CENTER FOR OPERATIONS RESEARCH & ECONOMETRICS

UNIVERSITE CATHOLIQUE DE LOUVAIN

Report from the Research Director for the period July 1, 1989 to June 30, 1990

1.	Personnel	2
2.	Research Activities	7
3.	Publications	33
4.	Seminars and Workshops	48
5.	Meetings held at CORE	58
6.	CORE Lectures Series	62
7.	Academic Visits	63
8.	Conferences and Meetings	67
9.	Institutional Aspects	72

CORE, 34 VOIE DU ROMAN PAYS, 1348 LOUVAIN-LA-NEUVE, BELGIUM. TEL 010/47.43.21 - DIRECT LINE 010/47.

Introduction

This year at CORE has been marked by the inauguration of the CORE Lecture Series. In October Martin GRÖTSCHEL of the University of Augsburg gave a remarkable series of five lectures on "modelling, algorithms and practical problem solving in combinatorial optimization", and this was followed up in May by David KREPS of Stanford University who gave a stimulating and provocative series of talks "concerning one justification that is often given for the use of the Nash equilibrium concept in modeling economic institutions and phenomena". This new series is financed by the CORE Foundation, which also provided funds for students to attend the lectures. The next lecture series will be in Econometrics and will be held during the coming academic year.

Another important moment was the awarding of a Doctor Honoris Causa in Economics to Professors AUMANN and SEN. Bob AUMANN is a regular visitor to CORE, and his acceptance speech and seminar on "Irrationality in game theory" were as exciting as ever.

Again some come and go. Luc BAUWENS from GREQE has just been appointed to a chair in Econometrics and will be returning to Louvain-la-Neuve next January. Bruno VAN der LINDEN has obtained a permanent research position from the FNRS and will be working in the Economics Department.

Four doctoral theses were completed during the year, and 1989 provided 50 reprints and 65 discussion papers.

Our congratulations to Henry TULKENS who received the Prix Ferdinand de Lesseps for his book on *La performance économique des sociétés belges de transports urbains.*

Once again we are indebted to the secretarial and administrative staff at CORE for working too hard, and keeping our heads above water.

1. PERSONNEL

1.1. During the academic year 1989-1990, the research staff of CORE consisted of *Faculty Members* of the Université Catholique de Louvain (UCL), the Katholieke Universiteit Leuven (KUL), the Université Libre de Bruxelles (ULB), the Facultés Universitaires Saint-Louis, Bruxelles, the Université de Liège, and the Facultés Notre-Dame de la Paix, Namur.

Anton P. BARTEN
Claude d'ASPREMONT
Jacques H. DREZE
Françoise FORGES
Louis GEVERS
Victor GINSBURGH
Jean J. GABSZEWICZ
Wolfgang HÄRDLE
Jean-Paul LAMBERT
Etienne LOUTE
Maurice MARCHAND
Jean-François MERTENS
Michel MOUCHART
José PARIS
Pierre PESTIEAU
Yves POCHET
Heraklis POLEMARCHAKIS
Jean-Marie ROLIN
Léopold SIMAR
Yves SMEERS
Frans SPINNEWYN
Jacques-François THISSE
Henry TULKENS
Jean WAELBROECK
Laurence A. WOLSEY

Researchers

Jacqueline BOUCHER
Jean-Noël de GOTTAL
Bernard DE MEYER
Dominique DEPRINS
Daniel DE WOLF
Geert DHAENE
Isabel GRILO
Dominique GUSBIN
Marie-Astrid JAMAR de BOLSEE
Olivier JANSSENS de BISTHOVEN
Bernard LEBRUN
Françoise LEFEVRE
Joseph LEGRAND
Marc LEOTARD
Fatemeh MEHTA
Anne-Marie RUTGEERTS
Michel SCHAFFERS
Berwin TURLACH
Philippe VANDEN EECKAUT
Bruno VAN der LINDEN
Patrick WATTEYNE

Visiting Faculty Members and Research Fellows

Syed AHSAN, Concordia University, Québec.
Kurt M. ANSTREICHER*, Yale School of Organization and Management.
Gonzalez Jesus Rafael ARAQUE*, State University of New York.
James BERGIN*, Queen's University.
Laurence BROZE, Université de Lille III.
Christophe CHAMLEY, Boston University.
Bernard CORNET, Université Paris-Dauphine.
Robert DESCHAMPS, Facultés Universitaires Notre-Dame de la Paix, Namur.
Rodolphe DOS SANTOS FERREIRA, Université Louis Pasteur, Strasbourg.

---

* holds a CORE fellowship.

Jayasri DUTTA, Columbia University.
Jean-Pierre FLORENS, Université des Sciences Sociales, Toulouse.
Martine LABBÉ, University of Rotterdam.
Knox LOVELL, University of North Carolina
Thomas MAGNANTI, Massachusetts Institute of Technology.
Jacek OSIEWALSKI*, Academy of Economics, Krakow.
Dominique PEETERS, Département de Géographie, U.C.L.
Cheng-Zhang QIN*, University of California at Los Angeles.
Gomatan RAVINDRAN*, Indian Statistical Institute, New Delhi.
Pietro REICHLIN, Universita di Roma.
Nicolas SCHMITT, University of Western Ontario.
Daniel TYTECA, Institut d'Administration et de Gestion, U.C.L.
Serge WIBAUT, Facultés Universitaires Notre-Dame de la Paix, Namur.

Short Term Visitors

In addition to the longer stays of the visiting faculty and research fellows, CORE benefitted from the visits of a number of scholars whose stays ranged from a few days to a few weeks. Among these are :

A. BILLOT, Université Paris II
Robin BOADWAY, Queen's University
Nunzio CAPUCCIO, Universita di Trieste
Parkash CHANDER, Indian Statistical Institute
Daniela COCCHI, Universita di Bologna
Jérôme DETEMPLE, Columbia University
Egbert DIERKER, University of Wien
V. DUBROVSKI, Academy of Sciences of USSR
Piero GOTTARDI, Cambridge University
A.P. JURG, University of Nijmegen
Michael KEEN, University of Essex
H. LIERO, Universität Berlin
Salvador LOPEZ GARCIA, Universita de Barcelona
M. KEYSER, University of Rotterdam
Philippe MICHEL, Université Paris I

---

* holds a CORE fellowship.

Michael NUSSBAUM, Karl Weierstrass Institute Berlin
Renzo ORSI, Universita di Bologna
James PECK, Northwestern University
Jorge PINHO de SOUSA, Universidade do Porto
Takatoshi TABUCHI, University of Tsukuba, Japan
Mark STEEL, Tilburg University
Pietro SICONOLFI, Columbia University
Sylvain SORIN, Université Louis Pasteur, Strasboug
Alexander TSYBAKOV, Academy of Sciences of USSR
Philippe VIEU, Université de Toulouse
Lisa WOOD, University of North Carolina
Israel ZANG, Tel Aviv University

Graduate Students

El Houssaine AGHEZZAF, Faculté des Sciences.
Karen AARDAL, Faculté des Sciences Appliquées.
Svend ALBAEK, Faculté des Sciences Economiques, Sociales et Politiques.
Jorge AMAYA, Faculté des Sciences Appliquées.
Vicky BARHAM, Faculté des Sciences Economiques, Sociales et Politiques.
Giulio CODOGNATO, Faculté des Sciences Economiques, Sociales et Politiques.
Francisco DE SOUSA RAMOS, Faculté des Sciences Economiques, Sociales et Politiques.
Cid de SOUZA, Faculté des Sciences Appliquées.
Joseph HAKIZAMUNGU, Faculté des Sciences.
Kuang-Kai PENG, Faculté des Sciences Appliquées.
Jing-Yuan WEI, Faculté des Sciences Appliquées.
Ping Yuan YEN, Faculté des Sciences Appliquées.
Liang ZOU, Faculté des Sciences Economiques, Sociales et Politiques.

1.2. The following visiting faculty members and research fellows will be in residence for all or part of the 1990-1991 academic year.

Rabah AMIR, State University of New York at Stony Brook
Viviane GASCON, Université de Montréal
Christian GOURIÉROUX, Université Parix IX
Birgit GRUND, Humboldt Universität

Peter HALL, Australian National University
Hidehiko ICHIMURA, University of Minnesota
Charles MANSKI, University of Wisconsin
Philippe MONGIN, Centre National de la Recherche Scientifique, Paris
Tito PIETRA, Rutgers University
Abraham PUNNEN, Indian Institute of Technology
Scott THOMPSON, University of Minnesota

1.3. Jean J. GABSZEWICZ will be on leave at Ecole des Hautes Etudes en Sciences Sociales, Marseille for the first term of academic year 1990-1991, and Jacques-François THISSE will spend the first semester at Virginia Polytechnic Institute, Blacksburg. Bruno VAN der LINDEN obtained a permanent research position from the Fonds National de la Recherche Scientifique.

1.4. Other items

Jean-Paul LAMBERT has edited (jointly with Louis PHLIPS) the first *EEA Directory of Economists* which has appeared as the January issue of the *European Economic Review*.

He has been elected Dean of the Faculty of Economic, Social and Political Sciences of the Facultés Universitaires Saint-Louis, Bruxelles for a three years term.

The Prix Ferdinand de Lesseps has been awarded to the book *La performance économique des sociétés belges de transports urbains*, edited by B. THIRY and H. TULKENS on behalf of the Fédération Nationale des Travaux Publics, Paris.

2. RESEARCH ACTIVITIES

The first three parts of this section, organised by major areas of research, give abstracts of the discussion papers that appeared in the period covered by this report. The fourth section discusses ongoing research projects at CORE that are sponsored by outside agencies in the form of grants or contracts.

2.1. Operations Research

Albert WAGELMANS, Stan van HOESEL and Antoon KOOLEN, Economic lot-sizing: An $O(n \log n)$-algorithm that runs in linear time in the Wagner-Whitin case (8922).

> We consider the n-period economic lot-sizing problem, where the cost coefficients are not restricted in sign. In their seminal paper Wagner and Whitin proposed an $O(n^2)$-algorithm for the special case of this problem where the marginal production costs are equal in all periods and the unit holding costs are non-negative. It is well known that their approach can also be used to solve the general problem, without affecting the complexity of the algorithm.
>
> In this paper we present an algorithm to solve the economic lot-sizing problem in $O(n \log n)$ time and we show how the Wagner-Whitin case can be solved in linear time. These time bounds can be obtained without the use of any complicated data structure.
>
> Furthermore, we show how Wagner and Whitin's and our algorithm are related to algorithms that solve the dual of the simple plant location formulation of the economic lot-sizing problem.

Laurence A. WOLSEY, Formulating single machine scheduling problems with precedence constraints (8924).

> We consider mathematical programming formulations for the precedence-constrained scheduling problem that involve both start-time and sequence determining variables. A formulation with $O(n^2)$ constraints is derived that is sufficient to solve the problem with n jobs by linear programming when the precedence constraints are transitive series-parallel. A stronger formulation with $O(n^3)$ constraints is shown to be at least as strong as the formulations based on valid inequalities involving only start-time variables proposed by Queyranne and Wang.

Kurt M. ANSTREICHER, On the performance of Karmarkar's algorithm over a sequence of iterations (8934).

We consider Karmarkar's projective algorithm for linear programming, with real arithmetic and exact linesearch of the potential function. We show that for every $n \geq 3$ there is a linear program, with n variables, such that the algorithm obtains a potential reduction of about 1.3 on each iteration. For the same problems the algorithm requires $O(\ln(n))$ iterations to reduce the objective gap by a given factor. We thus prove that in the worst case the convergence of Karmarkar's algorithm, with exact linesearch, cannot be independent of n, and moreover potential reduction may be a poor indicator of algorithm performance.

Ravindra K. AHUJA and Thomas L. MAGNANTI, Some recent advances in network flows (8936).

The literature on network flow problems is extensive, and over the past 40 years researchers have made continuous improvements to algorithms for solving several classes of problems. However, the surge of activity on the algorithmic aspects of network flow problems over the past few years has been particularly striking. Several techniques have proven to be very successful in permitting researchers to make these recent contributions: (i) scaling of the problem data; (ii) improved analysis of algorithms, especially amortized average case performance and the use of potential functions; and (iii) enhanced data structures. In this survey, we illustrate some of these techniques and their usefulness in developing faster network flow algorithms. Our discussion focuses on the design of faster algorithms from the worst case perspective and we limit our discussion to the following fundamental problems: the shortest path problem, the maximum flow problem, and the minimum cost flow problem. We consider several representative algorithms from each problem class including the radix heap algorithm for the shortest path problem, preflow push algorithms for the maximum flow problem, and the pseudoflow push algorithms for the minimum cost flow problem.

Kurt M. ANSTREICHER, A combined phase I – phase II scaled potential algorithm for linear programming (8939)

We develop an extension of the "affinely scaled potential function" algorithm which simultaneously obtains feasibility and optimality in a standard form linear program, without the addition of any "M" terms. The method, and its lower-bounding procedure, are particularly simple compared with previous interior algorithms not requiring feasibility.

Ronald L. RARDIN and Laurence A. WOLSEY, Valid inequalities and projecting the multicommodity extended formulation for uncapacitated fixed charge network flow problems (9024).

Multicommodity extended formulations of single source uncapacitated fixed charge network flow problems have significantly sharper linear programming relaxations than the standard flow formulations. However the tradeoff is the introduction of many new constraints and variables to accomodate a sink-oriented flow disaggregation. In this paper we introduce a new family of *dicut collection* inequalities and show that they completely describe the projection of the multicommodity formulation onto the original variables. A *simple* subclass is seen to include a variety of known inequalities for particular models, and combinatorial separation is examined for some special cases.

Kurt M. ANSTREICHER and Patrick WATTEYNE, A family of search directions for Karmarkar's algorithm (9030).

We consider a new family of search directions for the standard form variant of Karmarkar's projective linear programming algorithm. The family includes the usual projected gradient direction, and also a direction first proposed by Mike Todd. We prove that any choice from the family preserves the algorithm's polynomial–time complexity. We then examine the computational behavior of the algorithm using different choices of directions. Although the theoretical complexity is the same for the different directions, in practice we find wide variations in algorithm performance. One particular choice consistently requires about 20% fewer iterations than the usual direction, while another requires a number of iterations which grows rapidly with problem size. Our computational results also demonstrate that a small number of monotonic steps on early iterations may considerably improve the performance of the algorithm.

Kurt M. ANSTREICHER, Strict monotonicity and improved complexity in the standard form projective algorithm for linear programming (9035).

In a recent paper, Xiao and Goldfarb show that a version of the standard form projective algorithm can achieve $O(\sqrt{n}L)$ step complexity, as opposed to the $O(nL)$ step complexity originally demonstrated for the algorithm. The analysis of Xiao and Goldfarb shows that the algorithm, using a constant, fixed steplength, approximately follows the central trajectory. Unfortunately, their proof technique precludes taking longer steps based on a linesearch of the potential function, as would gener-

ally be done in practice. In this paper we show that simple modifications of the projective algorithm obtain the same complexity improvement, while permitting a linesearch of the potential function on each step. An essential component is the addition of a single constraint, motivated by Xiao and Goldfarb's analysis, which makes the standard form algorithm strictly monotone in the true objective.

2.2. Mathematical Economics

Jean J. GABSZEWICZ and Philippe MICHEL, Capacity adjustments under demand fluctuations : an example (8925).

In a recent paper we have analyzed capacity adjustments in a competitive economy, assuming market demand to be stationary over time. Here we assume on the contrary that market demand fluctuates and, by means of an example, we study the investment cycles observed under alternative assumptions on firms' investment behaviour.

Helmuth CREMER, Maurice MARCHAND and Pierre PESTIEAU, The optimal leve and profile of unemployment insurance benefits in a model of employment mis match (8926).

The purpose of this paper is to derive the optimal level and profile of unemployment insurance benefits. The analysis rests on a search model in which risk averse job seekers face the possibility of a mismatch between the employment they prefer and the employment they are offered. We show that unemployment compensations are socially desirable and further, when these compensations are allowed to vary with the duration of unemployment, they should decline over time.

Jean-François MERTENS, Equilibrium and rationality : context and history-dependence (8927).

We show that the correct context-independence requirements on a solution theory for non cooperative games imply that, in some cases, solutions have to be history-dependent.

Jean J. GABSZEWICZ and Jacques-François THISSE. Location (8928).

This paper provides a survey of the main contributions recently developed in spatial competition. Two types of games are considered:

(i) inside location games where firms choose their location within the residential area; (ii) outside location games where firms choose their location outside the residential area. Theses two families of games are akin to horizontal and vertical product differentiation respectively. For each type of games, we consider successively the price competition and the price-location problems. Two prices policies are studied, i.e., mill pricing and spatial discriminatory pricing. Finally, we discuss the location problem under parametric given prices.

Paul CHAMPSAUR and Bernard CORNET, Walrasian exchange process (8930).

Consider a pure exchange economy $\mathcal{E}$, with ℓ commodities and m consumers. A Walrasian exchange process is a C^1 path, which associates to each time t, an allocation $x(t) = (x_1(t), \ldots, x_m(t))$ and a price system $p(t)$ such that the infinitesimal trade $\frac{d}{dt}x(t) = (\frac{d}{dt}x_1(t), \ldots, \frac{d}{dt}x_m(t))$ and the price system $p(t)$ are determined competitively in the associated marginal economy $\mathcal{E}'$ in which the consumers maximize their "marginal" utility subject to their ("marginal") budget constraint $p(t) \cdot \frac{d}{dt}x_i(t) \doteq 0$ (together with a technical conditions).

Our main result states that, under standard assumptions, a Walrasian exchange process is a price adjustment process, in the sense that, (i) for each t, $x(t)$ is attainable, (ii) the utility of each consumer is non-decreasing along time, (iii) exchange takes place at the current price $p(t)$, i.e., $p(t) \cdot \frac{d}{dt}x_i(t) = 0$ for every i, and (iii) when $t \to +\infty, x(t)$ converges to a Pareto optimum x^* and $p(t)$ converges to the price system p^* which sustains the Pareto optimum x^*.

Victor A. GINSBURGH and Henri R. SNEESSENS, Structural shocks and investment subsidies in an overlapping generations model with perfect foresight (8931).

The paper is concerned with investment subsidies and their effect on structural adjustments. We construct a two-sector overlapping generations model where consumers live for two periods, both consumers and firms have perfect foresight, and prices and wages are perfectly flexible, so that the economy is always at full-employment. The structural shock is represented by an unanticipated permanent change in consumers' preferences. This change induces firms to scrap part of their capital stock in one sector and to invest in the other. Because adjustment costs make capital imperfectly mobile across sectors, this structural change implies a loss of welfare for the generations living at the moment of the shock. The question is whether the scrapping and investment rates generated by the market are optimal, or whether there is room for government intervention.

It is shown by means of a numerical example, that investment subsidies alone cannot improve each generation's welfare. This result can be achieved however if the government combines its investment incentives with an appropriate system of compensatory transfers from future to current generations.

Bernard DE MEYER, Repeated games and multidimensional normal distribution (8932).

If we denote by $v_n(p)$ the value of the n-times repeated zero-sum game with incomplete information on one side and by $u(p)$ the value of the average game then the error term $\epsilon_n(p) = v_n(p) - cav(u)(p)$ is known to converge to zero at least as rapidly as $1/\sqrt{n}$.

In this article we prove that, for a special class of games, $\psi_n(p) = \sqrt{n}\epsilon_n(p)$ converges to some function $\psi(p)$ which is related to the multidimensional normal law. This generalizes a result of the Mertens and Zamir (1977) to more than two states of nature.

The class of games we are studying here may be described as follows: Both players have the same number of actions (Square games); player 1 — who maximizes and is informed of the true state of nature — has an unique optimal completely mixed strategy in the average game which does not depend on $\mathbf{p}$. The payoff corresponding to action i of player 1, action j of player 2 and state of nature k is of the form $a_{ij}^k = b_i^k + \lambda^k \omega_{ij}$, where $\lambda^k > 0$.

The function ψ is then a homographic transformation of the conjugate of the convolution of some 1-homogeneous function with a centred normal law whose covariance-matrix can be calculated from the a_{ij}^k.

Cheng-Zhong QIN, The inner core of an N-person game (8933).

In this paper sufficient conditions for games and economies to have non-empty inner cores are established, its properties are analyzed, and some applications to the economic models are discussed. The key condition is shown to be stronger than but very close to that of *cardinal balance*, and hence it characterizes a class of NTU games that is even larger than both the class of NTU polyhedral games and that of *cardinal balnced with slack* NTU games.

Claude d'ASPREMONT and Louis-André GÉRARD-VARET, Utilitarian fundamentalism and limited information (8935).

The paper examines Harsanyi's fundamental utility approach and restates the Impersonal Choice Utilitarianism Theorem. Incentive theory is then used to evaluate the result from a pragmatic point of view.

Heraklis M. POLEMARCHAKIS, When the asset market is incomplete : a short proof and further results (9001).

The asset market is incomplete and assets traded at an initial period.

Competitive equilibria may fail to exist. This may occur in a robust economy with strictly monotonically increasing individual preferences over consumptions bundles and with only one commodity if the individual budget constraints in the asset market are stated with weak inequality. It is due to the satiation that induced individual preferences over portfolios display when asset payoffs are positive for some realizations of uncertainty and negative for others. Stating the individual budget constraints in the asset market with equality suffices to restore the existence of competitive equilibria.

Pseudo-equilibria, a weaker notion, exist and competitive equilibria exist generically when asset payoffs are denominated in multiple commodities. This is the case with no restrictions on the asset structure, such as consumption during the asset trading period, as long as the individual budget constraints in the asset market are stated with equality.

Heraklis M. POLEMARCHAKIS, The economic implications of an incomplete asset market (9002).

The incompleteness of the asset market affects nontrivially the existence, the optimality and the determinacy of competitive equilibria. Also the revelation of information by prices and the serial properties of macroeconomic aggregates.

Parkash CHANDER and Henry TULKENS, Exchange processes, the core and competitive allocations (9003).

The purpose of this paper is to discuss whether for a pure exchange economy, some MDP-type process can be shown to converge from the initial endowments to an allocation in the core. Such a process is exhibited

which has this property, at least in the case of economies with quasi-linear utilities. The process is also of the nature of a "non-tâtonnement", in the sense hat it involves prices. This recourse to prices is shown to be due to the "replicable" nature of the process. With those prices, the core allocation to which it converges is also a competitive equilibrium.

Robin BOADWAY and Maurice MARCHAND, Optimal linear taxation in models with occupational choice (9004).

The purpose of this paper is to investigate the implication of occupational choice for linear income taxation. Occupational choice is restricted to entrepreneurship versus wage earning. Different settings are considered, concerning the introduction of uncertainty and that of individuals' heterogeneity as to ability or risk aversion. For each setting, an optimal tax formula is derived and shown to be made up of various components pertaining to insurance, redistribution and efficiency effects.

Bernard LEBRUN, Repeated trade and asymmetric information : a principal-agent analysis in the auction framework (9005).

A purchaser (typically a governmental agency) awards projects to a cartel of bidders through repeated auctions. The bidders'costs of production are stochastic and their actual values at each period are unknown to the purchaser. Moreover this governmental agency (call it "the State") has imperfect information about the true cost structure and hesitates between two cost probability distributions. We study the equilibria of the repeated game with discounting. One of the main results is that the limit set of the equilibrium payoffs of the repeated auction for the discount factor tending towards one and the limit set of the pure completely revealing perfect Bayesian equilibrium payoffs are identical. This limit set is characterized by simple one-period mechanisms determining average prices and average probabilities of trade conditional on the cartel's cost distribution. The results of this paper hold as well when the State maximizes a linear welfare function and can be applied to the reverse situation where an uninformed seller faces an informed buyer with stochastic reservation prices.

Jean-François MERTENS, Essential maps, and manifolds (9006).

Let $(M, \partial M)$ be a compact n-manifold with boundary, orientable over a field K with characteristic p. For $f : (Y, \partial Y) \to (M, \partial M)$, with Y compact, and $(X, \partial X)$ a compact pair, $g : X \to M$, let $(P, \partial P) = \{y, x) \in$

$Y \times (X, \partial X) \mid f(y) = g(x)\}$ denote the fibered product, with p as projection to $(X, \partial X)$. In Čech-cohomology with coefficients K, we show that if $\check{H}^n(f)$ is injective, so is $\check{H}^*(p)$ – and a number of strengthenings, which point to some concept of p-essential map from one compact pair to another.

Jean-François MERTENS, The "small worlds" axiom for stable equilibria (9007).

The "small worlds" axiom was introduced in (4), with the meaning that, if the payoffs to a subset of the players are unaffected by the actions of the outsiders (or if just their best reply correspondence is unaffected), the solutions (the stable sets) of the game between insiders are exactly the projections of the solutions of the larger game.
We prove here this property for the p-stable sets, whatever be the characteristic p.

Damien NEVEN, George NORMAN and Jacques-François THISSE, Attitudes towards foreign products and international price competition (9008).

In this paper we analyse price competition between firms established in different countries when demand is sensitive to national biases. The intensity of this bias varies across consumers. In this context, trade arises because of the dispersion of consumers' perception of the foreign good; when consumer attitudes are diverse enough, one firm concentrates on consumers with an intensive bias, leaving room for the other which will serve consumers with a low bias. Next, an increase in import tariff will unambiguously lead to a general increase in price since, in equilibrium, the domestic firms will decide to increase margins. Finally, we identify conditions under which "Buy Domestic" campaigns increase local welfare and output.

Jayasri DUTTA and Heraklis M. POLEMARCHAKIS, Asset pricing and observability (9010).

We consider observable restrictions on asset prices in an exchange economy with general preferences and endowments and an asset structure that may be incomplete.

- Asset prices satisfy the martingale property with respect to a class of probability measures; however, generically, not with respect to the empirical measure.
- Attainable assets are priced at their expected payoffs with a correction for covariance with a benchmark return. This benchmark is

a complete description of attitudes towards risk in the asset market. There is a unique portfolio of marketed assets that yields the benchmark return.

- For attainable assets, the Capital Asset Pricing Model holds with respect to the return of a portfolio of marketed assets that is essentially unique.
- Under restrictive assumptions on the utility functions and the initial endowments of individuals and on the asset structure, the asset market is effectively complete, 2-fund separation obtains and all assets, not necessarily attainable, can be priced at their expected payoff with a correction for covariance with the benchmark return; also, the Capital Asset Pricing Model holds with respect to the return of the aggregate consumption portfolio.

We also examine implications for the approximate pricing of nonattainable assets when the asset market is not effectively complete.

Jerôme DETEMPLE, Piero GOTTARDI and Heraklis M. POLEMARCHAKIS, The relevance of financial policy (9011).

When the asset market is incomplete, equilibrium allocations are not invariant to changes in the financial policies of firms: in the presence of secondary assets, such as options, whose payoffs depend nonlinearly on the price of equity, the range of attainable reallocations of revenue varies as a firm alters its position in the asset market. Corporate financial policy is thus relevant.

Kenneth MISCHEL, Heraklis M. POLEMARCHAKIS and Pietro SICONOLFI, Noninformative rational expectations equilibria when assets are nominal : an example (9012).

When assets are nominal, noninformative rational expectations equilibria exist.

C. OLECH, T. PARTHASARATHY and G. RAVINDRAN, Almost N-matrices and its applications to linear complementarity problem and global univalence (9014).

An almost N-matrix A is one with real entries whose determinant is positive and proper principal minors are negative. In this paper we obtain some characterization results for almost N-matrices that are similar to N-matrices. Among other things we show that an almost N-matrix of first category with $n \geq 4$ belongs to the class of Q-matrices. As an application we derive a new univalence result.

Claude d'ASPREMONT, Jacques CRÉMER and Louis-André GÉRARD-VARET, Incentives and the existence of Pareto-optimal revelation (9015).

From the characterization of strongly and Bayesian incentive compatible Pareto-optimal mechanisms with transferable utilities, we derive the following results. If there are only two types per individual then a strongly incentive compatible Pareto-optimal mechanism exists. If there are only two individuals (with more than three types) then there are sets of beliefs (open in the class of all beliefs) for which no Bayesian incentive compatible Pareto-optimal mechanism exists. If there are more than two individuals then the class of beliefs for which such mechanisms exist is open and dense in the class of all beliefs.

David CASS and Heraklis M. POLEMARCHAKIS, Convexity and sunspots : a remark (9017).

Economies in which competitive equilibrium allocations are optimal and individual preferences are strictly convex are immune to sunspots; this is so even in the presence of non-convexities in production.

Yasushi ASAMI, Masahisa FUJITA and Jacques-François THISSE, On the design of noncooperative games supporting optimal spatial allocations (9019).

As is well known, location models are often subject to nonexistence of equilibria; even when an equilibrium exists, it is seldom socially efficient. With these difficulties in mind, we design noncooperative games supporting the optimal allocation in a spatial economy formed by a continuum of households and a small number of firms. To this effect, we introduce into a model of spatial competition the consumption of land by households. Using the process of land capitalization, we specify a firm's payoff as the sum of its profit and its share of the total land rent; firms choose price and location simultaneously. Households choose their location, lot size and consumption of the firms' product in response to firms' decisions. We show that, for a fixed number of firms, the unique Nash equilibrium is given by the socially optimal locations of firms together with marginal cost pricing. When the number of firms is variable, the optimal allocation can be sustained as a free-entry equilibrium.

Jayasri DUTTA and Heraklis M. POLEMARCHAKIS, Investment and the aggregation of risks (9020).

A competitive equilibrium may preserve, even magnify, firm-specific risks in the aggregate. This is the case if firms can anticipate their productivities when they make investment decisions, or, alternatively, if capital can be reallocated once the productivities of firms are realized. In a large economy, output is serially correlated and the real rate of interest varies countercyclically. On the contrary, in a large economy without anticipation or shiftable investment, a competitive equilibrium is essentially riskless.

Jacques H. DRÈZE, Stability of a Keynesian adjustment process (9021).

The paper studies the stability of an adjustment process on prices and quantities that converges in finitely many steps to an equilibrium admitting excess supply of (some) factors of production. The finite convergence results from the fact that the leading adjustments are finite, and the equilibrium concept allows for ε-discrepancies between transacted input levels and those required by technology. The excess supply of factors of production at the equilibrium is associated with downward rigidities of nominal factor prices. These rigidities are best understood as reflecting non-competitive supply behaviour by owners of the production factors.

The modeling of the economy embodies a distinction between primary inputs and other commodities. The leading adjustments concern the prices and quantities of primary inputs; quantity adjustments reflect the profit seeking decisions of producers (firms) and price increases take place under the pressure of excess demand. Thus, the quantity adjustments are decentralised firm by firm, and the price adjustments are decentralised market by market.

A tâtonnement process is studied first, to clear the ground on a simpler case. The main interest, however, goes to a non-tâtonnement process, with production and consumption activities carried out in continuous time out of equilibrium. Feasibility of these activities is ensured by inventories, and it is shown that bounded inventory levels are sufficient for feasibility.

Jacques-François THISSE and David E. WILDASIN, Public facility location and urban spatial structure. Equilibrium and welfare analysis (9025).

We consider a model in which the location of a single public facility is fixed somewhere in an urban area. There are two firms that then

choose locations; the locations of households, competing for space in the land market, are also endogenous. The analysis examines the nature of the spatial equilibrium and its dependence on the presence of the public facility. The firms may be agglomerated at the public facility or dispersed around it, depending on the parameters of the model. The welfare implications of changes in income, transportation cost, and the location of the facility are also studied.

Per Baltzer OVERGAARD, On the nature of advertising and its role as a signal of quality (9026).

The paper explores a firm's use of advertising expenditures as a transmitter of information to uninformed consumers. Featuring a refined (non-cooperative) equilibrium notion, we show that the role of advertising as a signal of quality depends critically on its nature. If advertising has a direct information content it will be used as a complement to prices to signal quality. If advertising is purely dissipative, it is an inefficient signal and will not be used to signal quality. The unique self-enforcing equilibrium is fully revealing (i.e. separating), and the price of a high-quality firm is distorted upwards and informative advertising expenditures downwards relative to the full-information optimum. Hence, a high-quality firm sacrifices potential customers to allow the remaining consumers to infer quality correctly. Contrary to most of the literature, we show that 'best buys' are not advertised most heavily.

Françoise FORGES, Sunspot equilibrium as a game-theoretical solution concept (9029).

This paper investigates some relationship between sunspot and (extensive form) correlated equilibria in market games.

James BERGIN, A model of strategic behaviour in repeated games (9032).

This paper develops a general repeated game model over arbitrary time domain. The model includes the standard repeated game and the most general forms of differential game. The paper considers the issue of formulating strategic behaviour in a general framework which include continuous time behaviour. There are obvious requirements which a strategy must necessarily satisfy. These requirements are stated as axioms and within this axiomatic framework a class of strategies (called variable response strategies, VRS) is developed. In this class of strategy, a player is committed at any point in time to history independent behaviour for

a positive length of time. However this length of time of commitment depends on the way the history evolves locally. Thus the speed of reaction to the evolution of the history is *not* bounded away from zero in the VRS formulation. Nevertheless, it is shown that these strategies generate unambiguous outcomes on any subgame and so are well defined. A characterization of the set of subgame perfect equilibria relative to variable response strategies is given.

Following this discussion, we show that this class of strategy contains in a natural way a general class of differential game strategy. This result is of independent interest as it provides an alternative perspective on differential equations. The fact that VR strategies have a response time not bounded away from 0 is essential to this result. A major virtue of the approach is that none of the technical assumptions of the differential formulation (such as Lipschitz conditions) are required.

Pierre PESTIEAU and U.M. POSSEN, Tax evasion and occupational choice (9033).

This paper is concerned with the combined effect of tax compliance and tax audit policy on the occupational choice of individuals and on public policy objectives such as tax revenue, total production, and social welfare. Individuals are assumed to have a choice between riskless work and a risky entrepreneurial occupation. They are only differentiated according to their attitudes towards risk. More risk averse individuals go into the safe occupation and less risk averse people become entrepreneurs. Tax evasion is only accessible to the latter and therefore its control tends to discourage risk taking.

Whether control of tax evasion is desirable for the economy as a whole depends on the objective function of the government. It is shown that tax audit policy has conflicting effects on tax revenue, per capita income, and social welfare. These conflicts are illustrated through a numerical example. In this paper, the emphasis is placed on the clarity and the simplicity of the presentation so as to argue that even though the tax schedule can hardly be differentiated across individuals, tax evasion and its control can be used by policymakers to introduce variability in the individual's tax treatment.

Beth ALLEN and Jacques-François THISSE, Price equilibria in pure strategies for homogeneous oligopoly (9034).

For a homogeneous product oligopoly market, possibilities for pure strategy Nash equilibria in prices are studied. Consumers, who each nonstrategically purchase one unit up to a common reservation price, are hypothe-

sized to be more likely to notice large price differences (and therefore buy from the cheapest firm) than slightly different prices. For the duopoly case, existence, uniqueness, characterization and comparative statics are provided. Examples are given with 2 and n firms. A general symmetric n-firm model is proposed and a sufficient condition for existence of equilibrium in pure strategies is demonstrated.

Nicholas SCHMITT, Equilibria and entry in two interdependent spatial markets (9036).

This paper investigates the market equilibrium and entry location in interdependent spatial markets. It is first shown that for some international trade problems, an explicit two-market spatial model with a representative firm brings more general results than those obtained with existing appproaches. Then, modifying the game, entry location is analysed and import replacement strategy is shown to be a strong feature of the model. This possible strategy of entry provides an incentive to incumbent firms to establish multi-market production.

Françoise LEFÈVRE, The Shapley value of a Walrasian perfectly competitive market may fail to exist (9037).

A counter-example for the existence of the Shapley value of non-differentiable perfectly competitive Walrasian (i.e., pure exchange) economies is given. The model used is that of a non-atomic continuum of traders. The appropriate – and most powerful – value in the non-differentiable case, introduced by Mertens (1988a) is considered; the existence and unicity of this value for monetary (i.e., transferable utility) markets was established by Mertens (1988b), without any differentiability assumption. Moreover, we show in fact that, for any concave utility representation of this economy, the corresponding side-payment game has an asymptotic value which involves a non-zero transfer.

Philippe MICHEL, Criticism of the social time-preference hypothesis in optimal growth (9039).

The aim of this paper is to reconsider the following question: which should be the weighting of future generations in the intertemporal social welfare function? I propose a simple answer: use as discount rate the marginal productivity of the Golden Rule capital stock which is identical to the growth rate of population. As a consequence, the intertemporal

welfare objective should be the undiscounted sum of generational utilities, extending the Ramsey's original approach.

Jacques DRÈZE and Charles R. BEAN, Europe's employment problem : introduction and synthesis (9041).

The paper is a synthesis of the research carried out within the European Unemployment Programme. It presents a detailed description of the single theoretical model adopted by the ten different countries taking part in the programme, in order to examine the relationship between key economic variables and identify the sources of the problem of persistent and steadily increasing unemployment. It also reports on empirical results obtained by the participants, highlighting aspects, such as wages, prices and productivity, where national comparisons are interesting, as well as aspects which are more specific to the common model, such as output, employment and demand. A summary of broad empirical regularities, emanating from the EUP is then followed by some policy recommendations.

James BERGIN, Existence of equilibrium in anonymous sequential games with general state space of aggregate uncertainty (9043).

In this paper we consider Anonymous Sequential Games with Aggregate Uncertainty and provide two equilibrium existence results for a general state space representing aggregate uncertainty.

Claude d'ASPREMONT, Rodolphe DOS SANTOS FERREIRA and Louis-André GÉRARD-VARET, Imperfect competition, rational expectations and unemployment (9044).

Examples of overlapping generations economies are given where unemployment arises in all perfect foresight equilibria, whatever the (exogenous) sequence of money wages, because of imperfect competition prevailing in the output market. Whether inflationary (with unemployment converging to zero) or not (with, at best, full employment alternating with unemployment), such equilibria can be ascribed to high intertemporal or intersectoral complementarity and a small number of firms either in a Cournot oligopoly or in monopolistic competition.

Cheng-Zhong QIN, The inner core and the strongly inhibitive set (9045).

> The inner core, motivated by the study of competitive outcomes in the cores of market games, is shown to be contained in the strongly inhibitive set, and coincides with the strongly inhibitive set for a large class of games.

Claude d'ASPREMONT and Louis GEVERS, Invariance, neutrality and weakly continuous expected utility (9046).

> This paper is concerned with preference orderings among decisions under uncertainty and their utility representations. Our approach is axiomatic and we attempt to bridge the gap between measurement theory and a weakly continuous version of expected utility: by this, we mean that different values of our expected utility indicator unambiguously imply strict preference, whereas two decisions under uncertainty having the same value are not necessarily indifferent. We rely on several versions of the invariance and neutrality axioms that are familiar in social choice theory and we hope that their meaning is even more transparent in a context where interpersonal utility comparisons are excluded. The preference orderings that we characterize are all separable (they meet the sure thing principle) and the relevance of our work for positive economics may be criticized on this ground.

2.3. Econometrics

Wolfgang HÄRDLE and J.S. MARRON, Bootstrap simultaneous error bars for nonparametric regression (8923).

> Simultaneous error bars are constructed for nonparametric kernel estimates of regression functions. The method is based on the bootstrap, where resampling is done from a suitably estimated residual distribution. The error bars are seen to give asymptotically correct coverage probabilities uniformly over any number of gridpoints. Applications to an economic problem are given and comparison to both pointwise and Bonferroni-type bars is presented through a simulation study.

John H. DONALDSON and Jayasri DUTTA, Anticipation and the aggregation of sector-specific risks (8929).

> This paper examines the sole of private information as a source of aggregate fluctuations.

We consider an economy where several firms face uncertainty in the form of productivity shocks. In the absence of private information, there are no aggregate effects of these idiosyncratic shocks; output in constant over time. However, if firms can anticipate their individual shocks, the optimal allocation displays aggregate randomness: as a result, output, employment and investment vary cyclically over time.

We also show that this model is observationally equivalent to one which assumes that all firms face the same aggregate shock; for each equilibrium path of this model, one can construct a process of "aggregate shocks" which yields the same path at equilibrium.

Jean-Pierre FLORENS, Michel MOUCHART and Jean-Marie ROLIN, Invariance arguments in Bayesian statistics (8937).

Invariance arguments are used, in Bayesian statistics, for, at least, three types of questions: definition and properties of so-called non-informative prior distributions, integration of nuisance parameters using a mutually sufficient pair of statistics and parameters, and asymptotic questions. In this paper, the concept of invariance, standard in measure theory, is extended to the conditional case and is shown to provide a suitable framework to define invariant Bayesian experiments, even in the case of improper prior distributions. This framework is then used to successively deal with the three types of invariance questions met in Bayesian statistics.

Wolfgang HÄRDLE and Peter HALL, Simple formulae for steps and limits in the backfitting algorithm (8938).

We show that in the case of a large and very important class of curve estimators, which includes histospline estimators, simple and elegant step-by-step formulae can be given for the backfitting algorithm. The result of each cycle of the algorithm may be represented succintly in terms of a sequence of d projections in n-dimensional space, where d is the number of design coordinates and n is sample size. This representation overcomes technical problems reported by other authors in studying the convergence of the backfitting algorithm. It follows from our formulae that the limit of the algorithm is simply the projection of the data onto that vector space which is orthogonal to the space of all n-vectors fixed by each of the projections. The formulae also provide the convergence rate of the algorithm, the variance of the backfitting estimator, consistency of the estimator, and the relationship of the estimator to that obtained by directly minimizing mean squared distance.

Jacek OSIEWALSKI, A note on Bayesian inference in a regression model with elliptical errors (8940)

In this note estimation and prediction are considered for a (linear or nonlinear) regression model with the error vector distributed as a scale mixture of multivariate normal distributions. The results obtained for the linear model by Zellner (19786), Jammalamadaka et al. (1987) and Chib et al. (1988) are explained and generalized to much more general classes of regression models and prior distributions.

Wolfgang HÄRDLE, Peter HALL and J.S. MARRON. Regression smoothing parameters that are not far from their optimum (9009).

It is well known that data driven regression smoothing parameters $\hat{h}$ based on cross-validation and related methods exhibit a slow rate of convergence to its optimum. In an earlier paper we showed that this rate can be as slow as $n^{-1/10}$, i.e. for a bandwidth $\hat{h}_0$ optimising the averaged squared error, $n^{1/10}(\hat{h} - \hat{h}_0)/\hat{h}_0$ tends to an asymptotic normal distribution. In this paper we consider mean averaged squared error optimal bandwidths h_0. This (non-random) smoothing parameter can be much faster approximated. We use the technique of double smoothing to show that there is an $\hat{h}$ so that under certain conditions $n^{1/2}(\hat{h} - h_0)/h_0$ tends to an asymptotic normal distribution. The double smoothing technique is based on employing an oversmooth auxiliary kernel estimates for reflecting the correct bias behavior.

Wolfgang HÄRDLE and Michael NUSSBAUM. Kernel estimation : the equivalent spline smoothing method (9013).

Among nonparametric smoothers, there is a well-known correspondence between kernel and Fourier series methods, pivoted by the Fourier transform of the kernel. This suggests a similar relationship between kernel and spline estimators. A known special case is the result of Silverman (1984) on the effective kernel for the classical Reinsch-Schoenberg smoothing spline in the nonparametric regression model. We present an extension by showing that a large class of kernel estimators have a spline equivalent, in the sense of identical asymptotic local behaviour of the weighting coefficients. This general class of spline smoothers includes also the minimax linear estimator over Sobolev ellipsoids. The analysis is carried out for piecewise linear splines and equidistant design.

Wolfgang HÄRDLE and M. JERISON. Cross section Engel curves over time (9016).

Methods for nonparametric estimation and comparison of cross section Engel curves are presented and applied to U.K. expenditure data. Real Engel curves (with quantity demanded and real total expenditure on the axes) vary over time, but their shapes are generally quite stable. Mean normalized Engel curves are defined and are found not to vary greatly over time. Consequences of such invariance for the testing of microeconomic demand models are investigated.

Jacek OSIEWALSKI and Mark STEEL. Semi-conjugate prior densities in multivariate t regression models (9018).

The meaning of conjugate prior densities for a linear regression model is examined when we venture outside the usual realm of exponential models. For a non-Normal elliptical family of data densities, we introduce a class of so-called semi-conjugate prior densities, fully coherent with the uncontroversial conjugate prior in a Normal framework.

We discuss results from the literature on the particular case of Student t errors, and derive a semi-conjugate prior for such models.

Since the transformation used to obtain this prior does not affect the regression coefficient vector, any semi-conjugate prior leads to exactly the same marginal Student t prior and posterior densities for this vector as in the reference case of a Normal regression model with conjugate prior.

It is shown that these semi-conjugate prior densities allow us to obtain most posterior results analytically under informative prior assumptions at the cost of putting a finite upper bound on the unknown error precision parameter, and thus restricting the original parameter space.

Jayasri DUTTA and Asad ZAMAN. What do heteroskedasticity tests detect ? (9022).

A test can be said to 'detect' an alternative hypothesis only if its power against this alternative exceeds its size. Using this principle to define the implicit null and alternative for a test, we analyze the performance of several popular tests for heteroskedasticity. The tests examined belong to one of two broad classes: a class of exact tests, where the test statistic writes as a ratio of quadratic forms; and a class of tests based on projections, which are asymptotically distributed as chi-squared. We show that for each test, there exist many kinds of heteroskedasticity which the tests fails to detect. Using a technique due to Pitman, we construct a test which detects *all* kinds of heteroskedasticity in the normal model.

Françoise LEFÈVRE, The estimation of the multivariate structural errors-in-variables model without any a priori on the covariance matrix of the errors (9023).

The multivariate structural errors-in-variables model without any a priori on the covariance matrix of the errors is considered. Under the assumption – necessary to get an identifiable model – that the distribution of the true variables cannot be transformed by any non constant affine function on the true affine subspace to a normal distribution, we give a strongly consistent estimator of this subspace, that converges almost surely to the true affine subspace with a speed of the order $O(n^{-1/2})$. This estimator and the result are invariant under the affine group on the space of the variables. The proof of the speed of convergence is given under the assumption that the true variables have finite moments of order α, the smallest multiple of 4 strictly larger than $2k(m-k)$, where m is the number of variables in the model and k is the number of equations. This assumption – convenient for the proof – could probably be dropped. The possible extension of our result to more general models – including the functional model – is discussed.

Wolfgang HÄRDLE and Alexander B. TSYBAKOV. Remarks on sliced inverse regression (9027).

This is a discussion of sliced inverse regression.

Wolfgang HÄRDLE and Alexander B. TSYBAKOV. Robust locally adaptive nonparametric regression (9028).

The problem of robust nonparametric regression estimation is considered. We study pointwise asymptotic normality of variable bandwidth M-smoothers. A locally optimal bandwidth is derived, and the "plug-in" method is used for data-driven local bandwidth selection. Asymptotic optimality of local bandwidth selectors based on robust pilot estimators is proved. The work improves upon earlier contributions since we get the estimates that have smaller mean squared error under weaker assumptions on the error distribution and on the ψ-function of M-smoother.

Wolfgang HÄRDLE and Philippe VIEU. Kernel regression smoothing of time series (9031).

A class of nonparametric regression smoothers for time series is defined by the kernel method. The kernel approach allows flexible modelling of

a time series without reference to a specific parametric class. The technique is applicable to detection of nonlinear dependencies in time series and to prediction in smooth regression models with serially correlated observations.

In practice these estimators are to be tuned by a *smoothing parameter*. A data driven selector for this smoothing parameter is presented that asymptotically minimizes a squared error measure. We prove asymptotic optimality of this selector. We illustrate the technique with a simulated example and by constructing a smooth prediction curve for the variation of gold prices. In both cases, the nonparametric method proves to be useful in uncovering nonlinear structure.

Wolfgang HÄRDLE and Michael NUSSBAUM. Bootstrap confidence bands (9038).

Bootstrap confidence bands are constructed for nonparametric regression. Resampling is based on a suitably estimated residual distribution often called the *Wild Bootstrap*. The method is to construct first a fine grid of error bars with simultaneous coverage probability. Second the endpoints of these error bars are joined via polygon pieces or parabolae using assumptions on the local curvature of the regression curve.

Wolfgang HÄRDLE and David SCOTT. Smoothing by weighted averaging of rounded points (9040).

Nonparametric smoothing techniques are generating much interest not only among theoretical statisticians but among applied workers in biostatistics, economics, and engineering. The benefits of this more flexible method come at the cost of greater computation. In higher dimensions, the computational burden can also be enormous when resampling methods for confidence intervals are used. One idea for reduction of computational cost is to do a data compression. In the case of multivariate density estimation, for example, the averaged shifted histogram is such a algorithm with significantly reduced computational effort. The ideas of the averaged shifted histogram algorithm can be extended to other nonparametric estimation problems such as regression and also to algorithms for additive modeling of high dimensional surfaces. In this paper the common framework for the so-called *Weighted Averaging of Rounded Points* (WARP*ing*) is presented in these situations and examples are given with real data from LANDSAT observations and from a study of binomial response variables. The reduction of computational cost is discussed versus the loss in statistical efficiency.

Nunzio CAPPUCCIO and Renzo ORSI, Testing exogeneity in overindentified models (9042).

> In this paper we analyse the consequences of model overidentification on testing exogeneity, when maximum likelihood techniques for estimation and inference are used. This situation is viewed as a particular case of the more general problem of considering how restrictions on nuisance parameters could help in making inference on the parameters of interest. At first a general model is considered. A suitable likelihood function factorization is used which alows a simple derivation of the information matrix and other tools useful for building up joint tests of exogeneity and overidentifying restrictions both of Wald and Lagrange Multiplier type. The asymptotic local power of the exogeneity test in the justidentified model is compared with that in the overidentified one, when we assume that this last is the true model. Then the pseudo-likelihood framework is used to derive the consequences of working with a model where overidentifying restrictions are erroneously imposed. The inconsistency introduced by imposing false restrictions is analysed and the consequences of the misspecification on the exogeneity test are carefully examined.

2.4. Research Projects under Contracts

A. Projet d'Action de Recherches Concertées (PAC)

This six-year research program, started in 1987, is financed by the Belgian government under contract 87/92-106. Its objectives are twofold : to develop research activities in three applied fields (employment policies, measurement of productive efficiency in public enterprises, and production planning) and to design computer-aided modeling systems in the fields of Operations Research and Econometrics.

Bruno VAN der LINDEN has continued his research work on the comparative effects on employment of alternative ways to finance social security under the guidance of Michel MOUCHART. He has focused on the macroeconomic impact of exempting from the payroll tax some fixed part of monthly salaries. As this proposal modifies the relative labour costs of skilled and unskilled workers, his aim has been to model labour demand according to worker qualification and to collect microeconomic data appropriate for this purpose. In the field of productive efficiency measurement, Marie-Astrid JAMAR has replaced as researcher Philippe VANDEN EECKHAUT who has continued his activities in this topic under another

contract. They have developed productive efficiency studies of retail banking, municipalities and courts in Belgium. They have worked under the guidance of Henry TULKENS. Jean-Noël de GOTTAL has pursued with Yves SMEERS his work on computer-aided modeling systems as applied to energy. Finally, Michel SCHAFFERS has started with Laurence WOLSEY research on the complexity of algorithms used to solve problems in production planning.

B. Projects on Energy

B.1. Project on Household Energy Consumption

Under convention 88-08 with the Ministry of Economic Affairs, Michel MOUCHART and Anne-Marie RUTGEERTS have enlarged a simulation model of the household demand for energy by desaggregating this demand by end-use and by fuel. The inputs of this model were partly obtained from an analysis of a survey conducted in 1986 in such a way that it produced a sample representative of each of the 3 regions of Belgium. Satellite models were also developed as well as some more traditional study on aggregate data.

B.2. Work on Energy : Energy Trade Models

Different actions have been pursued in the development of multiregional energy models. A first one financed by the European Commission aims at including considerations of security of supply in a multi-regional electricity model. Shortage is taken into account through expected shortage costs that are added to the operating costs. The evaluation of the expectation is made by resorting to bounding techniques. A particular attention is given to the construction of upper bounds on the expected operations and shortage costs. These techniques are to be implemented in the gas and electricity trade models developed before for looking at electricity and natural gas exchanges in the Community.

Another related subject deals with the introduction of regulatory constraints in these trade models. Different types of trade of gas and electricity are currently envisaged by the European Commission. They go from a simple transit obligation for trade between utilities to a full common carriage. The economic effects of these obligations is difficult to measure. Some modelling of these issues has been undertaken with the final goal of including them in the existing gas and electricity trade models. This work is also supported on a more general scale by the Ministry

of Economic Affairs. In this task, general surveys of the institutional and political background of the gas and electricity industry among the different member states of the Community are conducted and discussed with representatives of both the administration and the industry.

Joseph LEGRAND, Jacqueline BOUCHER and Olivier JANSSENS de BISTHOVEN have been supported by these projects.

C. Performance Studies in Belgian Public Services

Under a four year grant (n° 2.4528.88) with the Belgian Fonds de la Recherche Fondamentale Collective, and jointly with the Université de Liège (Service d'Economie Publique of Pierre PESTIEAU), Maurice MARCHAND and Henry TULKENS are heading a research project on managerial incentives in the public sector. The aim is both to further develop performance indicators that have been devised in the past for several public enterprises in Belgium, and to link these measures with incentive schemes designed to promote efficiency. Philippe VAN-DEN EECKAUT has been appointed as research assistant (half time) under this grant. Working papers on banks, courts and urban transit, resulting from this research, are listed in section 3.3. below.

D. Market Competition with Profit and Non-profit Firms

Maurice MARCHAND and Jacques THISSE have been granted by the Fonds de la Recherche Fondamentale Collective financing for a four-year research project under contract FRFC 2.4537.90. This project deals with the interaction of profit and non-profit firms competing in the same market. It will focus on the circumstances that make this competition in price and quality beneficial in terms of efficiency and equity. Isabelle GRILO started to work on this project on January 1, 1990.

E. Markets and Organizations : A Game-Theoretic Approach

Claude d'ASPREMONT is heading a project granted by SPES (Stimulation Plan for Economic Science) of the European Commission for 36 months, starting in Autumn 1989.

The objective of the project is to develop the game-theoretic analysis of organizations. The main questions examined concern decentralization, information asymmetries or limitations, organizational coordination and innovation. The areas

of research are : auctions, insurance and labour contracts, industrial competitive structure, R & D and product differenciation, regulation of public and private production, unemployment and macroeconomic policy with imperfect competition. The project involves 4 institutions : CORE, Louvain-la-Neuve; GREQE-EHESS, Marseille; Center for Economic Research, Tilburg and Laboratoire d'Econométrie de l'Ecole Polytechnique, Paris. Activities consist in a series of workshops and conferences and in multiple exchanges of visitors. Many short visitors have been financed in 1989-1990, and the first conference will be organized at CIRM, Luminy, October 2-6, 1990.

F. Microeconomic Data Bank

Jean-Paul LAMBERT and Michel MOUCHART, jointly with the Department of Economics (Robert LEROY and Henri SNEESSENS) are heading a research project entitled "Microeconomic data bank on employment and wages and research on the labour market" and granted by the Belgian Fonds de la Recherche Fondamentale Collective. Fati MEHTA has worked on this project with the participation of Bruno VAN der LINDEN.

The object of the contract is to organize and to perform statistical analysis on a sizeable data bank of individual trajectories (7 to 8 years) on the labour market. This work should involve both handling large data files and modelling individual behaviour. Merging that data bank with other data bank on companies is also under consideration.

G. European Unemployment Programme, phase II

Jean-Paul LAMBERT and Michel MOUCHART at CORE and Henri SNEESSENS at the Department of Economics are taking part in an international project involving several European research centers and coordinated by Charles BEAN at the London School of Economics. This joint research programme, supported by SPES (Stimulation Plan for Economic Science) and the Sloan Foundation, is an extension of the earlier European Unemployment Programme. The topics to be pursued at CORE are (i) the micro-econometric analysis of the labour market with particular emphasis on the modelling and the estimation of duration of unemployment and of intersectorial mobility and (ii) a more appropriate treatment of the interactions between supply constraints and international macroeconomic interdependence.

3. PUBLICATIONS

3.1. The following **Discussion Papers** were issued during the period covered by this report.

8922 Economic lot-sizing : An $O(n \log n)$-algorithm that runs in linear time in the Wagner-Within case,
Albert WAGELMANS, Stan van HOESEL and Antoon KOLEN.

8923 Bootstrap simultaneous error bars for nonparametric regression,
Wolfgang HÄRDLE and J.S. MARRON.

8924 Formulating single machine scheduling problems with precedence constraints,
Laurence A. WOLSEY.

8925 Capacity adjustments under demand fluctuations : an example,
Jean J. GABSZEWICZ and Philippe MICHEL.

8926 The optimal level and profile of unemployment insurance benefits in a model of employment mismatch,
Helmuth CREMER, Maurice MARCHAND and Pierre PESTIEAU.

8927 Equilibrium and rationality : context and history-dependence,
Jean-François MERTENS.

8928 Location,
Jean J. GABSZEWICZ and Jacques-François THISSE.

8929 Anticipation and the aggregation of sector-specific risks,
John DONALDSON and Jayasri DUTTA.

8930 Walrasian exchange processes,
Paul CHAMPSAUR and Bernard CORNET.

8931 Structural shocks and investment subsidies in an overlapping generations model with perfect foresight,
Victor GINSBURGH and Henri R. SNEESSENS.

8932 Repeated games and multidimensional normal distribution,
Bernard DE MEYER .

8933 The inner core of an N-person game,
Cheng-Zhong QIN.

8934 On the performance of Karmarkar's algorithm over a sequence of iterations,
Kurt M. ANSTREICHER.

8935 Utilitarian fundamentalism and limited information,
Claude d'ASPREMONT and Louis-André GÉRARD-VARET.

8936 Some recent advances in network flows,
Ravindra K. AHUJA and Thomas L. MAGNANTI.

8937 Invariance arguments in Bayesian statistics,
Jean-Pierre FLORENS, Michel MOUCHART and Jean-Marie ROLIN.

8938 Simple formulae for steps and limits in the backfitting algorithm,
Wolfgang HÄRDLE and Peter HALL.

8939 A combined phase I – phase II scaled potential algorithm for linear programming,
Kurt M. ANSTREICHER.

8940 A note on Bayesian inference in a regression model with elliptical errors,
Jacek OSIEWALSKI.

9001 When the asset market is incomplete : a short proof and further results,
Heraklis M. POLEMARCHAKIS.

9002 The economic implications of an incomplete asset market,
Heraklis M. POLEMARCHAKIS.

9003 Exchange processes, the core and competitive allocations,
Parkash CHANDER and Henry TULKENS.

9004 Optimal linear taxation in models with occupational choice,
Robin BOADWAY and Maurice MARCHAND.

9005 Repeated trade and asymmetric information : a principal-agent analysis in the auction framework,
Bernard LEBRUN.

9006 Essential maps, and manifolds,
Jean-François MERTENS.

9007 The "small worlds" axiom for stable equilibria,
Jean-François MERTENS.

9008 Attitudes towards foreign products and international price competition,
Damien NEVEN, George NORMAN and Jacques-François THISSE.

9009 Regression smoothing parameters that are not far from their optimum,
Wolfgang HÄRDLE, Peter HALL and J.S. MARRON.

9010 Asset pricing and observability,
Jayasri DUTTA and Heraklis M. POLEMARCHAKIS.

9011 The relevance of financial policy,
Jérôme DETEMPLE, Piero GOTTARDI and Heraklis M. POLEMARCHAKIS.

9012 Noninformative rational expectations equilibria when assets are nominal : an example,
Kenneth MISCHEL, Heraklis M. POLEMARCHAKIS and Pietro SICONOLFI.

9013 Kernel estimaton : the equivalent spline smoothing method,
Wolfgang HÄRDLE and Michael NUSSBAUM.

9014 Almost N-matrices and its applications to linear complementarity problem and global univalence,
C. OLECH, T. PARTHASARATHY and G. RAVINDRAN.

9015 Incentives and the existence of Pareto-optimal revelation,
Claude d'ASPREMONT, Jacques CRÉMER and Louis-André GÉRARD-VARET.

9016 Cross section Engel curves over time,
Wolfgang HÄRDLE and M. JERISON.

9017 Convexity and sunspots : a remark,
David CASS and Heraklis M. POLEMARCHAKIS.

9018 Semi-conjugate prior densities in multivariate t regression models,
Jacek OSIEWALSKI and Mark STEEL.

9019 On the design of noncooperative games supporting optimal spatial allocations,
Yasushi ASAMI, Masahisa FUJITA and Jacques-François THISSE.

9020 Investment and the aggregation of risks,
Jayasri DUTTA and Heraklis M. POLEMARCHAKIS.

9021 Stability of a Keynesian adjustment process,
Jacques H. DRÈZE.

9022 What do heteroskedasticity tests detect ?,
Jayasri DUTTA and Asad ZAMAN.

9023 The estimation of the multivariate structural errors-in-variables model without any a priori on the covariance matrix of the errors,
Françoise LEFÈVRE.

9024 Valid inequalities and projecting the multicommodity extended formulation for uncapacitated fixed charge network flow problems,
Ronald L. RARDIN and Laurence A. WOLSEY.

9025 Public facility location and urban spatial structure – equilibrium and welfare analysis,
Jacques-François THISSE and David E. WILDASIN.

9026 On the nature of advertising and its role as a signal of quality,
Per Baltzer OVERGAARD.

9027 Remarks on sliced inverse regression,
Wolfgang HÄRDLE and Alexander B. TSYBAKOV.

9028 Robust locally adaptive nonparametric regression,
Wolfgang HÄRDLE and Alexander T. TSYBAKOV.

9029 Sunspot equilibrium as a game-theoretical solution concept,
Françoise FORGES.

9030 A family of search directions for Karmarkar's algorithm,
Kurt M. ANSTREICHER and Patrick WATTEYNE.

9031 Kernel regression smoothing of time series,
Wolfgang HÄRDLE and Philippe VIEU.

9032 A model of strategic behaviour in repeated games,
James BERGIN.

9033 Tax evasion and occupational choice,
Pierre PESTIEAU and U.M. POSSEN.

9034 Price equilibria in pure strategies for homogeneous oligopoly,
Beth ALLEN and Jacques-François THISSE.

9035 Strict monotonicity and improved complexity in the standard form projective algorithm for linear programming,
Kurt M. ANSTREICHER.

9036 Equilibria and entry in two interdependent spatial markets,
Nicolas SCHMITT.

9037 The Shapley value of a Walrasian perfectly competitive market may fail to exist,
Françoise LEFÈVRE.

9038 Bootstrap confidence bands,
Wolfgang HÄRDLE and Michael NUSSBAUM.

9039 Criticism of the social time-preference hypothesis in optimal growth,
Philippe MICHEL.

9040 Smoothing by weighted averaging of rounded points,
Wolfgang HÄRDLE and David W. SCOTT.

9041 Europe's employment problem : introduction and synthesis,
Jacques DRÈZE and Charles R. BEAN.

9042 Testing exogeneity in overidentified models,
Nunzio CAPUCCIO and Renzo ORSI.

9043 Existence of equilibrium in anonymous sequential games with general state space of aggregate uncertainty,
James BERGIN.

9044 Imperfect competition, rational expectations and unemployment,
Claude d'ASPREMONT, Rodolphe DOS SANTOS FERREIRA and Louis-André GÉRARD-VARET.

9045 The inner core and the strongly inhibitive set,
Cheng-Zhong QIN.

9046 Invariance, neutrality and weakly continuous expected utility,
Claude d'ASPREMONT and Louis GEVERS.

CORE Discussion Papers undergo an internal refereeing process which is more informal than, but similar to, journal refereeing.

3.2. CORE issued **Reprints** of the following articles during this period :

840. Richard SCHMALENSEE and Jacques-François THISSE. Perceptual maps and the optimal location of new products : an integrative essay. *International Journal of Research in Marketing*, 5, 225–249, 1988.

841. Georges L. NEMHAUSER and Laurence A. WOLSEY. Integer programming. In *Handbooks in Operations Research and Econometrics*, I, edited by G.L. Nemhauser et al. Amsterdam, North-Holland, 447-527, 1989.

842. Laurence A. WOLSEY. Submodularity and valid inequalities in capacitated fixed charge networks. *Operations Research Letters*, 8, 119–124, 1989.

843. Claude d'ASPREMONT, Rodolphe DOS SANTOS FERREIRA and Louis-André GÉRARD-VARET. Unemployment in an extended Cournot oligopoly model. *Oxford Economic Papers*, 41, 490–505, 1989.

844. Pierre PESTIEAU, Endogenous population and fixed input in a growth model with altruisme. In *Economic Theory of Optimal Population*, edited by K.F. Zimmermann. Berlin, Springer Verlag, 91–103, 1989.

845. Moshe BEN-AKIVA, André DE PALMA and Jacques-François THISSE. Spatial competition with differentiated products. *Regional Science and Urban Economics*, 19, 5–19, 1989.

846. Jonathan H. HAMILTON, Jacques-François THISSE and Anita WESKAMP. Spatial discrimination. Bertrand vs. Cournot in a model of location choice. *Regional Science and Urban Economics*, 19, 87–102, 1989.

847. Bernard CORNET and Guy LAROQUE. Lipschitz properties of solutions in mathematical programming. *Journal of Optimization Theory and Applications*, 53(3), 407–427, 1987.

848. Russell DAVIDSON, Mathias DEWATRIPONT, Victor GINSBURGH and Martine LABBÉ. On the welfare effects of anti-discrimination regulations in the EC car market. *International Journal of Industrial Organization*, 7, 205–230, 1989.

849. Victor GINSBURGH and Philippe MICHEL. Adjustment costs, concentration and price behaviour. *The Journal of Industrial Economics*, 36(4), 477-481, 1988.

850. Ezra EINY and Ehud LEHRER. Regular simple games. *International Journal of Game Theory*, 18, 195–207, 1989.

851. Louis PHLIPS and Jean-François RICHARD. A dynamic oligopoly model with demand inertia and inventories. *Mathematical Social Sciences*, 18, 1–32, 1989.

852. Jacques H. DRÈZE. Espérance morale avec risque moral. *L'actualité économique. Revue d'analyse économique*, 63(2-3), 40–56, 1989.

853. Christian GOLLIER. Risk-sharing on the labour-market : how to treat young generations ? *The Geneva Papers on Risk and Insurance*, 14, 26–53, 1989.

854. Paul CHAMPSAUR and Jean-Charles ROCHET. Multiproduct duopolists. *Econometrica*, 57(3), 533–557, 1989.

855. David WILDASIN. Demand estimation for public goods. Distortionary taxation and other sources of bias. *Regional Science and Urban Economics*, 19, 353–379, 1989.

856. Robin BOADWAY, Pierre PESTIEAU and David WILDASIN. Tax-transfer policies and the voluntary provision of public goods. *Journal of Public Economics*, 39, 157–176, 1989.

857. Michel MOUCHART and Jean-Marie ROLIN. On maximal ancillarity. *Statistica*, XLIX(1), 21–37, 1989.

858. Claude d'ASPREMONT, Rodolphe DOS SANTOS FERREIRA and Louis-André GÉRARD-VARET. Unemployment in a Cournot oligopoly model with Ford effects. *Recherches Economiques de Louvain*, 55(1), 35–60, 1989.

859. Jacques DRÈZE. L'autogestion et la théorie économique : efficacité, financement et emploi. In *L'entreprise coopérative, tradition et renouveau*. Bruxelles, Labor, 55-70, 1988.

860. Jacques DRÈZE and Charles WYPLOSZ. Une stratégie de croissance ambidextre pour l'Europe : l'autonomie par la coopération. *Revue Economique*, 3, 627–640, 1988.

861. Jayasri DUTTA and Heraklis POLEMARCHAKIS. Credit constraints and investment finance : some evidence from Greece. In *Fiscal Policy, Economic Adjustment and Financial Markets*, edited by G. Monti. Washington D.C., International Fund, 158–182, 1989.

862. Dominique DEPRINS and Léopold SIMAR. Estimation de frontières déterministes avec facteurs exogènes d'inefficacité. *Annales d'économie et de statistique*, 14, 117-150, 1989.

863. J.-M. HURIOT, T.E. SMITH and Jacques-François THISSE, Minimum-cost distances in spatial analysis. *Geographical Analysis*, 21(4), 294–315, 1989.

864. Laurence A. WOLSEY. Strong formulations for mixed integer programming : a survey. *Mathematical Programming*, 45, 173–191, 1989.

865. Simon P. ANDERSON, Marie-Paule DONSIMONI and Jean J. GABSZEWICZ. Is international trade profitable to oligopolistic industries. *International Economic Review*, 30(4), 725–733, 1989.

866. Jean-François MERTENS. Stable equilibria – a reformulation. Part I. Definition and basic properties. *Mathematics of Operations Research*, 14(4), 575–625, 1989.

867. Robert J. GARY-BOBO. Cournot-Walras and locally consistent equilibria. *Journal of Economic Theory*, 49(1), 10–32, 1989.

868. Philippe R. SCHOLTÈS. Dual v uniform prices – an application. *Energy Economics*, 18–26, 1990.

869. Sergio PERELMAN and Pierre PESTIEAU. The performance of public enterprises : a comparative efficiency study of railways and postal service. In *Public Finance and Performance of Enterprises.* Proceedings of the 43rd Congress of the International Institute of Public Finance, Paris, 1987. Detroit (MI), Wayne State University Press, 365–381, 1989.

870. Christophe CHAMLEY, Maurice MARCHAND and Pierre PESTIEAU. Linear incentive schemes to control public firms. *European Journal of Political Economy*, 5, 229–243, 1989.

871. Dominique GUSBIN and Yves SMEERS. Cost consideration on CO2 abatement. In *Environmental Models: Emissions and Consequences*, edited by J. Fenhann et al. Amsterdam, Elsevier, 65–70, 1990.

872. Ezra EINY and Abraham NEYMAN. Large symmetric games are characterized by completeness of the desirability relation. *Journal of Mathematical Economics*, 48(2), 369–385, 1989.

873. Ezra EINY. On preference relations which satisfy weak independence property. *Journal of Mathematical Economics*, 18, 291–300, 1989.

874. Joseph ABDOU and Jean-François MERTENS. Correlated effectivity functions. *Economics Letters*, 30, 97–101, 1989.

875. Pierre HANJOUL, Pierre HANSEN, Dominique PEETERS and Jacques-François THISSE. Uncapacitated plant location under alternative spatial price policies. *Management Science*, 36(1), 41–57, 1990.

876. Maurice MARCHAND and Pierre PESTIEAU. Shadow prices for public production in an open economy with disequilibrium. *Journal of Development Economics*, 32, 1–15, 1990.

877. André DE PALMA, Victor GINSBURGH, Martine LABBÉ and Jacques-François THISSE. Competitive location with random utilities. *Transportation Science*, 23(4), 244–252, 1990.

878. Martin E. DYER and Laurence WOLSEY. Formulating the single machine sequencing problem with release dates as a mixed integer program. *Discrete Applied Mathematics*, 26, 255-270, 1990.

879. Jean-Marc BONNISSEAU and Bernard CORNET. Fixed-point theorems and Morse's lemma for Lipschitzian functions. *Journal of Mathematical Analysis and Applications*, 146(2), 318–332, 1990.

880. Maurice MARCHAND, Pierre PESTIEAU and Serge WIBAUT. Optimal commodity taxation and tax reform under unemployment. *Scandinavian Journal of Economics*, 91(3), 547–563, 1989.

881. Jayasri DUTTA and Herakles POLEMARCHAKIS. Asset markets and equilibrium processes. *Review of Economic Studies*, 57, 229–254, 1990.

882. Damien NEVEN et Jacques-François THISSE. Choix des produits : concurrence en qualité et en variété. *Annales d'Economie et de Statistique*, 15/16, 85–112, 1989.

883. Françoise FORGES. Correlated equilibrium in two-person zero-sum games. *Econometrica*, 58(2), 515, 1990.

884. André de PALMA et Jacques-François THISSE. Les modèles de choix discret. *Annales d'Economie et de Statistique*, 14, 151–190, 1989.

885. Françoise FORGES. Equilibria with communication in a job market example. *The Quarterly Journal of Economics*, 105, 375–398, 1990.

886. Jayasri DUTTA. On resampling inference in econometric models. In *Contributions to Econometric Theory and Applications. Essays in Honour of A.L. Nagar*, edited by R.A.L. Carter, J. Dutta and A. Ullah. New York, Springer Verlag, 293–320, 1990.

887. Heraklis M. POLEMARCHAKIS and Bon-Il KU. Options and equilibrium. *Journal of Mathematical Economics*, 19, 107–112, 1990.

888. Victor GINSBURGH and Geneviève VANHAMME. Price differences in the EC car market. Some further results. *Annales d'Economie et de Statistique*, 15/16, 137–149, 1989.

889. Robin W. BOADWAY and David E. WILDASIN. Optimal tax-subsidy policies for industrial adjustment to uncertain shocks. *Oxford Economic Papers*, 42, 105–134, 1990.

3.3. Other papers which did not appear in the *Discussion Paper* or *Reprint* Series :

A. Working Papers

Kurt ANSTREICHER. On monotonicity in the scaled potential algorithm for linear programming. Mimeo, January 1990 (submitted to *Linear Algebra and its Applications*).

Kurt ANSTREICHER. On partial updating in a potential reduction linear programming algorithm of Kojima, Miluno and Yoshise (with R. Bosch). Mimeo, June 1990 (submitted to *Algorithmica*).

Jesus R. ARAQUE. A polyhedral approach to vehicle routing. Mimeo, prepared for the New York ORSA/TIMS meeting, October 1989.

Jacqueline BOUCHER et Yves SMEERS. Etude sur l'intégration des marchés européens du gaz et de l'électricité. Bruxelles, Ministère des Affaires Economiques, 1989.

Jacqueline BOUCHER and Yves SMEERS. Public procurement in the gas industry : an analysis of the gas merchant companies. Mimeo, 1989.

Jacqueline BOUCHER et Yves SMEERS. Evolution du secteur gazier communautaire à l'horizon 2010 dans le contexte de l'achèvement du maché intérieur. Bruxelles, Commission des Communautés Européennes, 1989.

Jacqueline BOUCHER, Dominique GUSBIN, Joseph LEGRAND, Yves SMEERS et J.Y. WEI. Rapport final contrat EN3M-0080-B (EDF). Bruxelles, Commission des Communautés Européennes, 1990.

Jean-Noël de GOTTAL. Structure d'un système informatique intégré par la gestion des données nécessaires au modèle EFOMNI. Rapport final convention 88-06. Bruxelles, Ministère des Affaires Economiques, 1989.

Françoise FORGES. Trading games with asymmetric information. Discussion Paper 880, The Centre for Mathematical Studies in Economics and Management Science, Northwestern University, Evanston, 1990.

Victor GINSBURGH. Second-hand markets and monopoly power (with S. ANDERSON). CEME Discussion Paper 8911, Université Libre de Bruxelles, 1989.

Victor GINSBURGH. Quantity adjustment costs and price stickiness (with Ph. MICHEL and Ph. MOËS). GREQE Discussion Paper 80A07, 1989.

Victor GINSBURGH. The effects on unemployment of reducing social security contributions : a general equilibrium analysis (with C. DEWATRIPONT, S. ERLICH and D. van REGEMORTER). CEME Discussion Paper 8913, Université Libre de Bruxelles, 1989.

Victor GINSBURGH. On the GATT retaliation rule (with S. WEBER). Mimeo, 1990.

Victor GINSBURGH. In the Cournot-Walras model, there may be more to gain by changing the normalization rule then by eliminating imperfections. A two-goods economy example. Mimeo, 1990.

Victor GINSBURGH. Is art such a bad investment (with O. CHANEL and L.-A. GÉRARD-VARET). Mimeo, 1990.

Marie-Astrid JAMAR et Henry TULKENS. Mesure de l'efficacité productive à la STIB : résultats pour la période 1986–1989. Document de travail du Fonds de Documentation Statistique et Economique sur les Services Publics Belges, c/o CORE, Université Catholique de Louvain, Louvain-la-Neuve, avril 1990.

Marie-Astrid JAMAR et Henry TULKENS. Mesure de l'efficacité de l'activité des tribunaux et évaluation de l'arriéré judiciaire. Document de travail du Fonds de Documentation Statistique et Economique sur les Services Publics Belges, c/o CORE, Université Catholique de Louvain, Louvain-la-Neuve, avril 1990.

Martine LABBÉ. The stochastic queue location problem in the plane (with J.B.G. FRENK, R.J. VISSCHER and S. ZHANG). Report 8948/A, Econometric Institute, Erasmus Universiteit, Rotterdam, 1989.

Martine LABBÉ. The stochastic k-priority queue location problem (with J.B.G. FRANK and S. ZHANG). Report 8951/A, Econometric Institute, Erasmus Universiteit, Rotterdam, 1989.

Martine LABBÉ. Heuristics for the 0-1 minknapsack problem (with J. CSIRIC, J.B.G. FRENK and S. ZHANG). Report 9013/A, Econometric Institute, Erasmus Universiteit, Rotterdam, 1990.

Martine LABBÉ. Fast algorithms for dual bin packing (with J. CSIRIC, J.B.G. FRENK and S. ZHANG). Report 9022/A, Econometric Institute, Erasmus Universiteit, Rotterdam, 1990.

Martine LABBÉ. From the median to the generalized center (with P. HANSEN and J.-F THISSE). Report 9053/A, Econometric Institute, Erasmus Universiteit, Rotterdam, 1990.

Martine LABBÉ. On locating path- or three-shaped facilities on networks (with S.L. HAKIMI, E.F. SCHMEICHEL). Report 9055/A, Econometric Institute, Erasmus Universiteit, Rotterdam, 1990.

Jean-Paul LAMBERT. Structural mismatch, demand and capacity constraints in the rise of French unemployment (with F. GAGEY and B. OTTENWAELTER). Forthcoming in *Europe's Employment Problem*, J.H. Drèze et al. (eds). Cambridge (MA), MIT Press, 1990.

Jean-Paul LAMBERT. "Comments" on the article "Labour market policies and unemployment in the OECD", by R. Jackman, C. Pissarides and S. Savouri. Cahier du CEREC 9001, Facultés Universitaires Saint-Louis. Forthcoming in *Economic Policy*.

Fati MEHTA. Belgian unemployment : the story of a small open economy caught in a worlwide recession (with H. SNEESSENS). Working Paper 8909, Département des Sciences Economiques, Université Catholique de Louvain, 1989.

Fati MEHTA. Employment and unemployment : a new microeconomic databank for Belgium, an explanatory note. Mimeo, Département des Sciences Economiques, Université Catholique de Louvain, 1990.

Michel MOUCHART. Teaching Bayesian statistics : from economic to statistical rationality (with J.-P. FLORENS). Mimeo, 1990.

Michel MOUCHART. Construction d'un modèle multi-usages et multi-énergies de la consommation résidentielle énergétique (avec A.-M. RUTGEERTS). Rapport final de la convention de recherche 88-08 avec le Ministère des Affaires Economiques, 1989.

Jacek OSIEWALSKI. Robust Bayesian inference in elleptical regression models (with M. STEEL). CentER Discussion Paper 9032, Tilburg University, 1990.

Jacek OSIEWALSKI. Posterior inference on the degrees of freedom parameter in multivariate-t regression models. Mimeo, CentER, Tilburg University, 1990.

Pierre PESTIEAU. Pay-as-you-go social security in a changing environment (with R. BOADWAY and D. WILDASIN). Mimeo, 1989.

Pierre PESTIEAU. Some determinants of debt neutrality in OECD nations (with S. PERELMAN). Mimeo, 1989.

Pierre PESTIEAU. Explaining and measuring French intended bequests (with S. PERELMAN). Mimeo, 1989.

Pierre PESTIEAU and Henry TULKENS. Assessing the performance of public sector activities : some recent evidence from the productive efficiency viewpoint. Mimeo, Louvain-la-Neuve, 1990.

Gomatam RAVINDRAN. Non-zero sum stopping games with priority and Dynkins' games (with K. SZAJOWSKI). Mimeo, 1990.

Gomatam RAVINDRAN. Decomposition of bimatrix games (with A.P. JURG and S.H. TIJS. Mimeo, 1990.

Henry TULKENS. Strategic use of tax rates and credits in a model of international corporate income tax competition (with Jack MINTZ). Mimeo, Toronto and Louvain-la-Neuve, 1990.

Philippe VANDEN EECKHAUT, Marie-Astrid JAMAR and Henry TULKENS. A study of cost-efficiency and returns to scale for 235 municipalities in Belgium. Document de travail du Fonds de Documentation Statistique et Economique sur les Services Publics Belges, c/o CORE, Université Catholique de Louvain, Louvain-la-Neuve, October 1990.

Bruno VAN der LINDEN. Dans quelle mesure une diminution des cotisations patronales à la sécurité sociale stimule-t-elle l'emploi. *Bulletin de l'IRES* 142, Département des Sciences Economiques, Université Catholique de Louvain, 1990.

Bruno VAN der LINDEN. Diminution des cotisations patronales à la sécurité sociale et création d'emploi en Belgique. Forthcoming in *Recherches Economiques de Louvain*, 1990.

B. Published Papers

Karen AARDAL. A Benders decomposition based heuristic for the hierarchical production planning problem (with T. LARSON). *European Journal of Operations Research*, 45, 4–14, 1990.

Karen AARDAL. On the resemblance between the Kornai-Lijtck and cross decomposition techniques for block-angular linear programs (with A. ARI). *European Journal of Operations Research*, 46, 393–398, 1990.

Jean J. GABSZEWICZ. Cournot : 150 years after. *European Economic Review*, 33, 1989.

Victor GINSBURGH. Macroeconomic models and microeconomic theory. The contribution of general equilibrium theory (with J. MERCENIER). In *Challenges for Macroeconomic Modelling*, edited by W. Driehuis, M. Fase and H. den Hartog. Amsterdam, North Holland, 291–342, 1988.

Victor GINSBURGH. On the computation of the shadow wage rate in an autarkic agricultural environment (with J.P. KIEKENS). *European Review of Agricultural Economics*, 16, 137–144, 1989.

Victor GINSBURGH. On the use of mathematical programming in applied general equilibrium models. In *Actual Problems in Economic Science*, edited by I. Callastegui, M.A. Callastegui and F. Tusell. Goviemo Vasco, 469–482, 1990.

Martine LABBÉ. Location of an obnoxious facility on a network : a voting approach. *Networks*, 20, 197–207, 1990.

Jean-Paul LAMBERT. The French unemployment problem : lessons from a rationing model relying on business survey information. *European Economic Review*, 34, 423–433, 1990.

Jean-Paul LAMBERT. Pourquoi l'université. *La Revue Nouvelle*, 4, 77-84, 1990.

Michel MOUCHART. Linear Bayes estimation in finite populations with a categorical auxiliary variable (with D. COCCHI). *Statistics*, 21, 3, 1990.

Dominique PEETERS. The location of fire stations in a rural environment : a case study (with D. RICHARD and H. BEGUIN). *Environment and Planning A*, 22, 39–52, 1990.

Dominique PEETERS. Optimiser la localisation des écoles primaires : le cas de Mouscron, Belgique (avec H. BEGUIN et J. DECONNINCK). *Revue d'Economie Régionale et Urbaine*, 5, 795–806, 1989.

Pierre PESTIEAU. Non-cooperative behavior and efficient provision of public goods (with R. BOADWAY and D. WILDASIN). *Public Finance*, 44, 1–7, 1989.

Pierre PESTIEAU. Measuring the performance of public enterprises : a must in times of privatization. *Annals of Public and Cooperative Economy*, 60, 293–306, 1989.

Pierre PESTIEAU. Les économies de dimension dans l'assurance française (with J.M. LAHAYE and S. PERELMAN). *Revue d'Economie Financière*, 11, 105–111, 1990.

Pierre PESTIEAU. L'entreprise d'assurance : économies d'échelle et performance (with Ch. PIRARD). *Revue d'Economie Financière*, 11, 93–104, 1990.

3.4. The following **books** by members of the CORE staff were published during the period covered by this report.

Bernard CORNET and Henry TULKENS (eds.). *Contributions to Operations Research and Economics. The Twentieth Anniversary of CORE.* Cambridge (MA), The MIT Press, 1989.

Bernard CORNET and Henry TULKENS (eds.). *Modélisation et décisions économiques.* Bruxelles, De Boeck-Wesmael, 1990.

Wolfgang HÄRDLE. *Nonparametric Curve Estimation from Time Series* (with L. GYÖRDFI, P. SARDA and Ph. VIEU). (Lecture Notes in Statistics 60). Berlin, Springer-Verlag, 1989.

Michel MOUCHART. *Elements of Bayesian Statistics* (with J.-P. FLORENS and J.-M. ROLIN). New York, M. Dekker, 1990.

Henry TULKENS. *Efficacité et management.* Travaux et actes de la 5ème Commission du 8ème Congrès des Economistes Belges de Langue Française. Charleroi, Centre Interunivesitaire de Formation Permanente (CIFoP), 1989.

3.5. Editorial Activities

Jean J. GABSZEWICZ,	associate editor *Journal of Economics*
Louis GEVERS,	associate editor *Social Choice and Welfare*
Victor GINSBURGH,	associate editor *Annales d'Economie et de Statistique* *Cahiers du CERO* *European Economic Review*
Wolfgang HÄRDLE,	associate editor *Cahiers du CERO* *Journal of the American Statistical Association* *Journal of Computational Statistics and Data Analysis* *Statistics*
Jean-Paul LAMBERT,	associate editor *Recherches Economiques de Louvain*
Maurice MARCHAND,	associate editor *Journal of Public Economics*
Jean-François MERTENS,	associate editor *International Journal of Game Theory* *Economic Theory* *Theory and Decision Library (Game Theory, Mathematical Economics and Operations Research)*
Pierre PESTIEAU,	associate editor *European Journal of Political Economy* *Journal of Population Economics* *Public Finance* *Regional Science and Urban Economics* co-editor *Journal of Population Economics*
Heraklis POLEMARCHAKIS,	associate editor *Economic Theory* *Geneva Papers on Risk and Insurance*

Jacques-François THISSE, associate editor
Annales d'Economie et de Statistique
International Journal of Industrial Organization
Journal of Industrial Economics
Journal of Regional Science
Regional Science and Urban Economics

Laurence WOLSEY, associate editor
Operations Research
co-editor
Mathematical Programming

3.6. Four Research Associates at CORE successfully defended their **Doctoral Dissertations** :

On September 22, 1989, Marie-Paule KESTEMONT, "Experimentations on Bayesian parametric and nonparametric prediction", (Docteur en Sciences, Université Catholique de Louvain), under the supervision of Michel MOUCHART.

On May 22, 1990, Liang ZOU, "Essays in principal-agent theory", (Docteur en Sciences Economiques Appliquées, Université Catholique de Louvain), under the supervision of Claude d'ASPREMONT and Maurice MARCHAND.

On June 18, 1990, Françoise LEFÈVRE, "The estimation of the multivariate structural errors-in-variables model without any a priori on the covariance matrix of the errors", (Docteur en Sciences, Université Catholique de Louvain), under the supervision of Jean-François MERTENS.

On June 19, 1990, Salvador LOPEZ GARCIA, "Wage subsidies in disequilibrium economies", (Docteur en Sciences Economiques, Université Catholique de Louvain), under the supervision of Maurice MARCHAND.

4. SEMINARS AND WORKSHOPS

The three regular weekly seminars in operations research, mathematical economics and econometrics were held from September through June. CORE also continued its participation in the sponsorship of the Séminaire Economique de Louvain.

4.1. The **Operations Research Seminar** met as follows :

1. September 12, 1989, Clyde MONMA, Bellcore,
   Designing survivable communication networks.
2. September 19, 1989, Rafael ARAQUE, State University at New York and CORE,
   On the polyhedral approach to vehicle routing.
3. September 26, 1989, Kurt ANSTREICHER, Yale School of Organization and Management and CORE,
   Long steps in a $0(M^3L)$ algorithm for linear programming.
4. October 31, 1989, Avent BALAKRISHNAN, Massachusetts Institute of Technology, and Tom MAGNANTI, Massachusetts Institute of Technology and CORE,
   A decomposition approach for planning capacity expansion in local telecommunication networks.
5. November 7, 1989, Margaret E. SLADE, University of British Columbia and GREQE-EHESS, Marseille,
   What does an oligopoly maximize ?
   (Joint seminar with the Mathematical Economics Seminar)
6. November 28, 1989, Kurt ANSTREICHER, Yale School of Organization and Management and CORE,
   On the performance of Karmarkar's algorithm over a sequence of iterations.
7. December 5, 1989, Alain HAURIE, Université de Genève,
   Turnpike properties in manufacturing flow controm models.
8. January 16, 1990, Don GOLDFARB, Columbia University,
   Strongly polynomial algorithms for minimum cost network flow problems.
9. January 23, 1990, Rob FREUND, Massachusetts Institute of Technology,
   Recent research on solving linear programs from an infeasible "warm start".
10. February 6, 1990, Rafael ARAQUE, State University at New York and CORE,
    Capacitated trees, capacitated routines and associated polyhedra.
11. February 20, 1990, Manfred PADBERG, New York University and Ecole Polytechnique, Paris,
    Lehman's forbidden minor characterization of ideal 0-1 matrices.

12. February 27, 1990, Martin DYER, University of Leeds,
Probabilistic analysis of the generalised assignment problem.

13. March 20, 1990, Andrzej PROSKUROWSKI, University of Oregon,
Algebraic theory of graph reduction.

14. March 27, 1990, Martine LABBÉ, Erasmus Universiteit Rotterdam,
The Voronoi partition of a network and its implications in location theory.

15. May 8, 1990, Mohamed HAOUARI, Ecole Centrale, Paris,
Modelling and solving vehicle routing problems with time windows using column generation.

16. May 15, 1990, Bob DANIEL, University of Buckingham,
Using arrays of transputers to do MIP by branch and bound.

4.2. The **Mathematical Economics Seminar** met as follows :

1. October 9, 1989, Jean GABSZEWICZ, CORE,
Quality uncertainty and price competition.

2. October 16, 1989, Cheng Zhong QIN, University of California at Los Angeles and CORE,
On a conjecture of Shapley and Shubik.

3. October 23, 1989, John ROBERTS, Stanford University,
Rationalizabilitly, learning and equilibrium in games with strategic complementarities.

4. October 30, 1989, Bernard CORNET, Université de Paris I and Laboratoire d'Econométrie de l'Ecole Polytechnique,
Walrasian exchange processes.

5. November 6, 1989, Charles BLACKORBY, University of British Columbia and GREQE-EHESS, Marseille,
On the observational equivalence of models with an infinitely-lived agent and overlapping generation models.

6. November 7, 1989, Margaret E. SLADE, University of British Columbia and GREQE-EHESS, Marseille,
What does an oligopoly maximize ?
(Joint seminar with the Mathematical Programming Seminar)

7. November 20, 1989, Philippe MONGIN, Ecole Normale Supérieure de Paris, and Département des Sciences Economiques.
Social choice theory in the case of Von Neumann-Morgenstern utilities.

8. December 4, 1989, Xavier VIVES, Universitat Autonoma de Barcelona,
How fast do rational agents learn ?

9. December 11, 1989, Mathias DEWATRIPONT, Université Libre de Bruxelles,
Renegotiation design under symmetric information.

10. December 18, 1989, James PECK, Northwestern University and CORE,
Sunspot-like effects of random endowments.

11. January 15, 1990, Roger GUESNERIE, EHESS-DELTA, Paris,
Eductive justification of the rational expectations hypothesis : application to goods markets and futures markets.

12. January 15, 1990, Peter HAMMOND, European University Institute, Florence,
Perfected option markets in economies with adverse selection.

13. January 22, 1990, Volker BÖHM, Universität Mannheim,
On imperfect competition in general equilibrium.

14. January 29, 1990, Jean-Marc BONNISSEAU, Université de Paris I et Ecole Polytechnique
Existence of Lindahl equilibrium in economies with non-convex production sets.

15. February 5, 1990, Heraklis POLEMARCHAKIS, CORE,
Noninformative rational expectations equilibria when assets are nominal : an example.

16. February 12, 1990, Israel ZANG, Tel Aviv University and CORE,
The limits of monopolizaton through acquisition.

17. February 19, 1990, Nicolas SCHMITT, University of Western Ontario, and CORE,
Trade policy with product differentiation and endogenous market structure : a spatial approach.

18. March 5, 1990, Christian GOLLIER, Ecole des Hautes Etudes Commeciales, Paris,
On the efficiency of credit rationing.

19. March 12, 1990, Henry TULKENS, CORE,
Exchange processes, the core and competitive allocations.

20. March 19, 1990, Marcel BOYER, Université de Montréal et GREMAQ,
Endogenous consumer information and market area in a spatial duopoly.

21. April 23, 1990, Ehud KALAI, Northwestern University,
Learning to play Nash equilibrium.

22. April 30, 1990, Pietro REICHLIN, Universita di Roma and CORE,
Government debt and equity capital in an economy with credit rationing.

23. May 3, 1990, Stephen M. GOLDFELD, Princeton University,
Optimal consumption-portfolio policies with habit formation.
(Joint seminar with Séminaire Economique de Louvain)

24. June 11, 1990, Paul MILGROM, Stanford University,
Multi-task principal-agent analysis : incentive contracts, asset ownership and job design.

25. June 18, 1990, Christophe CHAMLEY, Boston University and CORE,
The last shall be first : foreign borrowing and human capital accumulation.

4.3. The **Econometric Seminar** met as follows :

1. October 4, 1989, Robert BARTELS, University of Sydney and University of Bonn,
Estimation of appliciance load profiles for a residential end-use electricity simulation model.

2. October 11, 1989, Adriaan HOOGENDOORN, Centraal Bureau voor de Statistiek,
Using cart in a tax-date problem.

3. October 18, 1989, M. AERTS, Limburgs Universitair Centrum, Diepenbeek,
Tree structured regression and its implementation in XploRe.

4. November 8, 1989, Jayasri DUTTA, Katholieke Universiteit Leuven,
Resampling tests for heterogeneity.

5. November 15, 1989, Nunzio CAPPUCCIO, University of Trieste and CORE, and Renzo ORSI, University of Calabria and CORE,
Testing exogeneity in overidentified models.

6. November 22, 1989, Herman BIERENS, Free University, Amsterdam,
A consistent conditional moment test of functional form.

7. November 29, 1989, Jean-Marie DUFOUR, Université de Montréal,
Improved Berry-Esseen-Chebyshev bounds with statistical applications.

8. December 6, 1989, Alois KNEIP, University of Heidelberg,
Statistical tools to analyze samples of curves.

9. December 13, 1989, Mark STEEL, CentER, Universiteit Tilburg ,
Weak exogeneity in misspecified sequential models.

10. December 20, 1989, Michael VEALL, McMaster University,
Applications of resampling methods in econometrics.

11. January 31, 1990, Michael McALEER, Australian National University,
Modified rainbow tests.

12. January 31, 1990, Marc HALLIN, Université Libre de Bruxelles,
Rank tests in time series analysis.

13. February 7, 1990, Casper G. de VRIES, Katholieke Universiteit Leuven,
The tail index of exchange rate returns.

14. February 14, 1990, Philippe VIEU, Université Paul Sabatier, Toulouse,
Smoothing procedures in time series analysis.

15. February 21, 1990, Jacek OSIEWALSKI, Academy of Economis, Krakov, and CORE
Bayesian inference in multivariate t regression models.

16. February 28, 1990, Wolfgang HÄRDLE, CORE,
XploRe. A computing environment for eXploratory Regression and data analysis.

17. March 14, 1990, S. HYLLEBERG, University of Aarhus,
Seasonal cointegration : the Japanese consumption function 1961.1–1985.4.

18. March 21, 1990, H. LIERO, Akademie der Wissenschaften der DDR, Berlin,
Strong uniform consistency of conditional U-statistics.

19. March 28, 1990, A.B. TSYBAKOV, Academy of Sciences of the USSR,
Passive stochastic approximation.

20. April 18, 1990, Gerard PFANN, Universiteit Limburg and Université Catholique de Louvain,
Economic crisis and the asymmetric multivariate flexible accelerator model.

21. April 25, 1990, Werner HILDENBRAND, Universität Bonn,
Empirical evidence on the law of demand.
(Joint seminar with the Mathematical Economics Seminar)

22. May 2, 1990, Michael NUSSBAUM, Karl Weierstrass Institute, Berlin,
Choice of spline order in nonparameteric regression estimation.

23. May 2, 1990, Luc DEVROYE, McGill University,
Nonparametric density estimation.

24. May 9, 1990, Alain MONFORT, INSEE, Paris,
Simulation based inference in econometrics.

4.4. The **Séminaire Economique de Louvain** met as follows :

1. September 28, 1989, Martin RAMA, Centro de Investigaciones Economicas, Uruguay,
Déséquilibre, segmentation et recherche d'emploi dans le chômage d'équilibre.

2. November 7, 1989, Reinhilde VEUGELERS, Katholieke Universiteit Leuven,
Multinational entry : Micro-economic foundations and some empirical observations from the Belgian insurance market.

3. November 14, 1989, Damien NEVEN, INSEAD,
European integration, trade flows and redistribution.

4. November 16, 1989, A. KAPTEYN, Universiteit Tilburg,
Labour supply, income taxes and hours restrictions in the Netherlands.

5. November 21, 1989, Stephen MARTIN, European University Institute, Florence,
   Modeling oligopolistic interaction.
6. November 23, 1989, Hideki YAMAWAKI, WZB, Berlin,
   Exports and distributional activities : evidence on Japanese firms in the United States.
7. November 30, 1989, Gerard PFANN, Universiteit Limburg and Université Catholique de Louvain,
   Empirical analysis of optimal firm behaviour : asymmetric adjustment in labour demand in the manufacturing sector in the Netherlands and the United Kingdom.
8. December 7, 1989, Peter HOWITT, University of Western Ontario,
   A model of growth through creative destruction.
9. December 14, 1989, J. PACOLET, Katholieke Universiteit Leuven,
   Concentration, economies of scale and scope in the Belgian banking sector.
10. February 15, 1990, Heraklis M. POLEMARCHAKIS, CORE,
    The neutrality of money.
11. February 22, 1990, Paul REDING, Facultés Universitaires Notre Dame de la Paix, Namur,
    Leads and lags and capital controls on the official market of a dual exchange rate regime.
12. March 1, 1990, Jean-Paul FITOUSSI, O.F.C.E., Paris,
    Une théorie des années quatre-vingts
13. March 8, 1990, Ernst FEHR, University of Technology, Vienna,
    Firm-specific human capital and involuntary unemployment.
14. March 15, 1990, Stefano ZAMAGNI, Universita de Bologna,
    Self-interest and the Harsanyi-Rawls veil of ignorance. An impossibility result.
15. March 22, 1990, Torben ANDERSEN, University of Aarhus, Danemark,
    Asymmetric information and price stickiness in imperfectly competitive markets.
16. March 29, 1990, Pierre-Yves HENIN, Université de Paris I – Panthéon-Sorbonne,
    Contributions des chocs persistants et transitoires à la volatilité de la consommation.
17. April 19, 1990, Gary S. FIELDS, Cornell University,
    Inequality and development.
18. April 26, 1990, Neil de MARCHI, Duke University,
    Closing experiments on the natural rate hypothesis.

19. May 3, 1990, Stephen M. GOLDFELD, Princeton University,
Some hard approaches to the soft-budget constraint.

20. May 10, 1990, Mary GREGORY, Oxford University,
British productivity growth in 1980's : Mrs Thatcher miracle ?

21. May 16, 1990, Pierre MALGRANGE, CEPREMAP,
Une maquette de l'économie française avec anticipations rationnelles et concurrence monopolistique.

22. May 17, 1990, Bernard GAZIER, Université de Paris I,
Les objets de l'économie du travail.

23. May 31, 1990, Johan DEPREZ, Texas Tech University,
A macroeconomic re-examination of Eichner's theory of the mark-up.

24. June 7, 1990, Martin RAMA, Centro de Investigaciones Economicas, Uruguay,
Wage bargaining and economic performance in the open economy.

25. June 12, 1990, Dominique DEPRINS, Facultés Universitaires Saint Louis,
Estimation de frontières de production et mesures de l'efficacité technique.

26. June 14, 1990, Mary R. McCARTHY, Institut Universitaire Européen, Florence,
Les femmes sont-elles la cause de chômage ? Observations dans huit pays de l'O.C.D.E.

27. June 19, 1990, Benoit MULKAY, Facultés Universitaires Saint-Louis,
Analyse de la dispersion des comportements d'investissement des entreprises industrielles françaises.

4.5. A FNRS-NFWO Third Cycle on Mathematical Programming 1989-1990 was organized by Philippe TOINT, Facultés Universitaires Notre Dame de la Paix, Namur, and Laurence WOLSEY, CORE,

1. September 29, 1990, Etienne LOUTE, Facultés Universitaires Saint-Louis, Bruxelles and CORE
Software tools for mathematical programing software development : algorithms and user interface.

2. October 27, 1990, Laurence WOLSEY, CORE,
Recent algorithms for network problems.

3. November 24, 1990, J. TEGHEM, Ecole Polytechnique de Mons,
Multicriteria problems with integer variables.

4. January 26, 1990, Kurt ANSTREICHER, Yale University and CORE,
An introduction to interior point methods for linear programming.

5. February 23, 1990, J. STOER, University of Würzburg,
The state of the art in interior point methods for linear programming, I.

6. March 30, 1990, Kurt ANSTREICHER, Yale University and CORE,
   The state of the art in interior point methods for linear programming, II.
7. April 27, 1990, Nguyen van HIEN, Facultés Universitaires Notre Dame de la Paix, Namur,
   Nondifferentiable optimization : decomposition methods.
8. May 18, 1990, François LOUVEAUX, Facultés Universitaires Notre Dame de la Paix, Namur,
   Models and algorithms for localisation problems and tours under uncertainty.

4.6. An informal workshop in **network design** was also organised.

1. October 9, 1989, Thomas MAGNANTI, Massachussetts Institute of Technology and CORE, and Laurence WOLSEY, CORE
   Lot-sizing with start ups.
2. October 10 1989, Robert WEISMANTEL, University of Augsburg,
   Placement in VLSI design.
3. October 10, 1989, Alexander MARTIN, University of Augsburg,
   A cutting plane algorithm for the Steiner tree problem.
4. October 17, 1989, Doris ZEPF, University of Augsburg,
   Computing Voronoi diagrams with finite precision.
5. October 17, 1989, Yazid SHARAIHA, Imperial College,
   Graph theoretic approach to image processing.
6. October 19, 1989, Thomas LEKANE, Tractebel,
   Some fixed charge in network models.
7. November 8, 1989, Yves POCHET, Institut d'Administration et de Gestion, and CORE,
   Using discrete dynamic programs in variable redefinition techniques.

4.7. A Seminar in Quantitative Methods in Management was organized jointly by the Institut d'Administration et de Gestion and CORE

1. Thomas L. MAGNANTI, Massachusetts Institute of Technology and CORE,
   Designing communication, distribution and production network.

4.8. Claude d'ASPREMONT organised a **Workshop in Game Theory**.

1. November 22, 1989, Chen-Zhong QIN, CORE,
   Randomized blocking, welfare maximizing, and the inner core.

2. November 29, 1989, Gomatam RAVINDRAN, Indian Statistical Institute and CORE,
   M-matrices, characterization and application.

3. December 6, 1989, Bernard de MEYER, CORE,
   Repeated games and the normal distribution.

4. December 13, 1989, Bernard LEBRUN, CORE,
   Asymmetric information in repeated trade, an auction framework.

5. December 20, 1989, Jim PECK, Northwestern University and CORE,
   Correlated equilibrium and sunspot equilibrium in imperfectly competitive economies.

6. January 10, 1989, Françoise FORGES, CORE,
   Sunspots and market games.

7. January 17, 1989, Jean-François MERTENS, CORE,
   Cooperative theory without full committment power.

8. January 24, 1990, Sylvain SORIN, Université Louis Pasteur, Strasboug,
   Recent advances in dynamic programming.

9. January 30, 1990, James BERGIN, Queen's University and CORE,
   Anonymous sequential games with aggregate uncertainty.

10. February 13, 1990, Giulio CODOGNATO and Jean J. GABSZEWICZ, CORE,
    Cournot, Cournot-Walras and Walras equilibria in pure exchange economies : an example.

11. February 20, 1990, Dov MONDERER, Tel Aviv University,
    Common knowledge.

12. March 6, 1990, Claude d'ASPREMONT, CORE,
    Pareto-optimality and Bayesian incentive compatibility.

13. March 20, 1990, James BERGIN, Queen's University and CORE,
    A model of repeated games in continuous time.

14. March 27, 1990, Antoine SOUBEYRAN, Université de Valenciennes,
    Does concentration increase welfare ?

15. June 12, 1990, A.P. JURG, University of Nijmegen,
    On the finiteness of stable sets.

4.9. A Seminar in Public Economics was organised by Henry TULKENS.

1. April 19, 1990, Michael KEEN, University of Essex,
   Needs and targeting in social security analysis.

2. May 15, 1990, Syed AHSAN, Concordia University and CORE,
   Tax policy in a model of leisure, savings and asset behaviour.

4.10. Henry TULKENS also organised an **"Atelier de lecture et de discussion en 'Economie théorique et empirique de la production'"**.

1. November 27, 1989, Léopold SIMAR, Facultés Universitaires Saint-Louis and CORE,
   Estimating efficiencies from frontier models with panel data : a comparison of parametric, non parametric and semi-parametric methods.

2. January 8, 1990, Philippe VANDEN EECKHAUT, CORE,
   Le repérage et le traitement des outliers.

3. February 8, 1990, Sergio PERELMAN, Université de Liège,
   Estimation des foncitons de coûts dans les sociétés de transports urbains.

4. March 12, 1990, Marie-Astrid JAMAR, CORE,
   DEA : un tour d'horizon.

5. April 23, 1990, Henri-Jean GATHON et Fabienne GROSJEAN, Université de Liège,
   Efficacité productive et rendements d'échelle dans les banques belges (méthode paramétrique stochastique).

6. June 25, 1990, C. Knox LOVELL, University of North Carolina and CORE,
   Chance-constrained efficiency measurement.

7. June 28, 1990, Lisa WOOD, University of North Carolina and CORE,
   Modelling education production using DEA and regression analysis.

5. MEETINGS HELD AT CORE

5.1. Efficiency and Productivity Measurement in the Service Industries.

Henry TULKENS (organiser)

Programme

October 20, 1989

- **Introductory Remarks**, Henry TULKENS.

- **Session A : Methodological Issues I**

Chairman : Bernard THIRY, Université de Liège and CIRIEC.

· Finn FØRSUND, University of Oslo, and Lennart HJALMARSSON, University of Göteborg,
Approaches to the measurement of productivity and efficiency : An overview.

· Henry TULKENS, CORE, Université Catholique de Louvain and Facultés Universitaires Saint-Louis, Bruxelles,
FDH frontier estimates : A review of conceptual and methodological characteristics.

· Léopold SIMAR, Facultés Universitaires Saint-Louis, Bruxelles, and CORE, Université Catholique de Louvain,
Estimating efficiencies from frontier models with panel data : A comparison of parametric, non parametric and semi-parametric methods.
Discussant : Jacques MAIRESSE, Ecole Nationale de la Statistique et de l'Administration Economique, Paris.

- **Session B : Applications I**

Chairman : Lennart HJALMARSSON, University of Göteborg.

Medical Services :

· Rof FÄRE and Shawna GROSSKOPF, University of Southern Illinois at Carbondale and B. LINDGREN and Pontus ROOS, The Swedish Institute for Health Economics, Lund,
Productivity developments in Swedish hospitals : A Malmquist output index approach.

· Ingvar WESTERBERG, University of Linköping,
Technical efficiency in public dental care in Sweden.

Banking Services :

- Sigbjørm BERG, Bank of Norway, Finn FØRSUND, University of Oslo, and Eilev JANSEN, Bank of Norway,
  Bank output measurement and the construction of best practice frontiers.

- Catherine DEMAIN, Alain NAGLY, Henry TULKENS and Philippe VANDEN EECKAUT, CORE, Université Catholique de Louvain,
  Productive efficiency measurement in retail banking in Belgium.

Social and Municipal Services :

- Hans BJUREK and Lennart HJALMARSSON, University of Göteborg, and Finn FØRSUND, University of Oslo,
  Parametric and non parametric estimation of efficiency in Swedish local social insurance offices : a comparison.

- Marie-Astrid JAMAR, Henry TULKENS and Philippe VANDEN EECKAUT, CORE, Université Catholique de Louvain,
  A cost-efficiency study of the activities of 234 municipalities in Belgium.

October 21, 1989

- Session C : Methodological Issues II

Chairman : Finn FØRSUND, University of Oslo

- Erik MELLANDER, The Industrial Institute for Economic and Social Research (IUI), Stockholm,
  On the econometric analysis of production when there are no output data.
  Discussant : Joan MUYSKEN, University of Maastricht.

- Dominique DEPRINS, Facultés Universitaires Saint-Louis, Bruxelles,
  Introducing exogenous explanatory factors in deterministic production frontiers.

- Niels C. PETERSEN and Ole OLESEN, University of Odense,
  Chance constrained efficiency evaluation.
  Discussant : Etienne LOUTE, Facultés Universitaires Saint-Louis, Bruxelles, and CORE, Université Catholique de Louvain.

- Terje VASSDAL, University of Tromsø,
  A method to compare average and deterministic frontier functions.
  Discussant : Bernard THIRY, Université de Liège and CIRIEC.

- **Session D : Applications II**

Chairman : Pierre PESTIEAU, Université de Liège, and CORE, Université Catholique de Louvain

Transportation :

· Bernard DELHAUSSE, Sergio PERELMAN and Bernard THIRY, Université de Liège and CIRIEC,
Efficiency in Belgian urban and interurban bus transportation.

· Pierre BARLA and Sergio PERELMAN, Université de Liège,
Productivity comparison of airline companies.

· Henri Jean GATHON, Université de Liège,
Measuring technical efficiency in the European railroad industry by means of a stochastic production frontier.

Construction and Retail Distribution :

· Dolf ALBRIKTSEN, Norwegian Building Research Institute, and Finn FØRSUND, University of Oslo,
Productivity in Norwegian construction.

· Lennart HJALMARSSON and Ann VEIDERPASS, University of Göteborg,
Productivity, growth and productive efficiency in Swedish electricity retail distribution.

Judicial Services :

· Finn FØRSUND, University of Oslo, Erik HERNÆS and Sverre KITTELSEN, Center for Applied Economic Research, Oslo,
Productivity in public service production, with an application to courts.

· Marie-Astrid JAMAR and Henry TULKENS, CORE, Université Catholique de Louvain,
Applying productive efficiency measurement to Belgian courts.

- **Concluding Remarks**, Bernard THIRY.

5.2. Bonn-Louvain Seminars in Mathematical Economics

organised by the Institut für Gesellschafts- und Wirtschaftswissenschaften, Rheinische Friedrich-Wilhelms Universität Bonn and CORE.

- *First meeting, April 25, 1990*
  - . Werner HILDENBRAND, Universität Bonn,
    Empirical evidence on the law of demand.
  - . Heraklis POLEMARCHAKIS, CORE,
    Overlapping generations.

This is the first in a series of biannual meetings.

6. CORE LECTURE SERIES

6.1. Martin GRÖTSCHEL, University of Augsburg, presented a series of lectures on modelling, algorithms and practical problem solving in combinatorial optimization, entitled "Postmen, ground states of spin glasses, via optimization and cycles in binary matroids".

October 6, 1989, A survey.
October 11, 1989, Chinese postman and max cut problems in planar graphs.
October 13, 1989, Ground states of spin glasses.
October 18, 1989, Via minimisation.
October 20, 1989, Cycles in binary matroids.

6.2. David KREPS, Graduate School of Business, Stanford University, presented a series of lectures concerning one justification that is often given for the use of the Nash equilibrium concept in modeling economic institutions and phenomena entitled "Learning, experimentation, and equilibrium in games".

May 8, 1990, Game theory and economic modeling.
May 10, 1990, A theory leading to Nash equilibrium.
May 15, 1990, Refinements from the perspective of this theory.
May 17, 1990, (1) Learning cooperative behavior.
(2) Learning across information sets.

7. ACADEMIC VISITS

Academic visits by CORE members to other institutions :

July 1989 :

Jayasri DUTTA,	CentER, Tilburg
Michel MOUCHART,	GREMAQ, Université des Sciences Sociales, Toulouse

August 1989 :

Michel MOUCHART,	Interamerican Training Center of Statistics, Santiago, Chili

October 1989 :

Wolfgang HÄRDLE,	Free University, Amsterdam
	Centraal Bureau voor Statistics, Voorburg

November 1989 :

Karen AARDAL,	Erasmus University, Rotterdam,
	Centruum voor Wiskunde en Informatica, Amsterdam
Claude d'ASPREMONT,	Scuola Superiore S. Anna, Pisa
Daniel DE WOLF,	INRIA, Paris
Jayasri DUTTA,	CEPREMAP, Paris
	University of Copenhagen
Jean-Paul LAMBERT,	Centre Universitaire de Luxembourg
	Rijksuniversiteit Limburg, Maastricht
Henry TULKENS,	Norwegian School of Economics and Business Administration, Bergen
	Norwegian Research Center in Organization and Management, Bergen
Laurence WOLSEY,	Ecole Polytechnique de Poznan, Pologne

December 1989 :

Jorge AMAYA,	University of Chile, Santiago
Claude d'ASPREMONT,	Université Paris I
Jayasri DUTTA,	CEPREMAP, Paris

Wolfgang HÄRDLE,	Katholieke Universiteit Leuven
Martine LABBÉ,	Université Paris-Dauphine
Michel MOUCHART,	GREQE, Université d'Aix-Marseille
Henry TULKENS,	University of Odense

January 1990 :

Karen AARDAL,	Aarhus University
	Linköping University
Françoise FORGES,	GREQE, Marseille
Jean-Paul LAMBERT,	University of Münich
Michel MOUCHART,	GREMAQ, Université des Sciences Sociales, Toulouse
Pierre PESTIEAU,	Université Paris X Nanterre
Henry TULKENS,	Université de Montréal
Laurence WOLSEY,	EIASM, Bruxelles

February 1990 :

Jayasri DUTTA,	CREST-ENSAE, Paris
Jean-François MERTENS,	State University of New York at Stony Brook
Michel MOUCHART,	University of Granada
Pierre PESTIEAU,	Université Paris X Nanterre
Jean-Marie ROLIN,	Université Nationale du Rwanda, Butare
Henry TULKENS,	Katholieke Universiteit Leuven

March 1990 :

Françoise FORGES,	Northwestern University
Wolfgang HÄRDLE,	INRA, Paris
	CentER, Tilburg University
Martine LABBÉ,	Université Libre de Bruxelles
Maurice MARCHAND,	Queen's University
Jean-François MERTENS,	State University of New York at Stony Brook
Henry TULKENS,	GREQE, Marseille
Gomatam RAVINDRAN,	University of Nijmegen
Laurence WOLSEY,	Georgia Institute of Technology

April 1990 :

Jesus R. ARAQUE,	University of Eindhoven
Françoise FORGES,	Northwestern University
Martine LABBÉ,	Universidade de Lisboa
	Universidade de Coimbra
Maurice MARCHAND,	Queen's University
	University of Toronto
Jean-François MERTENS,	State University of New York at Stony Brook
Jacques-François THISSE,	Virginia Polytechnic Institute and State University

May 1990 :

Karen AARDAL,	Yale University
	Massachusetts Institute of Technology
	Cornell University
Syed M. AHSAN,	University of Helsinki
	CentER, Tilburg University
	Johan Kepler University Linz
Kurt M. ANSTREICHER,	Delft University of Technology
Jesus R. ARAQUE,	University of Augsburg
Françoise FORGES,	Northwestern University
Victor GINSBURGH,	Ecole des Hautes Etudes en Sciences Sociales, Marseille,
Wolfgang HÄRDLE,	University of Heidelberg
	University of Düsseldorf
Martine LABBÉ,	Universidade de Lisboa
Michel MOUCHART,	University of Malaga
Jacek OSIEWALSKI,	CentER, Tilburg
Henry TULKENS,	University of Bologna
Laurence WOLSEY,	Bellcore, Morristown, New Jersey
	Georgia Institute of Technology
	Yale University

June 1990 :

Jayasri DUTTA,	University of Bonn
Françoise FORGES,	Duke University

Jean J. GABSZEWICZ, University of Bonn
Wolfgang HÄRDLE, University of Trier
University of Fribourg
Martine LABBÉ, University of California at Davis
Heraklis POLEMARCHAKIS, University of Bonn
Henry TULKENS, University of Toronto

8. CONFERENCES AND MEETINGS

CORE members attended the following conferences and most presented a paper.

July, 1989 :

Combinatorial Optimization Conference, Leeds
Karen AARDAL

Columbus Edwin Smart Symposium on Games and Behavior
Claude d'ASPREMONT

International Conference on Social Choice, Valencia
Claude d'ASPREMONT

World Conference on Transportation Research (WCTE'89), Yokohama
Martine LABBÉ

August, 1989 :

9th World Congress of the International Economic Association, Athens
Françoise FORGES, Jean J. GABSZEWICZ, Isabel GRILO and Jean-François MERTENS

Meeting of the Econometric Society, Santiago, Chile
Michel MOUCHART

47th Session of the International Statistical Institute, Paris
Michel MOUCHART

IIPF Congress on Public Finance and Steady Economic Growth, Buenos Aires
Pierre PESTIEAU

September, 1989 :

European Meeting of the Econometric Society, Munich
Claude d'ASPREMONT, Jacques THISSE

3ème Colloque de l'Association Charles Gide, Conseil de l'Europe, Strasbourg
Claude d'ASPREMONT

Fourth Annual Congress of the European Economic Association, Augsburg
Jean GABSZEWICZ, Jean-Paul LAMBERT, Maurice MARCHAND

Conférence Mondiale de l'Energie, Montréal

Dominique GUSBIN

International Symposium on "The Art of Full Employment", Maastricht

Jean-Paul LAMBERT

Sixth European Colloquium on Theoretical and Quantitative Geography, Chantilly

Dominique PEETERS

Colloque de l'Association de Science Régionale de Langue Française, Bordeaux

Dominique PEETERS

Boston Area Public Enterprise Group, Boston

Henry TULKENS

Conference on New Uses of DEA in Management, Austin, Texas

Henry TULKENS

October, 1989 :

Statistical Software Meeting, Utrecht

Wolfgang HÄRDLE

Ninth Panel Meeting of the Review *Economic Policy*, London,

Jean-Paul LAMBERT

Groupe de Contact FNRS "Finances et Economies Publiques", Leuven

Bruno VAN der LINDEN

November, 1989 :

Symposium on Applied General Equilibrium Models for Open Economies, Den Haag, Netherlands

Victor GINSBURGH

Xème Rencontre Franco-Belge de Statisticiens, Bruxelles

Joseph HAKIZAMUNGU, Michel MOUCHART (co-organiser),

Jean-Marie ROLIN and Léopold SIMAR

European Production on Study Group Colloquium, ENSAE, Paris

Henry TULKENS

December, 1989 :

IIème Congrès Franco-Chilien de Mathématiques Appliquées, Santiago, Chili

Jorge AMAYA

January, 1990 :

ORBEL V, Bruxelles

Karen AARDAL, Jesus R. ARAQUE, Cid DE SOUZA, Martine LABBÉ, Dominique PEETERS and Laurence WOLSEY

15th Conference on Mathematics of Operations Research, Dalfsen, Netherlands

Kurt ANSTREICHER

International Symposium on Interior Point Methods, Scheveningen, Netherlands

Jorge AMAYA and Kurt ANSTREICHER

Workshop on Applied General Equilibrium and Economic Development, Montréal

Victor GINSBURGH

Workshop on Operations Research/Microeconomics Interfaces, EIASM, Bruxelles

Martine LABBÉ and Jean-François THISSE

Geneva Association Conference on Productivity in Insurance, Paris

Pierre PESTIEAU

Colloquium on Applications of Combinatorial Optimization, Oberwolfach,

Laurence WOLSEY

February, 1990 :

Second Asilomar Workshop on Progress in Mathematical Programming, Monterey, California

Kurt ANSTREICHER (co-organizer)

Seminar on Location Theory, Rotterdam

Dominique PEETERS

April, 1990 :

European Doctoral Program in Quantitative Economics Annual Meeting, London

Giulio CODOGNATO, Claude d'ASPREMONT, Francisco DE SOUSA RAMOS, Isabel GRILO, Michel MOUCHART, Heraklis POLEMARCHAKIS

European Doctoral Program in Quantitative Methods in Management Annual Meeting,

Karen AARDAL, Patrick WATTEYNE, Laurence WOLSEY

Journées sur l'Economie des Réseaux, Paris

Victor GINSBURGH

Applied General Equilibrium Modeling, Bern, Switzerland

Victor GINSBURGH

Tenth Panel Meeting of the Review *Economic Policy*, Paris,

Jean-Paul LAMBERT

May, 1990 :

Integer Programming and Combinatorial Optimization Conference, Waterloo

Karen AARDAL

Journées de Statistique, Tours

Dominique DEPRINS, Michel MOUCHART, Jean-Marie ROLIN and Léopold SIMAR

Association d'Econométrie Appliquée : Econométrie et Marketing, Lyon

Victor GINSBURGH

Euro Working Group on Combinatorial Optimization, Barcelona

Martine LABBÉ

Colloque Bureau du Plan, Bruxelles

Jean-Paul LAMBERT

SESO Workshop on Overheidsinvesteringen in Mens en Infrastrukturen, Antwerpen

Pierre PESTIEAU

ISPE Conference on Fiscal Implications of an Ageing Population, Vaals

Pierre PESTIEAU

Workshop on Planning, Scheduling and Constraint Solving : Techniques, Tools and Applications, Katholieke Universiteit Leuven

Yves POCHET

June, 1990 :

5th International Conference on the Foundations and Applications of Utility, Risk and Decision Theories, Duke University

Françoise FORGES

Journées sur l'Economie de l'Art, Marseille

Victor GINSBURGH

ISOLDE V, International Symposium on Locational Decisions V, Los Angeles

Martine LABBÉ and Dominique PEETERS

ESPE Annual Congress, Istambul

Pierre PESTIEAU

Symposium on the Political Economy of Government Debt, Amsterdam

Pierre PESTIEAU

7èmes Journées de Microéconomie Appliquée, Université de Québec

Henry TULKENS

Second International Workshop on Project Management and Scheduling, Compiègne

Daniel TYTECA

9. INSTITUTIONAL ASPECTS

9.1. Management

Officers elected for the period September 1988 - August 1991 are :

President :	Jean J. GABSZEWICZ
Research Director :	Laurence WOLSEY
Co-directors :	Claude d'ASPREMONT
	Léopold SIMAR

9.2. External Support

Part of CORE's research activities continue to be supported by external sources :

A. The Belgian government supports projects on

(i) computer-aided modelling systems supervised by Maurice MARCHAND and Laurence A. WOLSEY

(ii) modelling of the energy systems,
  (a) a demand for energy from the household sector, supervised by Michel MOUCHART
  (b) impact of the internal market in the gas and electricity sectors, supervised by Yves SMEERS

(iii) microeconomic data bank on employment and wages and research on the labour market, supervised by Jean-Paul LAMBERT and Michel MOUCHART

(iv) modelling of market competition between profit and non-profit firms from the viewpoint of efficiency and equity in resource allocation, supervised by Maurice MARCHAND and Jacques THISSE

(v) development of a statistical data bank on Belgian public utilities, supervised by Maurice MARCHAND and Henry TULKENS

B. The Commission of the European Community supports projects on :

(i) markets and organisations : a game-theoretical approach, supervised by Claude d'ASPREMONT

(ii) European unemployment programme, phase II, supervised by Jean-Paul LAMBERT and Michel MOUCHART

(iii) modelling of the integrated electricity and gas markets supervised by Yves SMEERS