JEL Classification: F12, L13

Keywords: international trade, nation size, mill pricing, spatial competition.

- 2000/2 Non-standard approaches to integer programming.
Karen AARDAL, Robert WEISMANTEL and Laurence WOLSEY.

In this survey we address three of the principle algebraic approaches to integer programming. After introducing lattices and basis reduction, we first survey their use in integer programming, presenting among others Lenstra's algorithm that is polynomial in fixed dimension, and the solution of diophantine equations using basis reduction. The second topic concerns augmentation algorithms and test sets, including the role played by Hilbert and Gröbner bases in the development of a primal approach to solve a family of problems for all right-hand sides. Thirdly we survey the group approach of Gomory, showing the importance of subadditivity in integer programming and the generation of valid inequalities, as well the relation to the parametric problem cited above of solving for all right hand sides.

JEL Classification: MSC(1991): 90C10, 90C11

Keywords: Integer Programming, Lattice Basis Reduction, Lenstra's Algorithm, Test Sets, Augmentation Algorithms, Gröbner Basis, Test Sets, Asymptotic Group Problem, Subadditivity, Corner Polyhedron.

- 2000/3 Debt-sharing and secession: a generational accounting approach.
Philippe CATTOIR and Frédéric DOCQUIER.

This paper investigates one of the most important financial issues arising from a secession or a country partitioning, namely the sharing of the national public debt. Extending Drèze's distributive neutrality condition, we use the generational accounting technique and propose a dynamic debt-sharing criterion which takes into account both the true debt future generations inherit and their contributive capacity. The equivalence with Drèze's static rule is only obtained in the steady growth framework in the absence of initial regional debt. An application of our criterion to the Belgian case offers striking results.

JEL Classification: H60, H77

Keywords: debt-sharing, public debt, secession, generational accounting, distributive neutrality.

- 2000/4 Information at equilibrium.
Enrico MINELLI and Heracles M. POLEMARCHAKIS.

In a game with rational expectations individuals refine their information with the information revealed by the strategies of other individuals: their elementary acts of other individuals at each state of the world. At a Nash of a game with rational expectations, the information of individuals is essentially symmetric: the same profile is also an equilibrium of a game with symmetric information; and their acts are common knowledge. If each player has a veto act, which yields a minimum payoff that no other profile of strategies attains, then the veto profile is the only Nash equilibrium, and it is an equilibrium with rational expectations and essentially symmetric information; which accounts for the impossibility of speculation.

JEL Classification: D82

Keywords: Nash equilibrium, rational expectations, common knowledge.

- 2000/5 On the cut polyhedron.
Michele CONFORTI, Giovanni RINALDI and Laurence WOLSEY.

The cut polyhedron $cut(G)$ of an undirected graph $G = (V, E)$ is the dominant of the convex hull of all of its nonempty edge cutsets. After examining various compact extended formulations for $cut(G)$, we study some of its polyhedral properties. In particular, we characterize all of the facets induced by inequalities with right-hand side at most 2. These include all of the rank facets of the polyhedron.

- 2000/6 TV-broadcasting competition and advertising.
Jean J. GABSZEWICZ, Didier LAUSSEL and Nathalie SONNAC.

We analyse the rivalry between two TV-channels competing both on the market for audience and the market for advertising. We identify the nature of TV-programs emerging from this competition, and the quantity of advertising that TV-viewers will have to attend at equilibrium. Finally, we examine how a government's regulation of this quantity will affect programs' selection by the channels.

- 2000/7 State-dependent utility and decision theory.
Jacques H. DREZE and Aldo RUSTICHINI.

A survey paper prepared for the *Handbook of Utility Theory*. Covers the axiomatic foundations of decision making under uncertainty when conditional preferences are allowed to be state dependent, leading to an expected state-dependent utility representation. In the context of games against nature, subjective probabilities are not identified from observable choices among games, suggesting recourse to hypothetical preferences. In the context of one-person games with moral hazard, a generalised representation theorem (proved in the Appendix) asserts the existence of a closed convex set O of probabilities in the state space. Choices among games, with associated unobservable strategies, correspond to expected state-dependent utility maximisation, with probabilities chosen in the set O . When that set is full-dimensional, it is uniquely identified. Otherwise, identification is partial, suggesting again recourse to hypothetical preferences, as per a revised version of "conditional expected utility theory". The extent to which the state-dependent utility is identified is the same as that prevailing for the probabilities. The paper includes a discussion of risk aversion with state-dependent preferences; it concludes with a brief survey of applications to the demand for life insurance (a context of games against nature) and for safety (a context of one-person games with moral hazard).

- 2000/8 Does press advertising foster the “Pensée Unique” ?
Jean J. GABSZEWICZ, Didier LAUSSEL and Nathalie SONNAC.

The press industry depends in a crucial way on the possibility of financing an important fraction of its activities by advertising receipts. We show that this induces the editors of the newspapers to moderate the political message they display to their readers in order to make their newspaper more attractive as a media support for the advertisers, fostering thereby the ascent of the “Pensée Unique” ?

- 2000/9 Modelling practical lot-sizing problems as mixed integer programs.
Gaetan BELVAUX and Laurence A. WOLSEY.

In spite of the remarkable improvements in the quality of general purpose mixed integer programming software, the effective solution of a variety of lot-sizing problems depends crucially on the development of tight formulations for the special problem features occurring in practice. After reviewing some of the basic preprocessing techniques for handling safety stocks and multilevel problems, we discuss a variety of aspects arising particularly in small and large bucket (time period) models such as start-ups, changeovers, minimum batch sizes, choice of one or two set-ups per period, etc. A set of applications are described that contain one or more of these special features, and some indicative computational results are presented. Finally to show the variety of techniques that are needed, a slightly different (supply chain) application is presented, for which the a priori addition of some simple mixed integer inequalities based on aggregation leads to important improvements in the results.

Keywords: Lot-sizing, Production Planning, Mixed Integer Programming, Valid Inequalities, Reformulation.

- 2000/10 On knots and dynamics in games.
Stefano DE MICHELIS and Fabrizio GERMANO.

We extend Kohlberg and Mertens' (1986) structure theorem concerning the Nash equilibrium correspondence to show that its graph is not only homeomorphic to the underlying space of games but that it is also unknotted. This is then shown to have some basic consequences for dynamics whose rest points are Nash equilibria.

- 2000/11 Capital income taxation when markets are incomplete.
Mario TIRELLI.

In this paper we investigate the welfare effects of capital income taxation in a standard one commodity general equilibrium model with incomplete markets (GEI) and production. We consider a competitive economy of two periods with uncertainty over a finite number S of possible states of nature revealed in the second period. One perishable commodity is traded on $(S+1)$ spot markets, there are $1 < J < S$ security markets, and trade takes place among a finite number $H > 1$ of consumer types. Securities are equity contracts; claims on second period's returns from production plans which are selected by J firms in the interest of shareholders. The number of such contracts is insufficient to span all possible contingencies; that is we assume that the security markets are incomplete. The central planner is (uniquely) endowed with a system of *ad-valorem* taxes on corporate dividends. If H is not too large, there exist *tax reforms* that have positive welfare effects; yet, tax reforms with opposite effects do also exist. This result has implications for the theory of optimal taxation and social discounting.

JEL Classification: D52, H25, D61, H43

- 2000/12 New upper bounds for maximum-entropy sampling.
Alan HOFFMAN, Jon LEE and Joy WILLIAMS.

We develop and experiment with new upper bounds for the constrained maximum-entropy sampling problem. Our partition bounds are based on Fischer's inequality. Further new upper bounds combine the use of Fischer's inequality with previously developed bounds. We demonstrate this in detail by using the partitioning idea to strengthen the spectral bounds of Ko, Lee and Queyranne and of Lee. Computational evidence suggests that these bounds may be useful in solving problems to optimality in a branch-and-bound framework.

Keywords: experimental design, design of experiments, entropy, maximum-entropy sampling, spectral bound, Lagrangian, Fischer's inequality, branch-and-bound, matching, set partitioning.

- 2000/13 Confidence level solutions for stochastic programming.
Yu. NESTEROV and Jean-Philippe VIAL.

We propose an alternative approach to stochastic programming based on Monte-Carlo sampling and stochastic gradient optimization. The procedure is by essence probabilistic and the computed solution is a random variable. The associated objective value is doubly random, since it depends on two outcomes: the event in the stochastic program and the randomized algorithm. We propose a solution concept in which the probability that the randomized algorithm produces a solution with an expected objective value departing from the optimal one by more than ε is small enough. We derive complexity bounds for this process. We show that by repeating the basic process on independent sample, one can significantly sharpen the complexity bounds.

Keywords: Stochastic programming, Stochastic subgradient, Complexity estimate.

- 2000/14 Cooperative facility location games.
Michel X. GOEMANS and Martin SKUTELLA.

The location of facilities in order to provide service for customers is a well-studied problem in the operations research literature. In the basic model, there is a predefined cost for opening a facility and also for connecting a customer to a facility, the goal being to minimize the total cost. Often, both in the case of public facilities (such as libraries, municipal swimming pools, fire stations, ...) and private facilities (such as distribution centers, switching stations, ...), we may want to find a 'fair' allocation of the total cost to the customers — this is known as the cost allocation problem. A central question in cooperative game theory is whether the total cost can be allocated to the customers such that no coalition of customers has any incentive to build their own facility or to ask a competitor to service them.

We establish strong connections between fair cost allocations and linear programming relaxations for several variants of the facility location problem. In particular, we show that a fair cost allocation exists if and only if there is no integrality gap for a corresponding linear programming relaxation. We use this insight in order to give proofs for the existence of fair cost allocations for several classes of instances based on a subtle variant of randomized rounding. We also prove that it is in general NP-complete to decide whether a fair cost allocation exists and whether a given allocation is fair.

Keywords: facility location, cooperative games, LP relaxation, randomized rounding, core.

- 2000/15 Economic and social security in the twenty-first century, with attention to Europe.
Jacques H. DREZE.

A partly heuristic attempt at exploring long-run policies aimed at a second-best compromise between *ex ante* risk-sharing efficiency and *ex post* productive efficiency. Wage subsidies for low-skilled workers financed by taxes on high wages are advocated, together with improved risk sharing between capital and labour, between generations and between the countries belonging to EMU. The scope of the advocated policies is limited by considerations of moral hazard, time consistency and fiscal competition. Also, estimates of some key economic parameters remain very imprecise. Several avenues of further research are identified.

JEL Classification: D80, H20, E60

Keywords: social insurance, moral hazard, fiscal competition, intergenerational risk sharing, international risk sharing.

- 2000/16 An algebraic index theorem for non-smooth economies.
Gaël GIRAUD.

In this paper, we prove an existence theorem for equilibria in production economies with increasing returns, which generalizes the classic results on this topic. In particular, we eliminate both the free-disposal assumptions and any smoothness requirements on the boundary of the production sets. For this purpose, we propose a new definition of the topological degree for non-convex-valued correspondences defined on non-smooth topological manifolds.

JEL Classification: C62, D51

Keywords: Non-smooth production, topological degree, local homology, increasing returns.

- 2000/17 On the indices of zeros of nash fields.
Stefano DE MICHELIS and Fabrizio GERMANO.

Given a game and a dynamics on the space of strategies it is possible to associate to any component of Nash equilibria, an integer, this is the index, see Ritzberger (1994). This number gives useful information on the equilibrium set and in particular on its stability properties under the given dynamics.

We prove that indices of components always coincide with their local degrees for the projection map from the Nash equilibrium correspondence to the underlying space of games, so that essentially all dynamics have the same indices. This implies that in many cases the asymptotic properties of equilibria do not depend on the choice of dynamics, a question often debated in recent literature. In particular many equilibria are asymptotically unstable for any dynamics. Thus the result establishes a further link between the theory of learning and evolutionary dynamics, the theory of equilibrium refinements and the geometry of Nash equilibria.

The proof holds for very general situations that include not only any number of players and strategies but also general equilibrium settings and games with a continuum of pure strategies such as Shapley-Shubik type games, this case will be studied in a forthcoming paper.

- 2000/18 On the index and asymptotic stability of dynamics.
Stefano DE MICHELIS.

Given a compact connected component of zeros of a vector field, we give a necessary condition for its asymptotic stability in terms of its index and Euler characteristic.

- 2000/19 Constrained suboptimality and financial innovation in GEI with a single commodity.
Mario TIRELLI.

In this paper we exploit *global analysis* to explore welfare properties of a standard one-commodity GEI, under different notions of constrained Pareto optimality. In a unifying framework we revise and extend some of the leading results of the literature on incomplete markets and government intervention, including those concerning *financial innovation*.

JEL Classification: D52, D60, G10

- 2000/20 Subscription mechanisms for network formation.
Suresh MUTUSWAMI and Eyal WINTER.

We analyze a model of network formation where the costs of forming links are publicly known but an individual's benefits are not known to the social planner. The objective is to design a mechanism which not only ensures that an efficient network always forms in equilibrium but also ensures that the resulting net payoffs to the agents are equitable. We propose two mechanisms towards this end; in the first, agents announce sequentially the set of players with whom they wish to form links and a cost contribution. We show that all subgame perfect equilibria of this game result in the formation of an efficient network but the resulting net payoffs are asymmetric. The second mechanism corrects this asymmetry through a two-stage variant of the first mechanism. We also discuss an extension of the basic model to cover the case of directed graphs and give conditions under which the proposed mechanisms are immune to deviations by coalitions.

- 2000/21 Competitive selling mechanisms: the delegation principle and farsighted stability.
Frank H. PAGE, Jr.

We analyze the problem of competitive mechanism design within the context of a model of product differentiated oligopoly. In our model, firms compete via their catalogs, that is, via the sets of products (broadly defined) and prices firms offer to the market (i.e., catalogs are the primitives, while selling mechanisms are derived). In an oligopoly setting, participation by an agent in any one firm's catalog is endogenously determined. This fact leads naturally to a modification of the classical notion of incentive compatibility for mechanisms. We extend the classical notion of incentive compatibility to take into account endogenous participation, introducing the notion of participation incentive compatibility (PIC). Our main contribution is a characterization of all PIC selling mechanisms in terms of catalogs. In particular, we show that a selling mechanism is PIC if and only if there exists a unique, minimal catalog profile which implements the mechanisms. We call this characterization the *delegation principle* (Theorem 4). Using the delegation principle, we conclude that in order to solve the problem of competitive mechanism design, an essentially cooperative problem, it is sufficient to consider only the underlying noncooperative problem of catalog choice by firms. Moreover, using the delegation principle we show that corresponding to each PIC mechanism there is a unique profile of nonlinear pricing schedules which implements the mechanism - thus, extending the taxation principle to problems of competitive nonlinear pricing (Theorem 5). A second contribution is our application of the notion of farsighted stability to the problem of competitive mechanism design. We show that for any approximating finite subgame (of catalog choice), the farsightedly stable set of catalog profiles (and hence the farsightedly stable set of nonlinear pricing schedules) is nonempty (Theorem 10).

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- 2000/22 Distributive politics: does electoral competition promote inequality ?
Jean-François LASLIER and Nathalie PICARD
- Within the framework of pure redistribution (dividing one unit of a homogeneous good among identical individuals), the paper analyses the redistributions that arise from Downsian two-party electoral competition. It appears that the strategic behavior of vote-maximizing parties lead them to propose divisions which are not far from the egalitarian one.
- 2000/23 On the Wagner-Whitin lot-sizing polyhedron.
Olivier PEREIRA and Laurence WOLSEY
- We study a family of unbounded polyhedra arising in the study of uncapacitated lot-sizing problems with Wagner-Whitin costs. With n the number of periods, we completely characterize the bounded faces of maximal dimension, and derive an $O(n^2)$ algorithm to express any point within the polyhedron as a convex combination of extreme points and extreme rays. We also study adjacency on the polyhedra, and give a simple $O(n)$ test for adjacency. Finally we observe that if we optimize over these polyhedra, the face of optimal solutions can be found in $O(n^2)$.
- Keywords:** Polyhedra, Adjacency, Maximal Faces, Dual Algorithm, Lot-Sizing, Wagner-Whitin costs.
- 2000/24 The identification of preferences from equilibrium prices.
Pierre-André CHIAPPORI, Ivar EKELAND, Félix KUBLER and Heracles M. POLEMARCHAKIS
- The fundamentals of an exchange economy, the preferences of individuals, can be identified from the competitive equilibrium correspondence, which associates equilibrium prices of commodities to allocations of endowments; the argument extends to production economies. The essential step is the identification of fundamentals from aggregate demand as a function of the prices of commodities and the distribution of income. The graph of the equilibrium correspondence or of the aggregate demand function satisfy non - trivial restrictions. The identification of fundamentals allows for the prediction of the response of individuals and the economy to changes in the organization of production and exchange, while restrictions on the equilibrium correspondence or the aggregate demand function imply that general equilibrium theory has testable implications.
- JEL Classification:** D10, D50
Keywords: aggregation, equilibrium, identification, testability.
- 2000/25 The identification of preferences from equilibrium prices under uncertainty.
Pierre-André CHIAPPORI, Ivar EKELAND, Félix KUBLER and Heracles M. POLEMARCHAKIS
- The competitive equilibrium correspondence, which associates equilibrium prices of commodities and assets with allocations of endowments, identifies the preferences and beliefs of individuals under uncertainty; this is the case even if the asset market is incomplete.
- JEL Classification:** D52, D80
Keywords: equilibrium, uncertainty, identification.
- 2000/26 Equilibrium and arbitrage in incomplete asset markets with fixed prices.
Jean-Jacques HERINGS and Heracles M. POLEMARCHAKIS
- At arbitrary prices of commodities and assets, fix-price equilibria exist under weak assumptions: endowments need not satisfy an interiority condition, utility functions need only satisfy very weak monotonicity requirement, and the asset return matrix allows for redundant assets. Prices of assets may permit arbitrage. At equilibrium, though restricted through endogenously determined trading constraints, arbitrage possibilities may persist; in an example, an individual holds an arbitrage portfolio.
- JEL Classification:** D45, D52, D60
Keywords: incomplete asset market, fix-price equilibrium, arbitrage.

- 2000/27 Stable dynamics in transportation systems.
Yu. NESTEROV and André de PALMA

We present a new class of transportation systems, the stable dynamics models, which provides a natural link between the static and dynamic traffic network models. They can be seen as steady states of dynamic networks (flows are constant in time). These models turn out to be very easy to study analytically for simple networks. Moreover, they can be extended for large networks, for which efficient (and standard) algorithms to solve for equilibrium can be derived. We also present a formulation for the endogenous origin-destination case. Finally, this class of models leads to very natural and simple calibration methods.

Keywords: Convex optimization, static models, shortest path, variational inequalities, stable dynamics.

- 2000/28 Infinitely lived representative agent exchange economy with myopia.
Stefano LOVO

We consider a family of infinitely long lived representative agent economy where, each period, agents can only decide consumption plan of finite dimension n . It is shown that myopia generates indeterminacy and monetary equilibrium in infinitely lived representative economy. Any invertible dynamics with at most one monetary steady state that is increasing in the quantity of money can represent the set of equilibria of an appropriate myopic economy.

- 2000/29 Delays in claiming social security benefits.
Courtney COILE, Peter DIAMOND, Jonathan GRUBER and Alain JOUSTEN

This paper focuses on Social Security benefit claiming behavior, a take-up decision that has been ignored in the previous literature. Using financial calculations and simulations based on an expected utility maximization model, we show that delaying benefit claim for a period of time after retirement is optimal in a wide variety of cases and that gains from delay may be significant. We find that approximately 10% of men retiring before their 62nd birthday delay claiming for at least one year after eligibility. We estimate hazard and probit models using data from the New Beneficiary Data System to test four cross-sectional predictions. While the data suggest that too few men delay, we find that the pattern of delays by early retirees is generally consistent with the hypotheses generated by our theoretical model.

- 2000/30 Teaching versus research: a model of state university competition.
Elena DEL REY

This paper analyzes a competition game between two universities that teach and research in the same jurisdiction. The resulting equilibrium is unique and symmetric but differs according to preferences, technologies and public policy. The budget for university finance is exogenously given and consists of lump-sum amount and a per-student allocation. Under this finance structure, we are able to identify four types of equilibria characterized, respectively, by full-time teaching, full-time research, selective teaching plus research and mass teaching plus research. Conditions for each of them to take place are derived. By manipulating the parameters of the finance scheme the government can, in some cases, determine final levels of research and education quality.

JEL Classification: H8, I2, L3

Keywords: education, research, university competition.

- 2000/31 Indivisibility and divisibility polytopes.
Don COPPERSMITH and Jon LEE

We study the polytopes of binary n -strings that encode (positive) integers that are not divisible by a particular positive integer p – the *indivisibility polytopes*, as well as the more general “clipped cubes”. Also, we discuss a potential application to factoring. Finally, we present some results concerning divisibility polytopes.

Keywords: integer program, polytope, clipped cube, totally dual integral, ideal matrix, generalized set covering, binary encoding, divisible, factoring.

- 2000/32 Prospective aid and indebtedness relief: A proposal.
Lode BERLAGE, Danny CASSIMON, Jacques DREZE and Paul REDING

Primary needs of human development are not met in poor development countries. Although ambitious goals have been set by the international community to meet specific human development targets by 2015, Official Development Aid is lagging and excessive external debt continues to drain much needed resources from poor countries despite the recent HIPC (Highly Indebted Poor Countries) Initiative. This paper outlines a 15-year program for implementing the 2015 Human Development targets while resolving fully the debt overhang problem for a set of 49 poor countries. The proposal requires additional contributions from 23 rich countries amounting to 0.1 of 1% of their GDP over each of the 15 years. Although only a small part of the effort would take the form of debt cancellation, the outstanding debt of the 49 poor countries would be totally extinct by year 2015. The program, to be implemented in a multilateral framework in which all interested parties have an effective voice, relies on several basic premises: a long term commitment by donors; a fair burden sharing among creditors; a fair distribution of newly available resources among poor countries, heavily indebted or not; a targeting of these resources to human development programs; a conditionality guaranteeing reasonable aid effectiveness.

- 2000/33 Non redundancy of high order moment conditions for efficient GMM estimation of weak AR processes.

Laurence BROZE, Christian FRANCO and Jean-Michel ZAKOIAN

This paper considers GMM estimation of autoregressive processes. It is shown that, contrary to the case where the noise is independent (see Kim, Qian and Schmidt (1999)), using high-order moments can provide substantial efficiency gains for estimating the AR(p) model when the noise is only uncorrelated.

JEL Classification: C13, C22

Keywords: autoregressive process, efficiency gains, GMM, empirical autocorrelations, Yule-Walker estimator.

- 2000/34 Life-span and the determinacy of equilibrium in economies of overlapping generations.
Stefano DEMICHELIS and Heracles M. POLEMARCHAKIS

Equilibrium paths in an economy of overlapping generations are determinate.

Time is either discrete or continuous; in either case, it extends into the infinite future and, possibly, the infinite past. There is one, non-storable commodity at each date. The economy is stationary; intertemporal preferences are logarithmic; the endowments and discount factors of individuals need not depend continuously on time.

With continuous time, equilibrium paths of prices are smooth; this, even for endowments and discount factors of individuals that do not depend continuously on time.

With discrete time, as the number of periods in the life-span of individuals increases, equilibrium paths converge to the continuous time solutions.

If time extends infinitely into the infinite past as well as into the infinite future, in continuous time, all non-stationary equilibrium paths of prices are time-shifts of a single path; in addition, there are two stationary solutions; in discrete time, there is a one dimensional family of non-stationary solutions, up to time-shift; however the indeterminacy vanishes as the number of periods in the life-span of individuals tends to infinity.

If, alternatively, time has a finite starting point, in discrete time the degree of indeterminacy increases with the life-span of individuals, and, in continuous time, it is infinite; however these are families of exponentially decreasing oscillations which, although they may exhibit pseudo-chaotic behaviour for a while, as time tends to infinity they all get damped, and asymptotic behaviour is that of the economy that originates in the infinite past.

JEL Classification: D50, D90

Keywords: life-span, continuous time, overlapping generations, determinacy.

- 2000/35 Macroeconomic implications of switching the social security trust and towards a greater investment in equities.
Pierre PESTIEAU and Uri M. POSSEN

This paper shows that shifting the portfolio allocation of the social security trust fund towards more equity investment, *ceteris paribus*, reduces the aggregate capital stock as well as the average consumption level of all individuals except the poor retirees who receive an increase but at the cost of a large increase in uncertainty. If a larger capital stock is desired, reducing the supply of publicly supplied goods is the most effective tool. That change also increases the average private consumption of all the young and the wealthy retirees although it does reduce the average consumption and uncertainty of the old non-savers.

- 2000/36 Growth and equality effects of pension plans.
Frédéric DOCQUIER and Oliver PADDISON

We investigate the balanced growth effects of pension plans on the rate of growth and on equality in a closed economy where individual decisions about education are the engine of growth. We distinguish between pay-as-you-go and fully-funded pension systems and differentiate between *three* different benefit rules: a Beveridgean one (benefits are identical for all agents), a Bismarckian (earnings related) one depending on one's entire earnings history or a Bismarckian one depending on one's partial earnings history. Interestingly, in the latter case the steady state rate of growth is increasing in the rate of contributions.

JEL Classification: H55, I22, O41, D63

Keywords: Public Pensions, Education, Growth, Inequality.

- 2000/37 A spatial voting model where proportional rule leads to two-party equilibria.
Francesco DE SINOPOLI and Giovanna IANNANTUONI

In this paper we show that in a simple spatial model where the government is chosen under strict proportional rule, if the outcome function is a linear combination of parties' positions, with coefficients equal to their share of seats, only a two-party voting equilibrium basically exists. The two parties taking a positive number of votes are the two extremist ones. Applications of this result include an extension of the well-known Alesina and Rosenthal's model of divided government as well as a modified version of Besley and Coate's model of representative democracy. This result cannot be extended to a general outcome function but, however, when the policy is determined by the two leading parties, in pure strategies, only two-party equilibria can emerge. Analogous result holds for coalitions of parties.

JEL Classification: C72, D72

Keywords: Voting, Proportional Rule, Nash Equilibria.

- 2000/38 Bayesian non-linear modellings of the short term US interest rate: The help of non-parametric tools.

Michel LUBRANO

This paper is concerned with the empirical investigation of models of the US short term interest rate, using a mixture of classical non-parametric methods and of Bayesian parametric methods. The shape of the drift and volatility functions of the usual diffusion equation are first investigated using a preliminary non-parametric analysis. The paper then develops a Bayesian method for comparing models which is based on the ability of a model to minimise the Hellinger distance between the posterior predictive density and the density of the observed sample. A discretisation of the usual diffusion equation is estimated with different parameterisations which range from variants of the constant elasticity of variance model to various switching models which draw their justifications from the preliminary non-parametric analysis. The paper concludes by some implications for the term structure. It appears that a model good at reproducing the data density is not necessarily the best for simulating the yield curve.

JEL Classification: C11, C14, C22, C52, E43

Keywords: Bayesian econometrics, time series, non-parametric analysis, model evaluation, non-linear modelling, interest rates, term structure.

- 2000/39 Solving multi-item capacitated lot-sizing problems with setup times by branch-and-cut.
Andrew J. MILLER, George L. NEMHAUSER and Martin W.P. SAVELSBERGH

Instances of the multi-item capacitated lot-sizing problem with setup times (MCL) often appear in practice, either in standard form or with additional constraints, but they have generally been difficult to solve to optimality. In MCL demand for multiple items must be met over a time horizon, items compete for a shared capacity, and each setup uses up some of this capacity. In this paper we use results concerning the polyhedral structure of simplified models obtained from a single time period of MCL to obtain strong valid inequalities for MCL. To the best of our knowledge, these inequalities are the first to consider demand for multiple items and the joint capacity restriction simultaneously. We also discuss how to implement these inequalities successfully in a branch-and-cut algorithm. Our computational results suggest that our contributions represent significant progress in solving instances of MCL.

Keywords: Mixed integer programming, cutting planes, production planning, capacitated lot-sizing, setup times.

- 2000/40 Sunspot equilibria in a monetary economy with capital accumulation.
Gaetano BLOISE and Francesco MAGRIS

In this paper, we consider the determinacy of equilibrium prices, interest rate and income in an economy with liquidity constraints and capital accumulation. In particular, we show that, even though no extrinsic uncertainty affects fundamentals, under some conditions, rational expectations equilibria exist in which prices and quantities exhibit repetitive and persistent fluctuations. To prove the existence of such sunspot equilibria, we introduce a technique of general applicability to nonlinear macroeconomic models.

Keywords: Money, capital accumulation, indeterminacy, sunspot equilibrium, invariant set.

- 2000/41 A simple measure of risk aversion in the large and an application.
Parkash CHANDER

We introduce a simple measure of risk aversion in the large. Besides satisfying properties which are conceptually analogous to the usual properties of the Arrow-Pratt measure, the index of risk aversion in the large leads to a stronger concept of decreasing risk aversion, which necessarily implies decreasing absolute risk aversion but not necessarily non-increasing relative risk aversion. The index also leads to a recursive procedure for refining the set of $vN - M$ utility functions. We show that the majority of refinements considered in the theory of multiple risk bearing including that of mixed risk aversion can be obtained from this procedure. Finally, as an illustration, we apply the measure to characterize individual behaviour under uncertainty in the principal-agent model of optimal income tax enforcement in which the risks involved are indeed large.

JEL Classification: D80, D81, D82, H21

Keywords: expected utility, risk aversion, certainty equivalent, multiple risk bearing, principal-agent, audit probability.

- 2000/42 On the econometric estimation of the distance function representation of a production technology.
Tim COELLI

Recent developments in the econometric estimation of multi-output, multi-input distance functions have provided a promising new solution to the single-output restriction implicit in the standard production function. However, a suspicion that regressor endogeneity may introduce possible simultaneous equations bias has concerned some econometricians. In this paper we show that, under profit maximising behaviour, distance functions face no greater danger from such bias than their production function cousins. Furthermore, we prove that ordinary least squares (OLS) provides consistent estimates of an input distance function under an assumption of cost minimising behaviour. We also prove that OLS provides consistent estimates of an output distance function under an assumption of revenue maximising behaviour. These results are established for the Cobb-Douglas and translog functional forms, which are the two most commonly used functional forms in applied analyses. Our results provide strong support for the direct estimation of distance functions, and indicate that the instrumental variables (IV) methods, proposed by some authors, may not be required in many cases.

JEL Classification: C15, C21, C31, D20

Keywords: distance function, endogeneity, simultaneous equations bias.

- 2000/43 Identifying long-run behaviour with non-stationary data.
Luc BAUWENS and John HUNTER

Results for the identification of non-linear models are used to support the traditional form of the order condition by sufficient conditions. The sufficient conditions reveal a two step procedure for firstly checking generic identification and then testing identifiability. This approach can be extended to sub-blocks of the system and it generalizes to non-linear restrictions. The procedure is applied to an empirical model of the exchange rate, which is identified by diagonalising the system.

JEL Classification: C10, C22

Keywords: Cointegration, Identification, Identifiability, Order Condition, Sufficient Conditions.

- 2000/44 Monetary equilibria.
Jacques H. DREZE and Heracles M. POLEMARCHAKIS

The introduction of banks that issue money and supply balances and pay out their profits as dividends is the natural modification of the model of general competitive equilibrium that encompasses monetary economies with an operative transactions technology.

Monetary policy sets nominal rates of interest and accommodates the demand for balances; alternatively, it sets the supply of balances and rates of interest adjust for money markets to clear.

Competitive equilibria exist.

Under uncertainty, monetary policy fails to determine the distribution of the rate of inflation or the allocation of resources at equilibrium. If, in addition to rates of interest, monetary policy sets the prices of contingent loans subject to no-arbitrage constraints, or targets the distribution of the terminal level of prices, it lifts the multiplicity.

JEL Classification: D50, E40, E50

Keywords: money, equilibrium, monetary policy.

- 2000/45 Intraday value-at-risk.
Pierre GIOT

In this paper, we apply a collection of parametric (Normal, Normal GARCH, Student GARCH, RiskMetrics and high-frequency duration models) and non-parametric (empirical quantile, extreme distributions models) Value-at-Risk (VaR) techniques to *intraday* data for three stocks traded on the New York Stock Exchange. Because of the small time horizon of the intraday returns (15 and 30 minute returns), intraday VaR can be useful to market participants (traders, market makers) involved in frequent trading. As expected, the volatility features an important intraday seasonality, which must be removed prior to using the VaR models. The estimation and assessment of the VaR techniques indicate that the data displays a high kurtosis (fat tails), and that VaR models should take this important feature into account. More particularly, Student GARCH, empirical quantile and extreme distributions models perform relatively well.

JEL Classification: C22, C41, C53, G10

Keywords: Intraday volatility, Intraday Value-at-Risk, Duration models, NYSE.

2000/46 Auctions with discrete increments: a structural econometric approach based on dominated strategies.

Frédéric JOUNEAU and Olivier TORRES

We propose a structural econometric evaluation for auctions with discrete increments. Although very common in practice, this kind of mechanism raises many theoretical difficulties. First, there are no closed form equilibrium strategies. Thus the econometrician cannot rely on a single formula to build a model. Second, the discrete nature of the outcome complicates the inference.

Our econometric model is built on the weak assumption that bidders do not play some given dominated strategies. This implies that our results remain valid for many different kinds of equilibrium concepts. The specification of our model allows the computation of a Maximum Likelihood Estimator. Usual asymptotic tests and confidence regions derived from the likelihood function are shown to be unreliable. A new exact inference method proposed by Dufour [1998] is implemented to circumvent this difficulty. The procedure is applied to an auction in which travel agents bid to discount airline tickets.

From an economic viewpoint, we find that although the profit of the travel agents may be small, it is very unlikely that competition is tight. We also compare the rent kept by the winner of a discrete increment auction with that of a continuous auction. Our data show that the number of players is crucial. If the number of player is small, then the winning price is smaller when the tick is zero. In this case, the Vickrey auction is dominated (from the risk-neutral principal viewpoint) by the discrete increment mechanism. This may explain why we observe substantial ticks in many actual auction mechanisms.

Keywords: Auctions with discrete increments, finite sample inference, simulated inference.

2000/47 Dynamic knapsack sets and capacitated lot-sizing.

Marko LOPARIC, Hugues MARCHAND and Laurence A. WOLSEY

A dynamic knapsack set is a natural generalization of the 0-1 knapsack set with a continuous variable studied recently. For dynamic knapsack sets a large family of facet-defining inequalities, called dynamic knapsack inequalities, are derived by fixing variables to one and then lifting. Surprisingly such inequalities have the simultaneous lifting property, and for small instances provide a significant proportion of all the facet-defining inequalities.

We then consider single-item capacitated lot-sizing problems, and propose the joint study of three related sets. The first models the discrete lot-sizing problem, the second the continuous lot-sizing problem with Wagner-Whitin costs, and the third the continuous lot-sizing problem with arbitrary costs. The first set that arises is precisely a dynamic knapsack set, the second an intersection of dynamic knapsack sets, and the unrestricted problem can be viewed as both a relaxation and a restriction of the second. It follows that the dynamic knapsack inequalities and their generalizations provide strong valid inequalities for all three sets.

Some limited computation results are reported as an initial test of the effectiveness of these inequalities on capacitated lot-sizing problems.

Keywords: Knapsack sets, valid inequalities, simultaneous lifting, lot-sizing, Wagner-Whitin costs.

- 2000/48 Institutional rigidities and employment rigidity in the Italian large industrial firms.
Giuseppe RUSSO and David VEREDAS

Many indicators (OECD 1994) show that the Italian labour market is characterised by a strong pro-workers and pro-unions legislation. This is usually interpreted as a high degree of rigidity. It is known that, in response to shocks, firms in rigid labour markets tend to trade workers adjustment off individual working hours adjustment (Abraham-Houseman (1994)). We analyse this trade-off for the Italian large industrial firms, using the Kalman filter to get the impulse-response functions of employment and working hours to permanent and temporary shocks. We find that in the first 80s the terms of the trade off have changed, and employment has become more responsive to shocks. Firms seem thus to have circumvented the regulation: after the pro-workers “institutional push” of the ‘70s, a process of capital/labour substitution has allowed them to re-form their profit margins and to minimise the labour input. Institutions have tried to incentivate new hirings reducing the bias in favour of workers. Consequently, a deregulation process started in 1983-84 is changing the Italian labour market. Nonetheless, deregulation *per se* is unlikely to cause new hirings in an environment where the labour input has been minimised.

JEL Classification: C10, C32, J23

Keywords: institutions, specificity, Kalman filter.

- 2000/49 A branch-and-cut algorithm for the single commodity uncapacitated fixed charge network flow problem.

Francisco ORTEGA and Laurence A. WOLSEY

We present a branch-and-cut algorithm to solve the single commodity uncapacitated fixed charge network flow problem, which includes the Steiner tree problem, uncapacitated lot-sizing problems, and the fixed charge transportation problem as special cases. The cuts used are simple *dicut* inequalities and their variants. A crucial problem when separating these inequalities is to find the right cut set on which to generate the inequalities. The prototype branch-and-cut system, *bc – nd* includes a separation heuristic for the *dicut* inequalities, and problem specific primal heuristics, branching and pruning rules. Computational results show that *bc – nd* is competitive compared to a variety of special purpose algorithms for problems with explicit flow costs.

We also examine how general purpose MIP systems perform on such problems when provided with formulations that have been tightened a priori with *dicut* inequalities.

Keywords: Network Design, Fixed Charge, Branch and Cut, Dicut Inequalities, Branching, Heuristics, Minimum cost flow.

- 2000/50 A simple proof of existence of equilibrium in a one sector growth model with bounded or unbounded returns from below.

Jorge DURAN and Cuong LE VAN

We analyze a Ramsey economy when net investment is constrained to be non negative. We prove existence of a competitive equilibrium when utility need not be bounded from below and the Inada-type conditions need not hold. The analysis is carried out by means of a direct and technically standard strategy. This direct strategy (a) allows us to obtain detailed results concerning properties of competitive equilibria, and (b) is amenable to be easily adapted for the analysis of analogous models often found in macroeconomics.

JEL Classification: C62, D51, E13

Keywords: Ramsey model, one sector growth model, non negative net investment, competitive equilibrium.

- 2000/51 Combining problem structure with basis reduction to solve a class of hard integer programs.
 Quentin LOUVEAUX and Laurence A. WOLSEY

Recently Aardal et al. [2] have successfully solved some small difficult equality constrained integer programs by using basis reduction to reformulate the problems as inequality constrained integer programs in a different space. Here we adapt their method to solve integer programs that are larger, but have special structure. The practical problem motivating this work has variables x_{ij} and is a variant of the market share problem. More formally the problem can be viewed as finding a matrix $X \in \mathbb{Z}_+^{m \times n}$ satisfying $XA = C, BX = D$ where A, B, C, D are matrices of compatible dimensions, and the approach requires us to find a reduced basis of the lattice $\mathcal{L} = \{X \in \mathbb{Z}^{n \times n} : XA = 0, BX = 0\}$.

The main topic of this paper is a study of the lattice \mathcal{L} . It is shown that an integer basis of \mathcal{L} can be obtained by taking the Kronecker product of vectors from integer bases of two much smaller lattices. Furthermore the resulting basis is a reduced basis if the integer bases of the two small lattices are reduced bases, and a suitable ordering is chosen.

Finally some limited computational results are presented showing the benefits of making use of the problem structure.

Keywords: Integer programming, basis reduction, lattices, market share problem.

- 2000/52 On the polyhedral structure of a multi-item production planning model with setup times.
 Andrew J. MILLER, George L. NEMHAUSER and Martin W.P.SAVELSBERGH

We present and study a mixed integer programming model that arises as a substructure in many industrial applications. This model provides a relaxation of various capacitated production planning problems, more general fixed charge network flow problems, and other structured mixed integer programs. After distinguishing the general case, which is \mathcal{NP} -hard, from a polynomially solvable case, we analyze the polyhedral structure of the convex hull of this model, as well as of a strengthened LP relaxation. Among other results, we present valid inequalities that induce facets of the convex hull in the general case. These inequalities suffice to solve this model by linear programming in the polynomially solvable case mentioned above, and they have proven computationally effective in solving capacitated lot-sizing problems (see also Miller et al. [2000a, 2000b]).

Keywords: Mixed integer programming, production planning, polyhedral combinatorics, capacitated lot-sizing, fixed charge network flow.

- 2000/53 Endogenous business cycles and business formation with strategic investment.
 Claude d'ASPREMONT, Rodolphe DOS SANTOS FERREIRA and Louis-André GERARD-VARET

We study an endogenous business cycle model with Cournotian monopolistic competition and an endogenous number of firms in each sector. Our model is a simple general equilibrium macroeconomic model introducing overlapping generations both of consumers *and* firms. Firms strategically decide on investment in the first period of their life, and compete à la Cournot in the second period. Investment is taken to be in human capital or technological know-how, to have spillover effects and to be formed from simple labour supplied by young consumers in anticipation of the profit share they get when old. It is Cournot competition that allows to analyze the variation of monopoly power along the cycle, since the number of firms is endogenized. As this number increases, firms behave more and more competitively. The properties along the cycle are generated by business formation. They will include the counter-cyclicality of markups and prices, the pro-cyclicality of the number of firms and of real wages.

- 2000/54 Ad valorem and per unit taxation in an oligopoly model.
Lisa GRAZZINI

This paper compares the welfare effects of ad valorem and per unit commodity taxation, in a model of oligopolistic interaction. Our main result is that, when the number of consumers is sufficiently high, per unit taxes welfare dominate ad valorem taxes.

JEL Classification: H22, L13, C72, D51

Keywords: Imperfect competition, strategic market game, commodity taxation.

- 2000/55 Information advantage and dominant strategies in second-price auctions.
Ezra EINY, Ori HAIMANKO, Ram ORZACH and Aner SELA

We study a general model of common-value second-price auctions with differential information. We show that one of the bidders has an information advantage over the other bidders if and only if he possesses a dominant strategy. A dominant strategy is, in fact, unique, and is given by the conditional expectation of the common value with respect to his information field. Furthermore, when a bidder has information advantage, other bidders cannot make a profit.

JEL Classification: C72, D44, D82

Keywords: common-value second-price auctions, differential information, dominant strategies, information advantage.

- 2000/56 Price symmetry in a duopoly with congestion.
Ori HAIMANKO and Richard STEINBERG

We show that in a duopoly operating in a congested market, with a general congestion function and an arbitrary distribution of consumer disutility for congestion, there cannot exist an asymmetric Nash equilibrium. We also show that whenever an equilibrium does exist it is unique. Closed form expressions for the symmetric equilibrium prices and profits are provided.

JEL Classification: C72, D43

Keywords: duopolistic pricing, congestion, symmetric equilibria, covered market.

- 2000/57 On the strategic origin of Brownian Motion in finance.
Bernard DE MEYER and Hadiza MOUSSA SALEY

This paper is concerned with the strategic use of a private information on the stock market. A repeated auction model is used to analyze the evolution of the price system on a market with asymmetric information.

The model turns out to be a zero-sum repeated game with one-sided information, as introduced by Aumann and Maschler.

The stochastic evolution of the price system can be explicitly computed in the n times repeated case. As n grows to ∞ , this process tends to a continuous time martingale related to a Brownian Motion.

This paper provides in this way an endogenous justification for the appearance of Brownian Motion in finance theory.

- 2000/58 Public versus private insurance: a political economy argument.
Jean HINDRIKS

This paper analyzes the political support for a public insurance in the presence of a private insurance alternative. The public insurance is compulsory and offers a uniform insurance policy. The private insurance is voluntary and can offer different insurance policies to different individual risks. We show that adverse selection on the private insurance market can lead a majority of individuals to prefer public insurance over private insurance, even if the median risk is below the average risk (so that the median ends up subsidizing high-risk individuals). We also show that more risk aversion always leads to a greater political support for public insurance and that a mixture of public and private insurance is politically non sustainable. Lastly, we demonstrate how progressively more powerful information technology may help the private insurance market to mitigate the adverse selection problem and reduce the demand for public insurance threatening its political sustainability.

JEL Classification: H51, H23

Keywords: voting, insurance, adverse selection.

- 2000/59 From evolutionary to strategic stability.
Stefano DEMICHELIS and Klaus RITZBERGER

A component of Nash equilibria is (dynamically) *potentially stable* if there exists an evolutionary selection dynamics from a broad class for which the component is asymptotically stable. A necessary condition for potential stability is that the component's index agrees with its Euler characteristic. Second, if the latter is nonzero, the component contains a *strategically stable set*. If the Euler characteristic would be zero, the dynamics (which justifies potential stability) could be slightly perturbed so as to remove all zeros close to the component. Hence, any *robustly potentially stable* component contains equilibria which satisfy the strongest rationalistic refinement criteria.

- 2000/60 A comparison of financial duration models via density forecasts.
Luc BAUWENS, Pierre GIOT, Joachim GRAMMIG and David VEREDAS

Using density forecasts, we compare the predictive performance of duration models that have been developed for modelling intra-day data on stock markets. Our model portfolio encompasses the autoregressive conditional duration (ACD) model, its logarithmic version (Log-ACD), the threshold ACD (TACD) model – in each case with alternative error distributions –, the stochastic conditional duration model (SCD), and the stochastic volatility duration model (SVD). The evaluation is done on transaction, price, and volume durations of four stocks listed at the NYSE. The results lead us to conclude that the ACD/log-ACD/TACD/SCD models capture the dynamic dependence in the data in a satisfactory way. They fit correctly the conditional distribution of volume durations, but fail to do so for trade durations. The evidence is mixed for price durations and ACD based models, poor for the SCD model. The SVD model in its original version performs worse than the (Log-)ACD models on the dynamics of trade durations, and offers no improvement with respect to the distributional aspect. The SVD is not suitable to model volume durations. Regarding price durations the performance of the SVD is comparable to those of (Log-)ACD specifications that provide the best results.

JEL Classification: C41, C52, C53, G14

Keywords: duration, high frequency data, density forecast.

- 2000/61 Temporary bubbles in an economy with under-accumulation.
Philippe MICHEL and Bertrand WIGNIOLLE

This paper studies the equilibrium dynamics of an overlapping generations model with capital, money and cash-in-advance constraints. At each date the economy can experience two different regimes. In the first one the cash-in-advance constraint is binding and money is a dominated asset. In the second one, the constraint is strictly satisfied and money has the same return as capital. When the second regime holds on some finite interval, we say that the economy experiences a temporary bubble. We prove that temporary bubbles can exist in an economy which would experience under accumulation without money. We also show, in an example, that cyclical bubbles and sunspot equilibria may occur. Finally, we prove that money creation has the power to eliminate bubbles.

JEL Classification: D9, E4, G1

Keywords: overlapping generations model, bubbles, cash-in-advance constraint.

- 2000/62 Another perverse effect of monopoly power.
Jean J. GABSZEWICZ and Xavier Y. WAUTHY

We show that the simple fact that a monopolist sells a good in units which are indivisible may well induce him to select a quality for his product which is not the highest one, even if no cost of any sort is attached to quality improvement.

- 2000/63 Strategic multilateral exchange and taxes.
Jean J. GABSZEWICZ and Lisa GRAZZINI

This contribution investigates the effectiveness and welfare implications of fiscal policies in a context of multilateral trade, when traders behave strategically. The present approach deals simultaneously with two aspects of fiscal policies: collecting resources for redistributive purposes and correcting distortions related to imperfectly competitive behaviour.

JEL Classification: H30, L13, C72, D51

Keywords: imperfect competition, taxation, strategic market game.