

- 2009/1 Forecasting the direction of policy rate changes: The importance of ECB words
Carlo ROSA

This paper evaluates the predictive power of different information sets for the European Central Bank (ECB) interest rate setting behavior. We employ an ordered probit model, i.e. a limited dependent variable framework, to take into account the discreteness displayed by policy rate changes. The results show that the forecasting ability of standard Taylor-type variables, such as inflation and output gap, is fairly low both in-sample and out-of-sample, and is comparable to the performance of the random walk model. Instead by using broader information sets that include measures of core inflation, exchange rates and monetary aggregates, the accuracy of the forecasts about ECB future actions substantially improves. Moreover, ECB rhetoric contributes to a better understanding of its policy reaction function, and ECB statements complement the information contained in actual macro figures. Finally, we find that the ECB has been fairly successful in educating the public to anticipate the overall future direction of its monetary policy, but has been less successful in signaling the exact timing of rate changes.

- 2009/2 Consistent ranking of multivariate volatility models
Sébastien LAURENT, Jeroen V.K. ROMBOOTS and Francesco VIOLANTE

A large number of parameterizations have been proposed to model conditional variance dynamics in a multivariate framework. This paper examines the ranking of multivariate volatility models in terms of their ability to forecast out-of-sample conditional variance matrices. We investigate how sensitive the ranking is to alternative statistical loss functions which evaluate the distance between the true covariance matrix and its forecast. The evaluation of multivariate volatility models requires the use of a proxy for the unobservable volatility matrix which may shift the ranking of the models. Therefore, to preserve this ranking conditions with respect to the choice of the loss function have to be discussed. To do this, we extend the conditions defined in Hansen and Lunde (2006) to the multivariate framework. By invoking norm equivalence we are able to extend the class of loss functions that preserve the true ranking. In a simulation study, we sample data from a continuous time multivariate diffusion process to illustrate the sensitivity of the ranking to different choices of the loss functions and to the quality of the proxy. An application to three foreign exchange rates, where we compare the forecasting performance of 16 multivariate GARCH specifications, is provided.

JEL Classification: C10, C32, C51, C52, C53, G10

Keywords: volatility, multivariate GARCH, matrix norm and loss function, norm equivalence.

- 2009/3 The principal's dilemma
Dunia LÓPEZ-PINTADO and Juan D. MORENO-TERNERO

A recurrent dilemma in team management is to select between a team-based and an individual-based wage scheme. We explore such a dilemma in a simple model of production in teams, in which the team members may differ in their effort choices and qualification. We show that, in spite of enhancing output as the basis for payment, a team-based wage scheme might be less profitable for the principal than an individual-based wage scheme. We also highlight a deep misalignment between designing optimal (output-based) incentives for a team and treating its members

impartially. Finally, upon introducing the possibility of liquidity constraints in our model, we provide rationale for the so-called “rich get richer” hypothesis.

JEL Classification: C70, D23, D78

Keywords: team production, management, incentives, effort.

- 2009/4 A viability theory approach to a two-stage optimal control problem of technology adoption
Jacek B. KRAWCZYK and Oana-Silvia SEREA

A new technology adoption problem can be modelled as a two-stage control problem, in which model parameters (“technology”) might be altered at some time. An optimal solution to utility maximisation for this class of problems needs to contain information on the time, at which the change will take place (0, finite or never), along with the optimal control strategies before and after the change. For the change, or switch, to occur the “new technology” value function needs to dominate the “old technology” value function, after the switch. We characterise the value function using the fact that its hypograph is a viability kernel of an auxiliary problem and we study when the graphs can intersect. If they do not, the switch cannot occur at a positive time. Using this characterisation we analyse a technology adoption problem and show how to recognise the models, for which the switch will occur at time zero or never.

JEL Classification: C6, C61, C69

Keywords: technology adoption, value function, viability kernel, viscosity solutions.

- 2009/5 Regularity and stability of equilibria in an overlapping generations model with exogenous growth
Jean-François MERTENS and Anna RUBINCHIK

In an exogenous-growth economy with overlapping generations (OG) we analyse local stability of the balanced growth equilibria with respect to perturbations of consumption endowments, thought of as the “monetised” value of a government policy to individuals. We show that perturbed economies have a unique equilibrium in the neighbourhood, that the equilibrium allocation expressed in terms of efficient labour units is Fréchet differentiable in L_∞ with derivatives given by kernels, and that the equilibrium is stable in the sense that if perturbations converge to 0 at $\pm\infty$, the corresponding equilibria converge back to the unperturbed equilibrium at $\pm\infty$. As a corollary this implies a proof of non-vacuity of the main result in Mertens and Rubinchik (2006).

JEL Classification: D50, H43

Keywords: regularity of infinite economies; policy evaluation, overlapping generations, exogenous growth, intergenerational fairness, utilitarianism, relative utilitarianism.

- 2009/6 Using underapproximations for sparse nonnegative matrix factorization
Nicolas GILLIS and François GLINEUR

Nonnegative Matrix Factorization (NMF) has gathered a lot of attention in the last decade and has been successfully applied in numerous applications. It consists in the factorization of a nonnegative matrix by the product of two low-rank nonnegative matrices: $M \approx VW$. In this paper, we attempt to solve NMF problems

in a recursive way. In order to do that, we introduce a new variant called Nonnegative Matrix Underapproximation (NMU) by adding the upper bound constraint $VW \leq M$. Besides enabling a recursive procedure for NMF, these inequalities make NMU particularly well-suited to achieve a sparse representation, improving the part-based decomposition.

Although NMU is NP-hard (which we prove using its equivalence with the maximum edge biclique problem in bipartite graphs), we present two approaches to solve it: a method based on convex reformulations and a method based on Lagrangian relaxation. Finally, we provide some encouraging numerical results for image processing applications.

Keywords: nonnegative matrix factorization, underapproximation, maximum edge biclique problem, sparsity, image processing.

2009/7 Correlated risks, bivariate utility and optimal choices
Michel M. DENUIT, Louis EECKHOUDT and Mario MENEGATTI

In this paper, we consider a decision-maker facing a financial risk flanked by a background risk, possibly non-financial, such as health or environmental risk. A decision has to be made about the amount of an investment (in the financial dimension) resulting in a future benefit either in the same dimension (savings) or in the order dimension (environmental quality or health improvement). In the first case, we show that the optimal amount of savings decreases as the pair of risks increases in the bivariate increasing concave dominance rules of higher degrees which express the common preferences of all the decision-makers whose two-argument utility function possesses direct and cross derivatives fulfilling some specific requirements. Roughly speaking, the optimal amount of savings decreases as the two risks become "less positively correlated" or marginally improve in univariate stochastic dominance. In the second case, a similar conclusion on optimal investment is reached under alternative conditions on the derivatives of the utility function.

Keywords: bivariate higher order increasing concave stochastic dominance, precautionary savings, background risk, dependence.

2009/8 Adding independent risks in an insurance portfolio: which shape for the insurers' preferences?
Michel M. DENUIT, Louis EECKHOUDT and Mario MENEGATTI

Many papers in the literature have adopted the expected utility paradigm to analyze insurance decisions. Insurance companies manage policies by growing, by adding independent risks. Even if adding risks generally ultimately decreases the probability of insolvency, the impact on the insurer's expected utility is less clear. Indeed, it is not true that the risk aversion toward the additional loss generated by a new policy included in an insurance portfolio is a decreasing function of the number of contracts already underwritten (i.e. the "fallacy of large numbers"). In this paper, it is shown that most commonly used utility functions do not necessarily positively value the aggregation of independent risks so that they are not eligible for insurers. This casts some doubt about the conclusions drawn in the papers postulating such completely monotonic utilities for guiding insurers' choices. Finally, it is shown that the sufficient conditions for adding risks that can be found in the literature need to be refined by restricting the domain of definition of the insurer's utility function.

Keywords: expected utility, compensating premium, prudence, temperance.

- 2009/9 The Pareto principle of optimal inequality
Antoine BOMMIER and Stéphane ZUBER

The Pareto principle is often viewed as a mild requirement compatible with a variety of value judgements. In particular, it is generally thought that it can accommodate different views on the desirable degree of equality. We show that this is generally not true in intertemporal models where some uncertainty prevails. To do so, we formalize the concept of inequality aversion. We show that different degrees of inequality aversion are not possible in typical models of time-consistent dynamic decision under uncertainty.

JEL Classification: D6, D7, D81, D9

Keywords: inequality aversion, Pareto principle, uncertainty, time consistency.

- 2009/10 Environmental negotiations as dynamic games: Why so selfish?
Raouf BOUCEKKINE, Jacek B. KRAWCZYK and Thomas VALLEE

We study a trade-off between economic and environmental indicators using a two-stage optimal control setting where the player can switch to a cleaner technology, that is environmentally “efficient”, but economically less productive. We provide an analytical characterization of the solution paths for the case where the considered utility functions are increasing and strictly concave with respect to consumption and decreasing linearly with respect to the pollution stock. In this context, an isolated player will either immediately start using the environmentally efficient technology, or for ever continue applying the old and “dirty” technology. In a two-player (say, two neighbor countries) dynamic game where the pollution results from a sum of two consumptions, we prove existence of a Nash (open-loop) equilibrium, in which each player chooses the technology selfishly i.e., without considering the choice made by the other player. A Stackelberg game solution displays the same properties. Under cooperation, the country reluctant to adopt the technology as an equilibrium solution, chooses to switch to the cleaner technology provided it benefits from some “transfer” from the environmentally efficient partner.

JEL Classification: O41, Q56, Q58

Keywords: pollution, technology adoption, optimal control, dynamic games.

- 2009/11 Promoting clean technologies under imperfect competition
Théophile T. AZOMAHOU, Raouf BOUCEKKINE and Phu NGUYEN-VAN

We develop a general equilibrium multi-sector vintage capital model with energy-saving technological progress and an explicit energy market to study the impact of investment subsidies on investment and output. Energy and capital are assumed to be complementary in the production process. New machines are less energy consuming and scrapping is endogenous. The intermediate inputs sector is modelled *à la* Dixit-Stiglitz (1977). Two polar market structures are considered for the energy market, free entry and natural monopoly. The impact of imperfect competition on the outcomes of the decentralized equilibria are deeply characterized. We identify an original paradox: adoption subsidies may induce a larger investment into cleaner technologies either under free entry or natural monopoly. However, larger diffusion rates do not necessarily mean lower energy consumption at equilibrium, which may explain certain empirical puzzles.

JEL Classification: O40, E22, Q40

Keywords: energy-saving technological progress, vintage capital, market imperfections, natural monopoly, investment subsidies.

- 2009/12 On tax competition, public goods provision and jurisdictions' size
Patrice PIERETTI and Skerdilajda ZANAJ

In this paper, we analyse competition among jurisdictions to attract firms through low taxes on capital and/or high level of public goods, which enhance firms' productivity. We assume that the competing jurisdictions are different in (population) size and that the mobility of capital is costly. We find that for moderate mobility costs, small economies can attract foreign capital if they supply higher levels of public goods than larger jurisdictions, without being tax havens. If mobility costs are high, we recover the classical result that small jurisdictions are attractive to foreign capital if they engage in tax dumping. Finally, we show that there exists a subset of mobility costs for which the differentiation in public goods across jurisdictions is not able to relax tax competition.

JEL Classification: H25, H73, F13, F15, F22

Keywords: tax competition, public goods competition, spatial competition, foreign direct investments, country size.

- 2009/13 Bayesian option pricing using mixed normal heteroskedasticity models
Jeroen V.K. ROMBOUTS and Lars STENTOFT

While stochastic volatility models improve on the option pricing error when compared to the Black-Scholes-Merton model, mispricings remain. This paper uses mixed normal heteroskedasticity models to price options. Our model allows for significant negative skewness and time varying higher order moments of the risk neutral distribution. Parameter inference using Gibbs sampling is explained and we detail how to compute risk neutral predictive densities taking into account parameter uncertainty. When forecasting out-of-sample options on the S&P 500 index, substantial improvements are found compared to a benchmark model in terms of dollar losses and the ability to explain the smirk in implied volatilities.

JEL Classification: C11, C15, C22, G13

Keywords: Bayesian inference, option pricing, finite mixture models, out-of-sample prediction, GARCH models.

- 2009/14 The valuation of power futures based on optimal dispatch
Gauthier de MAERE d'AERTRYCKE and Yves SMEERS

The pricing of contingent claims in the wholesale power market is a controversial topic. Important challenges come from the non-storability of electricity and the number of parameters that impact the market. We propose an equilibrium model based on the fundamentals of power generation. In a perfect competitive market, spot electricity prices are determined by the marginal cost of producing the last unit of power. Electricity can be viewed as a derivative of demand, fuels prices and carbon emission price. We extend the Pirrong-Jermakayan model such as to incorporate the main factors driving the marginal cost and the non-linearities of electricity prices with respect to fuels prices. As in the Pirrong-Jermakayan framework, any contingent claims on power must satisfy a high dimensional PDE that embeds a market price of risk, as load is not a traded asset. Analyzing the

specificity of the marginal cost in power market, we simplify the problem for evaluating power futures so that it becomes computationally tractable. We test our model on the German EEX for "German Month Futures" with maturity of June and September 2008.

JEL Classification: C61, G13

Keywords: power contingent claims, PDE valuation of financial derivatives, unit commitment, market price of risk, EEX.

- 2009/15 Prices versus quantities in a vintage capital model
Thierry BRECHET, Tsvetomir TSACHEV and Vladimir M. VELIOV

The heterogeneity of the available physical capital with respect to productivity and emission intensity is an important factor for policy design, especially in the presence of emission restrictions. In a vintage capital model, reducing pollution requires to change the capital structure through investment in cleaner machines and to scrap the more polluting ones. In such a setting we show that emission tax and auctioned emission permits may yield contrasting outcomes. We also show that some failures in the permits market may undermine its efficiency and that imposing the emission cap over longer periods plays a regularizing role in the market.

- 2009/16 Reformulation and decomposition of integer programs
François VANDERBECK and Laurence A. WOLSEY

In this survey we examine ways to reformulate integer and mixed integer programs. Typically, but not exclusively, one reformulates so as to obtain stronger linear programming relaxations, and hence better bounds for use in a branch-and-bound based algorithm. First we cover in detail reformulations based on decomposition, such as Lagrangean relaxation, Dantzig-Wolfe column generation and the resulting branch-and-price algorithms. This is followed by an examination of Benders' type algorithms based on projection. Finally we discuss in detail extended formulations involving additional variables that are based on problem structure. These can often be used to provide strengthened a priori formulations. Reformulations obtained by adding cutting planes in the original variables are not treated here.

Keywords: Integer program, Lagrangean relaxation, column generation, branch-and-price, extended formulation, Benders' algorithm.

- 2009/17 What good is happiness?
Marc FLEURBAEY, Erik SCHOKKAERT and Koen DECANCO

In this paper we examine whether, and how, welfare economics should incorporate the insights from happiness and satisfaction studies. Our main point is that measuring well-being by reported satisfaction levels can come in conflict with individuals' judgments about their own lives and that these individual judgments should be respected. We propose an alternative measure of welfare in terms of equivalent incomes that does respect individual preferences. Satisfaction surveys are useful, however, to derive information about preferences. We illustrate our approach with panel data from the Russian Longitudinal Monitoring Survey (RLMS) for the period 1995-2003 and we compare the results for equivalent incomes with the results for subjective satisfaction.

JEL Classification: D60, D71

Keywords: happiness, satisfaction, preferences, welfare economics, psychology.

- 2009/18 The tradeoff between growth and redistribution: ELIE in an overlapping generations model
David DE LA CROIX and Michel LUBRANO

The ELIE scheme of Kolm taxes labour capacities instead of labour income in order to circumvent the distortionary effect of taxation on labour supply. Still, Kolm does not study the impact of ELIE on human capital formation and investment. In this paper, we build an overlapping generations (OLG) model with heterogeneous agents and endogenous growth driven by investment in human capital. We study the effect of ELIE on education investment and other aggregate economic variables. Calibrating the model to French data, we highlight a trade-off between growth and redistribution. With a perfect credit market, ELIE is successful in reducing inequalities and poverty, but it is at the expense of lower investment in education and slower growth. In an economy with an imperfect credit market where individuals cannot borrow to educate, the tradeoff between growth and redistribution is not overturned but is less severe. However, it is possible to overturn completely that trade-off simply by changing the base of taxation for the young generation which is equivalent to subsidising education.

JEL Classification: O41, H20, I38

Keywords: education, growth, redistribution, Kolm.

- 2009/19 Can education be good for both growth and the environment?
Thierry BRECHET and Fabien PRIEUR

We develop an overlapping generations model of growth and the environment with public policy on education. Beyond the traditional mechanisms through which knowledge, growth and the environment interplay, we stress out the role played by education on environmental awareness. Assuming first that environmental awareness is constant, we show the existence of a balanced growth path along which environmental quality increases continually. Then, if education enhances environmental awareness, the equilibrium properties are modified: the economy can reach a steady state or converge to an asymptotic balanced growth path. Therefore, education does not necessarily promote sustained and sustainable growth.

JEL Classification: Q56, D62, D91

Keywords: overlapping generations, public education, environmental maintenance, green awareness, sustainable growth.

- 2009/20 What do we know about comparing aggregate and disaggregate forecasts?
Giacomo SBRANA and Andrea SILVESTRINI

This paper compares the performance of “aggregate” and “disaggregate” predictors in forecasting contemporaneously aggregated vector ARMA processes. An aggregate predictor is built by forecasting directly the aggregate process, as it results from contemporaneous aggregation of the data generating vector process. A disaggregate predictor is obtained by aggregating univariate forecasts for the individual components of the data generating vector process. The necessary and sufficient condition for the equality of mean squared errors associated with the two competing methods is provided in the bivariate VMA(1) case. Furthermore, it is argued that the condition of equality of predictors as stated in Lütkepohl (1984b,

1987, 2004) is only sufficient (not necessary) for the equality of mean squared errors. Finally, it is shown that the equality of forecasting accuracy for the two predictors can be achieved using specific assumptions on the parameters of the VMA(1) structure. Monte Carlo simulations are in line with the analytical results. An empirical application that involves the problem of forecasting the Italian monetary aggregate M1 in the pre-EMU period is presented to illustrate the main findings.

JEL Classification: C10, C32, C43, C52

Keywords: contemporaneous aggregation, forecasting.

2009/21 Dynamic core-theoretic cooperation in a two-dimensional international environmental model

Marc GERMAIN, Henry TULKENS and Alphonse MAGNUS

This article deals with cooperation issues in international pollution problems in a two dimensional dynamic framework implied by the accumulation of the pollutant and of the capital goods. Assuming that countries do reevaluate at each period the advantages to cooperate or not given the current stocks of pollutant and capital, and under the assumption that damage cost functions are linear, we define at each period of time a transfer scheme between countries, which makes cooperation better for each of them than non-cooperation. This transfer scheme is also strategically stable in the sense that it discourages partial coalitions.

JEL Classification: Q54, Q58, F42, F53, O21

Keywords: stock pollutant, capital accumulation, international environmental agreements, dynamic core solution.

2009/22 Household behavior and individual autonomy

Claude D'ASPREMONT and Rodolphe DOS SANTOS FERREIRA

The paper proposes a model of household behavior with both private and public consumption where the spouses independently maximize their utilities, but taking into account, together with their own individual budget constraints, the collective household budget constraint (with public goods evaluated at Lindahl prices). The Lagrange multipliers associated with these constraints are used to parameterize the set of equilibria, in addition to the usual parameterization by income shares. The proposed game generalizes both the 'collective' model of household behavior and the non-cooperative game with voluntary contributions to public goods.

JEL Classification: D10, C72, H41

Keywords: intra-household allocation, household financial management, degree of autonomy, Lindahl prices, local income pooling, separate spheres.

2009/23 Education and social mobility

Helmuth CREMER, Philippe DE DONDER and Pierre PESTIEAU

This paper examines the degree of elitism of public education under two different social objectives. It illustrates a potential conflict between welfare and social mobility. In the absence of private supplementary education, utilitarian welfare increases with the degree of elitism of the public education system. On the other hand, elitism decreases the steady state proportion of heterogenous dynasties (those comprised of a skilled parent and an unskilled child, or vice versa) which is our measure of social mobility. Consequently, social mobility is maximized under the

least elitist public education system. We then open up the possibility for skilled parents to invest in private supplementary education for their child. We show that when private education is available, the degree of elitism that maximizes social mobility increases, while the welfare-maximizing degree of elitism decreases, provided that the inequality in productivity between the two types of agents is large enough. We provide a numerical example where the ranking between the welfare- and mobility-maximizing degree of elitism is reversed when private education is allowed — i.e., where the public education system that maximizes social mobility is more elitist than the one that maximizes welfare. Finally, we show that utilitarian welfare is always (weakly) higher when private supplementary education is available. However, to maximize social mobility it may be preferable to ban private supplements.

JEL Classification: H37

Keywords: elitism, egalitarianism, private education.

2009/24 Understanding volatility dynamics in the EU-ETS market: lessons *from* the future
María Eugenia SANIN and Francesco VIOLANTE

In this paper we study the short term price behavior of December 2008 future prices for EU emission allowances. We model returns and volatility dynamics of this price showing that a standard ARMA-GARCH framework is not adequate and that the gaussianity assumption is rejected due to the occurrence of a number of level and volatility outliers. To improve the fitness of the model, we combine the underlying price process with an additive stochastic jump process. The resulting distribution, a mixture of Gaussians, allows for endogenously determined jumps in the process governing the returns, while the mixing law determines the jump probability. The performance of the model is improved by introducing a time varying jump probability explained by two variables. The first one is the daily relative change in the volume of transactions and suggests that sharp increases in volume increase volatility even in the absence of changes in what recent literature considers as market fundamentals. The second one accounts for changes in the jump probability associated to the European Commission's announcements regarding the NAPs for Phase II. We find that announcements concerning the NAPs induce jumps in the process and tend to increase volatility. This result suggests authorities should advocate to increase stability in the regulatory environment which is crucial to allow traders to realize efficient trading strategies and informed investment decisions regarding pollution reduction.

JEL Classification: C16, C32, C51, C53, Q52, Q53

Keywords: EUA market, EU-ETS, carbon emission trading, Garch model, normal mixture.

2009/25 Lot-sizing with stock upper bounds and fixed charges
Marco DI SUMMA and Laurence A. WOLSEY

Here we study the discrete lot-sizing problem with an initial stock variable and an associated variable upper bound constraint. This problem is of interest in its own right, and is also a natural relaxation of the constant capacity lot-sizing problem with upper bounds and fixed charges on the stock variables. We show that the convex hull of solutions of the discrete lot-sizing problem is obtained as the intersection of two simpler sets, one involving just 0-1 variables and the second a mixing set with a variable upper bound constraint. For these two sets we derive both inequality descriptions and polynomial-size extended formulations of their

respective convex hulls. Finally we carry out some limited computational tests on single-item constant capacity lot-sizing problems with upper bounds and fixed charges on the stock variables in which we use the extended formulations derived above to strengthen the initial mixed integer programming formulations

Keywords: mixed integer programming, discrete lot-sizing, stock fixed costs, mixing sets.

2009/26 On the informational efficiency of simple scoring rules
Johanna M.M. GOERTZ and François MANIQUET

We study information aggregation in large elections. With two candidates, efficient information aggregation is possible in a large election (e.g., Feddersen and Pesendorfer [4, 5, 6], among others). We find that this result does not extend to large elections with more than two candidates. More precisely, we study a class of simple scoring rules in large voting games with Poisson population uncertainty and three candidates. We show that there is no simple scoring rule that aggregates information efficiently, even if preferences are dichotomous and a unique Condorcet winner always exists. We introduce a weaker criterion of informational efficiency that requires a voting rule to have at least one efficient equilibrium. Only approval voting satisfies this criterion.

JEL Classification: C72, D72, D81, D82

Keywords: efficient information aggregation, scoring rules, Poisson games, approval voting.

2009/27 On uncertainty when it affects successive markets
Jean GABSZEWICZ, Ornella TAROLA and Skerdilajda ZANAJ

In this paper, we examine how uncertainty can affect successive markets, when uncertainty can jointly influence both the upstream and downstream markets' conditions. The main result of the paper is that the equilibrium input and output quantities under stochastic dependence can be higher or lower than the corresponding quantities in the case of certainty equivalence depending on how much dependent are the events.

JEL Classification: L1, L120

2009/28 On production and abatement time scales in sustainable development. Can we loosen the *sustainability screw* ?
Jerzy A. FILAR, Jacek B. KRAWCZYK and Manju AGRAWAL

In this paper we carry out a preliminary exploration of a time scales' conjecture, which postulates that "reasonable" notions of sustainability must include a suitable synchronisation of time scales of both the processes of human development and those of the natural environment. We perform our analysis within a coarse, five variable, model of man-nature interactions expressed as a system of differential equations where production and human capital are coupled with both renewable and non-renewable natural resource. We demonstrate a phenomenon that we name the "sustainability screw" that describes a spiral like trajectory of the three key variables: non-renewable and renewable resources as well as the production capital. Under many plausible scenarios, this spiral tends unacceptably fast to an undesirable equilibrium. However, we also show that by adjusting the ratio of "intensity of production effort" and "intensity of abatement effort", parameters of

the relative time scales of production and natural recovery processes can be altered in a manner that produces, arguably, more sustainable trajectories.

JEL Classification: C61, Q01 - **MSC Classification:** 37N40, 34E99

Keywords: sustainable optimization systems, viability, multiple time scale.

- 2009/29 Clean technology adoption and its influence on tradeable emission permit prices
Maria Eugenia SANIN and Skerdilajda ZANAJ

In this paper we give an example in which the price of tradeable emission permits increases despite firms' adoption of a less polluting technology. This is in contrast with Montero (2002) and Parry (1998), among others. If two Cournot players switch to a cleaner technology, the price for permits may increase due to an increase in the net demand for permits and a decrease in net supply of permits after the clean technology is adopted. This is only the case when output demand is elastic.

JEL Classification: D43, L13, Q55

Keywords: environmental innovation, tradable emission permits, Cournot interaction.

- 2009/30 On the public economics of annuities with differential mortality
Antoine BOMMIER, Marie-Louise LEROUX and Jean-Marie LOZACHMEUR

This paper studies the problem of redistribution between individuals having different mortality rates. We use a continuous time model in which there are two types of individuals characterized by different survival probability paths. Individual preferences are represented by a generalized life cycle utility function which can exhibit temporal risk aversion. We successively compare utilitarian allocations when individuals exhibit temporal risk neutrality and temporal risk aversion. This problem is analyzed successively in the context of full information and asymmetric information on mortality rates.

JEL Classification: H55, H23, I31

Keywords: uncertain lifetime, redistribution, annuities, nonlinear taxation.

- 2009/31 Connections among farsighted agents
Gilles GRANDJEAN, Ana MAULEON and Vincent VANNETELBOSCH

We study the stability of social and economic networks when players are farsighted. In particular, we examine whether the networks formed by farsighted players are different from those formed by myopic players. We adopt Herings, Mauleon and Vannetelbosch's *Games and Economic Behavior*, forthcoming) notion of pairwise farsightedly stable set. We first investigate in some classical models of social and economic networks whether the pairwise farsightedly stable sets of networks coincide with the set of pairwise (myopically) stable networks and the set of strongly efficient networks. We then provide some primitive conditions on value functions and allocation rules so that the set of strongly efficient networks is the unique pairwise farsightedly stable set. Under the componentwise egalitarian allocation rule, the set of strongly efficient networks and the set of pairwise (myopically) stable networks that are immune to coalitional deviations are the unique pairwise farsightedly stable set if and only if the value function is top convex.

JEL Classification: A14, C70, D20

Keywords: farsighted players, stability, efficiency, connections model, buyer-seller networks.

- 2009/32 On the nature of price competition under universal service obligations: a note
Axel GAUTIER and Xavier WAUTHY

The imposition of universal coverage and uniform pricing constraints, as part of the universal service obligations, makes the universal service provider less aggressive in the price game when it competes with a firm that does not cover the whole set of markets (Valletti et al., 2002). In this paper, we fully characterize the resulting price equilibrium when universal service obligations are imposed. With a limited market coverage by the entrant or a small degree of degree of product differentiation, the equilibrium is a mixed strategy one.

JEL Classification: L13, L51

Keywords: universal service obligations, uniform pricing, price competition.

- 2009/33 Constrained infinite group relaxations of MIPs
Santanu S. DEY and Laurence A. WOLSEY

Recently minimal and extreme inequalities for continuous group relaxations of general mixed integer sets have been characterized. In this paper, we consider a stronger relaxation of general mixed integer sets by allowing constraints, such as bounds, on the free integer variables in the continuous group relaxation. We generalize a number of results for the continuous infinite group relaxation to this stronger relaxation and characterize the extreme inequalities when there are two integer variables.

- 2009/34 Winners and losers among a refugee-hosting population
Jean-François MAYSTADT and Philip VERWIMP

Every year, thousands of refugees are forced to leave their countries of origin and are hosted by their neighboring countries. However, very little is known about the impact of these refugees on the local economy and its inhabitants. Based on hypothesis formulated during a two-month iterative field research, a theoretical framework is used to understand how the refugee inflow would affect the good and labour markets of the local economy. We then test the theoretical predictions regarding the potential winners and losers among the refugee-hosting population, using household panel data collected in the region of Kagera in Tanzania. Our identification strategy exploits both time and spatial variations in the way households traced between 1991 and 2004 have been affected by the refugee inflows originating from Burundi (1993) and Rwanda (1994). Our results show that local hosts do not necessarily suffer from the refugee presence. Net economic benefits could even emerge provided a sufficient mass of refugees is gathered. Furthermore, the economic benefits appear to be unevenly distributed among the refugee-hosting population. Agricultural workers are likely to suffer the most from an increase in competition on the labor markets and the surging prices of several goods. On the contrary, non-agricultural workers and self-employed farmers are in a better position to benefit from such a refugee inflow. We also conjecture that the welfare deterioration experienced by those involved into business could be explained a selection effect resulting from the reported entry of larger-scale entrepreneurs from other regions.

JEL Classification: O12, O18, R12, R23

Keywords: refugees, Tanzania migration.

- 2009/35 Allocation of fixed costs and the weighted Shapley value
Pierre DEHEZ

The weighted value was introduced by Shapley in 1953 as an asymmetric version of his value. Since then several axiomatizations have been proposed including one by Shapley in 1981 specifically addressed to cost allocation, a context in which weights appear naturally. It was at the occasion of a comment in which he only stated the axioms. The present paper offers a proof of Shapley's statement as well as an alternative set of axioms. It is shown that the value is the unique rule which allocates *additional* fixed costs fairly: only the players who are concerned contribute to the fixed cost and they contribute in proportion to their weights.

JEL Classification: C71, D46

Keywords: cost allocation, Shapley value, fixed cost.

- 2009/36 Starting an R&D project under uncertainty
Sabien DOBBELAERE, Roland Iwan LUTTENS and Bettina PETERS

We study a two-stage R&D project with an abandonment option. Two types of uncertainty influence the decision to start R&D. Demand uncertainty is modelled as a lottery between a proportional increase and decrease in demand. Technical uncertainty is modelled as a lottery between a decrease and increase in the cost to continue R&D. We relate differences in uncertainty to differences in risk premia. We deduct testable hypotheses on the basis of which we empirically analyze the impact of uncertainty on the decision to start an R&D project. Using data for about 4000 German firms in manufacturing and services (CIS IV), our model predictions are strongly confirmed.

JEL Classification: D21, D81, L12, O31

Keywords: investment under uncertainty, R&D, demand uncertainty, technical uncertainty, entry threat.

- 2009/37 Aging society, health and the environment
Carlotta BALESTRA and Davide DOTTORI

Both environmental quality and health care expenditure are determinants of health and life expectancy, but the support for them appears to be different according to the electors' age, with a relatively larger support for health expenditure among the elderly as it is generally effective on a shorter horizon than environmental maintenance. With population aging, the political support for health care expenditure is then self-reinforcing. We cast this issue in an overlapping generations model with endogenous longevity, where lifespan depends on health care expenditure and environmental quality. We compare the long run outcomes for health care expenditure, environmental quality, lifespan, consumption and capital accumulation of an economy where agents vote over health spending and environmental maintenance, with those chosen by a social planner who takes into account also the welfare of future generations. The role played by other factors, such as the propensity for smoothing consumption or the degree of annuity markets, is also highlighted. Empirical evidence of age-biased environmental care is provided.

JEL Classification: I18, I12, D72, D91, H51, O40, Q20, Q28

Keywords: population aging, endogenous longevity, environmental and health expenditure, annuity markets, inter-generational conflict, overlapping generations.

- 2009/38 Urban concentration and economic growth: checking for specific regional effects
Alain PHOLO BALA

By using a semiparametric specification, we examine the impact of urban concentration in economic growth on different groups of countries that we classify according to a geographical criterion or according to their level of development. Facing a significant proportion of missing data, we handle that problem with a multiple imputation algorithm as advised in the statistical literature. Therefore using a Bayesian estimation we obtain parametric coefficients and non parametric curves. Then we may perform Yatchew's tests of equality of non parametric effects to check out if the model specification is the same in the different groups of countries..

JEL Classification: C14, C30, C49, R15

Keywords: urban primacy, economic growth, missing data, imputation, semiparametric estimation.

- 2009/39 Gates, hubs and urban primacy in Sub-Saharan Africa
Alain PHOLO BALA

We investigate the impact of changes in international trade and domestic transport costs on the internal geography of a domestic economy linked to the rest of the World through a hub. We address that issue by developing two three regions model, namely a version of the Footlose Entrepreneur and a model à la Ottaviano et al. (2002). One region represents the rest of the World, while the two others compose the domestic economy. One region of the Domestic economy, the hub, exhibits a 'geographical advantage' in terms of easier access to the rest of the World. We find the standard result that decreases in transports and trade costs raise the likelihood of agglomeration in the domestic economy. However, high interregional transport may induce partial agglomeration in the hinterland even in case of trade integration. Therefore depending on the level of transportation costs, hinterland remoteness may not be a locational 'disadvantage' as Behrens et al. (2007) pointed out.

JEL Classification: D58, F12, F15, R12

Keywords: economic geography, urban primacy, hub, developing countries.

- 2009/40 On efficiency, concentration and welfare
Nicolas BOCCARD

The welfare impact of a merger involves the market power offense and the efficiency defense. Salant et al. (1983) show that mergers among symmetric firms are unprofitable except for monopolization. We characterize the limit to this merger paradox in a simple linear Cournot oligopoly with asymmetric costs. Farrell and Shapiro (1990) provide sufficient conditions for a profitable merger to increase welfare but leave open whether it exists. We characterize the degree of cost asymmetry making a merger both profitable and socially desirable. Comparing rationalization and synergy within the efficiency defense, we show that for most industry structures, a rationalization merger is more likely to be welfare enhancing but a synergy merger is more likely to be profitable.

JEL Classification: L40, D43, D24

Keywords: merger, efficiency, concentration, welfare, antitrust, competition.

- 2009/41 A nonparametric copula based test for conditional independence with applications to Granger causality
Taoufik BOUEZMARNI, Jeroen V.K. ROMBOUTS and Abderrahim TAAMOUTI

This paper proposes a new nonparametric test for conditional independence, which is based on the comparison of Bernstein copula densities using the Hellinger distance. The test is easy to implement because it does not involve a weighting function in the test statistic, and it can be applied in general settings since there is no restriction on the dimension of the data. In fact, to apply the test, only a bandwidth is needed for the nonparametric copula. We prove that the test statistic is asymptotically pivotal under the null hypothesis, establish local power properties, and motivate the validity of the bootstrap technique that we use in finite sample settings. A simulation study illustrates the good size and power properties of the test. We illustrate the empirical relevance of our test by focusing on Granger causality using financial time series data to test for nonlinear leverage versus volatility feedback effects and to test for causality between stock returns and trading volume. In a third application, we investigate Granger causality between macroeconomic variables.

JEL Classification: C12, C14, C15, C19, G1, G12, E3, E4, E52

Keywords: nonparametric tests, conditional independence, Granger non-causality, Bernstein density copula, bootstrap, finance, volatility asymmetry, leverage effect, volatility feedback effect, macroeconomics.

- 2009/42 Antidumping protection hurts exporters: firm-level evidence from France
Jozef KONINGS and Hylke VANDENBUSSCHE

Firms protected by antidumping measures do not unequivocally benefit from them. Antidumping protection benefits non-exporters active on the protected market by raising their domestic sales, but hurts exporters of similar products as the protected ones. Export sales of protected firms fall by almost 8% compared to a relevant control group of unprotected firms. This effect more than doubles for firms that are global, i.e. firms with foreign affiliates. Measured at the product-level, extra-EU exports of goods protected by antidumping fall by 36% while exports to target countries fall by as much as 66% following protection. Protection also has an effect on the extensive margin, by raising the probability to start exporting for firms that were initially non-exporters. Existing exporters face a higher probability to stop exporting during protection. Finally, we find that the productivity of exporters falls while that of non-exporters rises during antidumping protection. We offer a number of plausible explanations for our findings that stem from the heterogeneous firm literature. We also discuss the importance of our findings for policy.

JEL Classification: F13, L41, O30, C2

Keywords: antidumping, firm-level exports, intensive margin, extensive margin, productivity, dif-in-dif.

- 2009/43 Retirement as a hedge
Pierre PESTIEAU and Uri M. POSSEN

This paper explores the effect of letting individuals choose their retirement age in a world of uncertainty where there exist both defined benefit (DB) and defined

contribution (DC) pension plans. The paper shows that giving individuals the flexibility to determine when to retire is an important tool for them when they are hedging against future uncertainty. It also finds that it is preferable to let people make their retirement decision after rather than before the uncertainty is lifted. Finally, it shows that shifting from DB to DC plans fosters the rate of activity of elderly workers.

JEL Classification: H55, J26

Keywords: retirement decision, defined benefit defined contribution.

- 2009/44 Lifting group inequalities and an application to mixing inequalities
Santanu S. DEY and Laurence A. WOLSEY

Given a valid inequality for the mixed integer infinite group relaxation, a lifting based approach is presented that can be used to strengthen this inequality. Bounds on the solution of the corresponding lifting problem and some necessary conditions for the lifted inequality to be minimal for the mixed integer infinite group relaxation are presented. Finally, these results are applied to generate a strengthened version of the mixing inequality that provides a new class of extreme inequalities for the two-row mixed integer infinite group relaxation.

Keywords: mixed integer programs, mixing inequalities, infinite group relaxations.

- 2009/45 Residential equilibrium in a multifractal metropolitan area
Jean CAVAILHES, Pierre FRANKHAUSER, Dominique PEETERS and Isabelle THOMAS

A residential location model derived from urban economics is combined with the geometry of a multifractal Sierpinski carpet to represent and model a metropolitan area. This area is made up of a system of built-up patches hierarchically organised around a city centre, and green areas arranged in an inverse hierarchical order (large open-spaces in the periphery). An analytical solution is obtained by using a specific geographic coding system for computing distances. The values of the parameters used in the model are based on the French medium sized metropolitan areas; a realistic benchmark is proposed and comparative-statics simulations are performed. The results show that the French peri-urbanisation process (which took place from 1970 onward) can be explained by an increase in income and a reduction in transport costs. Nevertheless, changes in household preferences, in particular an increased taste for open spaces, can also contribute to urban sprawl by making the gradient of land rents less steep and by making peripheral household locations more desirable.

JEL Classification: R12, R21

Keywords: peri-urban, residential localisation, fractal geometry, amenities.

- 2009/46 On the impact of trade on industrial structures: the role of entry cost heterogeneity
Daisuke OYAMA, Yasuhiro SATO and Takatoshi TABUCHI

This paper investigates the impacts of progressive trade openness, technological externalities, and heterogeneity of individuals on the formation of entrepreneurship in a two-country occupation choice model. We show that trade opening gives rise to a non-monotonic process of international specialization, in which the share of entrepreneurial firms in the large (small) country first increases (decreases) and

then decreases (increases), with the global economy exhibiting first de-industrialization and then re-industrialization. When countries have the same size, we also show that strong technological externalities make the symmetric equilibrium unstable, generating equilibrium multiplicity, while sufficient heterogeneity of individuals leads to the stability and uniqueness of the symmetric equilibrium.

JEL Classification: F12, F16, J24, O14, R12

Keywords: entrepreneurship, trade liberalization, externality, heterogeneity, stability.

- 2009/47 Competition among the big and the small
Ken-Ichi SHIMOMURA and Jacques-François THISSE

Armchair evidence shows that many industries are made of a few big commercial or manufacturing firms, which are able to affect the market outcome, and of a myriad of small family-run businesses with very few employees, each of which has a negligible impact on the market. Examples can be found in apparel, catering, publishers and bookstores, retailing, finance and insurances, and IT industries. We provide a new general equilibrium framework that encapsulates both market structures. Due to the higher toughness of the market, the entry of big firms leads them to sell more through a market expansion effect, which is generated by the exit of small firms. Furthermore, the level of social welfare increases with the number of oligopolistic firms because the procompetitive effect associated with the entry of a big firm dominates the resulting decrease in product variety.

JEL Classification: L13, L40

Keywords: oligopoly, monopolistic competition, product differentiation, welfare.

- 2009/48 Design and operations of gas transmission networks
Frédéric BABONNEAU, Yurii NESTEROV and Jean-Philippe VIAL

Problems dealing with the design and the operations of gas transmission networks are challenging. The difficulty mainly arises from the simultaneous modeling of gas transmission laws and of the investment costs. The combination of the two yields a non-linear non-convex optimization problem. To obviate this shortcoming, we propose a new formulation as a multi-objective problem, with two objectives. The first one is the investment cost function or a suitable approximation of it; the second is the cost of energy that is required to transmit the gas. This energy cost is approximated by the total energy dissipated into the network. This bi-criterion problem turns out to be convex and easily solvable by convex optimization solvers. Our continuous optimization formulation can be used as an efficient continuous relaxation for problems with non-divisible restrictions such as a limited number of available commercial pipe dimensions.

Keywords: gas transmission networks, reinforcement, convex optimization.

- 2009/49 How lotteries outperform auctions for charity
Olivier BOS

In their recent paper Goeree et al. (2005) determine that all-pay auctions are better for fundraising activities than lotteries. We show that the introduction of asymmetry among valuations with complete information could reverse this result. Complete information seems well suited to some charity environments.

JEL Classification: D44, D62, D64

Keywords: all-pay auctions, charity, complete information, lotteries.

- 2009/50 Entry accommodation under multiple commitment strategies: judo economics revisited
Nicolas BOCCARD and Xavier WAUTHY

We consider a stage-game where the entrant may simultaneously commit to its product's quality and the level of its production capacity before price competition takes place. We show that capacity limitation is more effective than quality reduction as a way to induce entry accommodation: the entrant tends to rely exclusively on capacity limitation in a subgame perfect equilibrium. This is so because capacity limitation drastically changes the nature of price competition by introducing local strategic substitutability whereas quality differentiation only alters the intensity of price competition.

JEL Classification: D43, L13, L51

Keywords: entry, quality, differentiation, Bertrand-Edgeworth competition.

- 2009/51 Multi-assets real options
Joachim GAHUNGU and Yves SMEERS

Real options present a wide topic in investment literature nowadays. However, despite big advances in the single asset investment pricing, the theory is miser of informations about problems involving more than one asset. We show in this paper that using dynamic programming, one can find an analytic trigger for a three assets simple exchange problem. Although we get a forward investment rule, one can not find the precise option value ex ante but only an average value. The precise option value depends on the first exit time from the continuation region which is stochastic.

This is a quite intuitive effect of the course of dimensionality of the problem. Valuating a single asset project gives a single condition for the optimal decision rule. The same holds for the simple exchange problem with two assets since the value of the project just depends on the price over cost ratio. In a three assets problem, as the project don't depend anymore of a single state variable, one can't run for a decision rule depending on the first exit time from the continuation region.

JEL Classification: C61, C63, G11

Keywords: real options, dynamic programming, price and cost uncertainty.

- 2009/52 Regulating quality by regulating quantity: a case against minimum quality standards
Nicolas BOCCARD and Xavier WAUTHY

We show in a simple model of entry with sunk cost, that a regulator prefers limiting the output, or capacity, of the incumbent firm rather than imposing a "Minimum Quality Standard" in order to help the entrant to provide high quality. As a by-product, our analysis makes a contribution to the study of Bertrand-Edgeworth competition in a market with differentiated products.

JEL Classification: D43, L13, L51

Keywords: quality, minimum quality standards, price competition.

- 2009/53 An incentive mechanism to break the low-skill immigration deadlock
David DE LA CROIX and Frédéric DOCQUIER

Although movements of capital, goods and services are growing in importance, workers movements are impeded by restrictive policies in rich countries. Such regulations carry substantial economic costs for developing countries, and prevent global inequality from declining. Even if rich countries are averse to global inequality, a single country lacks incentives to welcome additional migrants as it would bear the costs alone while the benefits accrue to all rich states. Aversion to global inequality confers a public good nature to the South-North migration of low-skill workers. We propose an alternative allocation of labor maximizing global welfare subject to the constraints that the rich countries are at least as well off as in the current “nationalist” (or “Nashionalist”) situation. This “no regret” allocation can be decentralized by a tax-subsidy scheme which makes people internalize the fact that as soon as a rich country welcomes an additional migrant, global inequalities are reduced, and everybody in the rich world is better off too. Our model is calibrated using statistics on immigration, working-age population and output. We simulate the proposed scheme on different sets of rich countries.

JEL Classification: F22, F55, D58, D6, D7

Keywords: public good, inequality aversion, immigration policy.

- 2009/54 "Mitigation, adaptation, suffering": In search of the right mix in the face of climate change
Henry TULKENS and Vincent VAN STEENBERGHE

The usually assumed two categories of costs involved in climate change policy analysis, namely abatement and damage costs, hide the presence of a third category, namely adaptation costs. This dodges the determination of an appropriate level for them. Including adaptation costs explicitly in the total environmental cost function allows one to characterize the optimal (cost minimizing) balance between the three categories, in statics as well as dynamics. Implications are derived for cost benefit analysis of adaptation expenditures.

JEL Classification: Q54, Q58

Keywords: cost of climate change, adaptation, mitigation, residual cost, envelope cost function, cost benefit analysis.

- 2009/55 Split rank of triangle and quadrilateral inequalities
Santanu S. DEY and Quentin LOUVEAUX

A simple relaxation of two rows of a simplex tableau is a mixed integer set consisting of two equations with two free integer variables and non-negative continuous variables. Recently Andersen et al. [2] and Cornuéjols and Margot [13] showed that the facet-defining inequalities of this set are either split cuts or intersection cuts obtained from lattice-free triangles and quadrilaterals. Through a result by Cook et al. [12], it is known that one particular class of facet-defining triangle inequality does not have a finite split rank. In this paper, we show that all other facet-defining triangle and quadrilateral inequalities have finite split rank. The proof is constructive and given a facet-defining triangle or quadrilateral inequality we present an explicit sequence of split inequalities that can be used to generate it.

Keywords: mixed integer programs, split rank, group relaxations.

- 2009/56 Neighbourhood effects and endogeneity issues
Claire DUJARDIN, Dominique PEETERS and Isabelle THOMAS

A recent body of research suggests that the spatial structure of cities might influence the socioeconomic characteristics and outcomes of their residents. In particular, the literature on neighbourhood effects emphasizes the potential influence of the socioeconomic composition of neighbourhoods in shaping individual's behaviours and outcomes, through social networks, peer influences or socialization effects. However, empirical work still has not reached a consensus regarding the existence and magnitude of such effects. This is mainly because the study of neighbourhood effects raises important methodological concerns that have not often been taken into account. Notably, as individuals with similar socioeconomic characteristics tend to sort themselves into certain parts of the city, the estimation of neighbourhood effects raises the issue of location choice endogeneity. Indeed, it is difficult to distinguish between neighbourhood effects and correlated effects, i.e. similarities in behaviours and outcomes arising from individuals having similar characteristics. This problem, if not adequately corrected for, may yield biased results.

In the first part of this paper, neighbourhood effects are defined and some methodological problems involved in measuring such effects are identified. Particular attention is paid to the endogeneity issue, giving a formal definition of the problem and reviewing the main methods that have been used in the literature to try to solve it. The second part is devoted to an empirical illustration of the study of neighbourhood effects, in the case of labour-market outcomes of young adults in Brussels. The effect of living in a deprived neighbourhood on the unemployment probability of young adults residing in Brussels is estimated using logistic regressions. The endogeneity of neighbourhood is addressed by restricting the sample to young adults residing with their parents. Then, a sensitivity analysis is used to assess the robustness of the results to the presence of both observed and unobserved parental covariates.

JEL Classification: R0, J6, C1

Keywords: neighbourhood effects, endogeneity, self-selection, sensitivity analysis, Brussels.

- 2009/57 Voting on pensions: sex and marriage
Marie-Louise LEROUX, Pierre PESTIEAU and Maria RACIONERO

Existing political economy models of pensions focus on age and productivity. In this paper we incorporate two additional individual characteristics: sex and marital status. We ignore the role of age, by assuming that people vote at the start of their life, and characterize the preferred rate of taxation that finances a Beveridgean pension scheme when individuals differ in wage, sex and marital status. We allow for two types of couples: one-breadwinner and two-breadwinner couples. Marriage pools both wage and longevity differences between men and women. Hence singles tend to have more extreme preferred tax rates than couples. We show that the majority voting outcome depends on the relative number of one-breadwinner couples and on the size of derived pension rights.

JEL Classification: D72, D78, H55

Keywords: social security, differential longevity, majority voting, individualization of pension rights.

- 2009/58 A note on price competition in product differentiation models
Jean J. GABSZEWICZ

We define a two-variant model of product differentiation which, depending on the number of consumers preferring one variant to the other, provides equilibrium prices reflecting the natural valuation of these variants by the market

- 2009/59 All-pay auctions with endogenous rewards
Olivier BOS and Martin RANGER

This paper examines a perfectly discriminating contest (all-pay auction) with two asymmetric players. Valuations are endogenous and depend on the effort each player invests in the contest. The shape of the valuation function is common knowledge and differs between the contestants. Some key properties of R&D races, lobbying activity and sport contests are captured by this framework. Once the unique equilibrium in mixed strategies analyzed, we derive a closed form of the expected expenditure of both players. We characterize the expected expenditure by the means of incomplete Beta functions. We focus on unordered valuations.

JEL Classification: D44, D72

Keywords: all-pay auctions, contests.

- 2009/60 On the fiscal treatment of life expectancy related choices
Julio DAVILA and Marie-Louise LEROUX

In an overlapping generations economy setup we show that, if individuals can improve their life expectancy by exerting some effort, costly in terms of either resources or utility, the competitive equilibrium steady state differs from the first best steady state. This is due to the fact that under perfect competition individuals fail to anticipate the impact of their longevity-enhancing effort on the return of their annuitized savings. We identify the policy instruments required to implement the first-best into a competitive equilibrium and show that they are specific to the form, whether utility or resources, that the effort takes.

JEL Classification: H21, D91

Keywords: life expectancy, health expenditures, taxation.

- 2009/61 On marginal likelihood computation in change-point models
Luc BAUWENS and Jeroen V.K. ROMBOUTS

Change-point models are useful for modeling time series subject to structural breaks. For interpretation and forecasting, it is essential to estimate correctly the number of change points in this class of models. In Bayesian inference, the number of change points is typically chosen by the marginal likelihood criterion, computed by Chib's method. This method requires to select a value in the parameter space at which the computation is done. We explain in detail how to perform Bayesian inference for a change-point dynamic regression model and how to compute its marginal likelihood. Motivated by our results from three empirical illustrations, a simulation study shows that Chib's method is robust with respect to the choice of the parameter value used in the computations, among posterior mean, mode and quartiles. Furthermore, the performance of the Bayesian information criterion, which is based on maximum likelihood estimates, in selecting the correct model is comparable to that of the marginal likelihood.

JEL Classification: C11, C22, C53

Keywords: BIC, change-point model, Chib's method, marginal likelihood.

- 2009/62 Exchange of indivisible goods and indifferences: the Top Trading Absorbing Sets mechanisms
Jorge ALCALDE-UNZU and Elena MOLIS

There is a wide range of economic problems involving the exchange of indivisible goods without monetary transfers, starting from the housing market model of the seminal paper of Shapley and Scarf [10] and including other problems like the kidney exchange or the school choice problems. For many of these models, the classical solution is the application of an algorithm/mechanism called Top Trading Cycles, attributed to David Gale, which satisfies good properties for the case of strict preferences. In this paper, we propose a family of mechanisms, called Top Trading Absorbing Sets mechanisms, that generalizes the Top Trading Cycles for the general case in which individuals can report indifferences, and preserves all its desirable properties.

JEL Classification: C71, C78, D71, D78

Keywords: housing market, indifferences, top trading cycles, absorbing sets.

- 2009/63 On spatial equilibria in a social interaction model
Pascal MOSSAY and Pierre PICARD

Social interactions are at the essence of societies and explain the gathering of individuals in villages, agglomerations, or cities. We study the emergence of multiple agglomerations as resulting from the interplay between spatial interaction externalities and competition in the land market. We show that the geographical nature of the residential space tremendously affects the properties of spatial equilibria. In particular, when agents locate on an open land strip (line segment), a single city emerges in equilibrium. In contrast, when the spatial economy extends along a closed land strip (circumference), multiple equilibria with odd numbers of cities arise. Spatial equilibrium configurations involve a high degree of spatial symmetry in terms of city size and location, and can be Pareto-ranked.

Keywords: social interaction, multiple agglomerations, spatial economy.

- 2009/64 A comparison of optimal tax policies when compensation or responsibility matter
Laurence JACQUET and Dirk VAN DE GAER

This paper examines optimal redistribution in a model with high and low-skilled individuals with heterogeneous tastes for labor, that either work or not. With such double heterogeneity, traditional Welfarist criteria including Utilitarianism fail to take the compensation-responsibility trade-off into account. As a response, several other criteria have been proposed in the literature. This paper is the first to compare the extent to which optimal policies based on different normative criteria obey the principles of compensation (for differential skills) and responsibility (for preferences for labor), when labor supply is along the extensive margin. The criteria from the social choice literature perform better in this regard than the traditional criteria, both in first and second best. More importantly, these equality of opportunity criteria push the second best policy away from an Earned Income Tax Credit and in the direction of a Negative Income tax.

JEL Classification: H21, D63

Keywords: optimal income taxation, equality of opportunity, heterogeneous preferences for labor.

- 2009/65 Why corrupt governments may receive more foreign aid

David DE LA CROIX and Clara DELAVALLADE

In this paper we argue that if the cross-country heterogeneity in productivity is more important than the heterogeneity in government quality, it can be optimal to give more foreign aid to more corrupt countries. We build a multi-country model of optimal aid in which we disentangle the correlation between aid and equilibrium corruption into two components: the first one reflects variations in the quality of institutions and the second encompasses variations in productivity levels. The data suggest that both components of the correlation are significant, however the effect of variations in productivity levels is stronger. This implies that most corrupt countries, since they are also the poorest, receive higher amounts of foreign aid.

JEL Classification: O19

Keywords: corruption, aid, government spending, institutions.

2009/66 Strongly rational sets for normal-form games
Gilles GRANDJEAN, Ana MAULEON and Vincent VANNETELBOSCH

Curb sets [Basu and Weibull, *Econ. Letters* 36 (1991), 141-146] are product sets of pure strategies containing all individual best-responses against beliefs restricted to the recommendations to the remaining players. The concept of minimal curb sets is a set-theoretic coarsening of the notion of strict Nash equilibrium. We introduce the concept of minimal strong curb sets which is a set-theoretic coarsening of the notion of strong Nash equilibrium. Strong curb sets are product sets of pure strategies such that each player's set of recommended strategies must contain all coalitional best-responses of each coalition to whatever belief each coalition member may have that is consistent with the recommendations to the other players. Minimal strong curb sets are shown to exist and are compared with other well known solution concepts. We also provide a dynamic learning process leading the players to playing strategies from a minimal strong curb set.

JEL Classification: C72

Keywords: set-valued solution concept, coalitional best-response, strong curb set, learning.

2009/67 Transfer pricing rules, OECD guidelines, and market distortions
Kristian BEHRENS, Susana PERALTA and Pierre M. PICARD

We study the impact of transfer pricing rules on sales prices, firms' organizational structure, and consumers' utility within a two-country monopolistic competition model featuring source-based profit taxes that differ across countries. Firms can either become multinationals, i.e., they serve the foreign market through a fully controlled affiliate; or they can become exporters, i.e., they serve the foreign market by contracting with an independent distributor. Compared to the benchmark cases, where tax authorities are either unable to audit firms or where they are able to audit them perfectly, the use of the OECD's Comparable Uncontrolled Price (CUP) or Cost-Plus (CP) rule distorts firms' output and pricing decisions. The reason is that the comparable arm's length transactions between exporters and distributors, which serve as benchmarks, are not efficient. We show that implementing the CUP or CP rules is detrimental to consumers in the low tax country, yet benefits consumers in the high tax country.

JEL Classification: F12, H25, H26, H87, L14

Keywords: transfer pricing, OECD guidelines, multinationals and exporters, organizational choice, arm's length principle.

- 2009/68 Endogenous network formation in patent contests and its role as a barrier to entry
Marco MARINUCCI and Wouter VERGOTE

In a setting of R&D co-opetition we study, by using an all-pay auction approach, how collaboration affects strategic decisions during a patent contest, and how the latter influences the possible collaboration network structures the firms can hope to form. The all pay auction approach allows us to 1) endogenize both network formation and R&D intensities and 2) take heterogeneous and private valuations for patents into account. We find that, different from previous literature, the complete network is not always the only pairwise stable network, even and especially if the benefits from cooperating are important. Interestingly, the other possible stable networks all have the realistic property that some firms decide not to participate in the contest. Thus, weak cooperation through network formation can serve as a barrier to entry on the market for innovation. We further show that there need not be any network that survives a well known refinement of pairwise stability, strong stability, which imposes networks to be immune to coalitional deviations.

JEL Classification: L14, L24, O32

Keywords: patent game, networks, R&D cooperation, all-pay auction.

- 2009/69 Asymmetric CAPM dependence for large dimensions: the Canonical Vine Autoregressive Model
Andréas HEINE and Alfonso VALDESOGO

We propose a new dynamic model for volatility and dependence in high dimensions, that allows for departures from the normal distribution, both in the marginals and in the dependence. The dependence is modeled with a dynamic canonical vine copula, which can be decomposed into a cascade of bivariate conditional copulas. Due to this decomposition, the model does not suffer from the curse of dimensionality. The canonical vine autoregressive (CAVA) captures asymmetries in the dependence structure. The model is applied to 95 S&P500 stocks. For the marginal distributions, we use non-Gaussian GARCH models, that are designed to capture skewness and kurtosis. By conditioning on the market index and on sector indexes, the dependence structure is much simplified and the model can be considered as a non-linear version of the CAPM or of a market model with sector effects. The model is shown to deliver good forecasts of Value-at-Risk.

JEL Classification: C32, C53, G10

Keywords: asymmetric dependence, high dimension, multivariate copula, multivariate GARCH, Value-at-Risk.

- 2009/70 Product differentiation and vertical integration in presence of double marginalization
Skerdilajda ZANAJ

In this paper, we present a model of endogenous vertical integration and horizontal differentiation. There exists two output brands and two versions of the input. The only mean for output differentiation is the input version used in output production. Firms may choose to vertically integrate to produce internally the required input version at marginal cost, rather than to buy it at the market price, if that version is

made available. We show that vertical mergers increase the possibility that output goods are differentiated. Moreover, this occurs when the cost to differentiate the input is high. On the other hand, vertical integration is detrimental for brand variety if the cost to differentiate inputs is negligible.

JEL Classification: D43, L13, L42

Keywords: horizontal differentiation, vertical agreements, successive Cournot oligopolies.

- 2009/71 Wives, husbands and wheelchairs: Optimal tax policy under gender-specific health
Marie-Louise LEROUX and Grégory PONTIERE

We study the optimal taxation problem in an economy composed of two-person households (men and women), where agents influence their own old-age dependency prospects through health spending. It is shown that the utilitarian social optimum can be decentralized by means of lump sum transfers from men to women, because women exhibit a higher disability-free life expectancy than men for a given level of health spending. Once self-oriented concerns for coexistence are introduced, the decentralization of the first-best requires also gender-specific subsidies on health spending aimed at internalizing the effect of each agent's health on the spouse's welfare. In the presence of singles in the population, the optimal policy requires also a differentiated subsidization of health spending for singles and couples. Finally, under imperfect observability of couples, the incentive compatibility constraints reinforce the need for subsidization of health spendings.

JEL Classification: H51, I12, I18, J14, J16

Keywords: long term care, optimal taxation, preventive health spending, gender differentials, old age dependency.

- 2009/72 Local quadratic convergence of polynomial-time interior-point methods for conic
optimization problems
Yu. NESTEROV and Levent TUNCEL

In this paper, we establish a local quadratic convergence of polynomial-time interior-point methods for general conic optimization problems. The main structural property used in our analysis is the logarithmic homogeneity of self-concordant barrier functions. We propose new path-following predictor-corrector schemes which work only in the dual space. They are based on an easily computable gradient proximity measure, which ensures an automatic transformation of the global linear rate of convergence to the local quadratic one under some mild assumptions. Our step-size procedure for the predictor step is related to the maximum step size (the one that takes us to the boundary). It appears that in order to obtain local superlinear convergence, we need to tighten the neighborhood of the central path proportionally to the current duality gap.

Keywords: conic optimization problem, worst-case complexity analysis, self-concordant barriers, polynomial-time methods, predictor-corrector methods, local quadratic convergence.

- 2009/73 Cycle commuting in Belgium: Spatial determinants and 're-cycling' strategies
Grégory VANDENBULCKE, Claire DUJARDIN, Isabelle THOMAS, Bas DE GEUS, Bart DEGRAEUWE, Romain MEEUSEN and Luc INT PANIS

This paper attempts to explain the spatial variation of the use of a bicycle for commuting to work at the level of the 589 municipalities in Belgium. Regression techniques were used and special attention was paid to autocorrelation, heterogeneity and multicollinearity. Spatial lag models were used to correct for the presence of spatial dependence and a disaggregated modelling strategy was adopted for the northern and southern parts of the country. The results show that much of the inter-municipality variation in bicycle use is related to environmental aspects such as the relief, traffic volumes and cycling accidents. Town size, distance travelled and demographic aspects also have some effect. In addition, there are regional differences in the effects of the structural covariates on bicycle use: the impact of variables such as traffic volume and cycling accidents differs substantially between the north and the south of the country. This paper also suggests that high rates of bicycle use in one municipality stimulate cycling in neighbouring municipalities, and hence that a mass effect can be initiated, i.e. more cycle commuting encourages even more commuters in the area to cycle. These findings provide some recommendations for decision-makers wishing to promote a shift from car to bicycle use.

Keywords: cycling, commuting, spatial lag model, spatial regime, pro-cycling strategies.

- 2009/74 Sustainability, optimality, and viability in the Ramsey model
Noël BONNEUIL and Raouf BOUCEKKINE

The Ramsey model of economic growth is revisited from the point of view of viability. A viable state is a state from which there exists at least one trajectory that remains in the set of constraints of minimal consumption and positive wealth. Viability is presented with a constraint of minimal consumption, then with an additional criterion of economic sustainability. The comparison of viability kernels with or without sustainability shows how much consumption should be reduced and when. The viable-optimal solution in the sense of inter-temporal consumption is obtained on the viability boundary of an auxiliary system. Technological progress works against population growth to favor the possibility for a given state of being viable or viable-sustainable.

JEL Classification: C61, C63, C65, O41

Keywords: viability theory, optimization, sustainability, Ramsey model.

- 2009/75 The principle of mutual recognition – A source of divergence?
Eric TOULEMONDE

Governments set numerous norms to protect consumers. Two countries may achieve the same level of protection of their consumers through different specifications. The adaptation costs induced by these differences create barriers to trade. The principle of mutual recognition addresses the problem by ensuring that products lawfully manufactured in one country are acceptable without adaptation in another country. We show that by shifting the transaction costs of adapting to several norms from firms to consumers the principle of mutual recognition creates disparities across countries and is (more) beneficial to larger countries.

JEL Classification: F13, F15, R12, R13

Keywords: technical barriers to trade, mutual recognition, economic geography, home market effect.

- 2009/76 How powerful is demography? The Serendipity Theorem revisited
David DE LA CROIX, Pierre PESTIEAU and Grégory PONTIÈRE

Introduced by Samuelson (1975), the Serendipity Theorem states that the competitive economy will converge towards the optimum steady-state provided the optimum population growth rate is imposed. This paper aims at exploring whether the Serendipity Theorem still holds in an economy with risky lifetime. We show that, under general conditions, including a perfect annuity market with actuarially fair return, imposing the optimum fertility rate and the optimum survival rate leads the competitive economy to the optimum steady-state. That Extended Serendipity Theorem is also shown to hold in economies where old adults work some fraction of the old-age, whatever the retirement age is fixed or chosen by the agents.

JEL Classification: E13, E21, I18, J10

Keywords: Serendipity Theorem, fertility, mortality, overlapping generations, retirement.

- 2009/77 Announcement wars as an equilibrium selection device
Nicola ACOCELLA, Giovanni DI BARTOLOMEO, Andrew HUGUES HALLETT and Paolo G. PIACQUADIO

This paper attempts to give a rationale to public announcements, so often observed in the real world, and to formalize the idea that they can be used as a form of equilibrium selection device when multiple equilibria arise. It also shows how announcements solve the problems of coordination failures as predicted by the empirical literature based on experimental studies.

JEL Classification: C72, C78, D61

Keywords: multiple Nash equilibria, coordination failure, cheap talk, policy games, announcement equilibrium.

- 2009/78 The taxation of savings in overlapping generations economies with unbacked risky assets
Julio DAVILA

This paper establishes, in the context of the Diamond (1965) overlapping generations economy with production, that the risk that savings in unbacked assets (like fiat money or public debt) become worthless implies that, not only the first-best steady state, but even the best steady state attainable with those saving instruments fails to be a competitive equilibrium outcome under *laissez-faire*. It is nonetheless shown as well that this best monetary steady state can be implemented as a competitive equilibrium with the adequate policy of taxes on returns to capital, subsidies to returns to monetary savings, and lump-sum transfers. Interestingly enough, this policy requires no redistribution of income among agents, unlike the implementation of the first-best steady state. The policy is balanced every period at the steady state and, since no public spending exists in the model, it serves the only purpose of implementing a steady state that provides all agents with a higher utility than the *laissez-faire* competitive equilibrium steady state. The results thus provide a rationale for an active fiscal policy that has nothing to do with redistributive goals

or the need to fund any kind of public spending.

JEL Classification: E62, E21, E22, H21

Keywords: taxation of savings, overlapping generations, asset bubble.

- 2009/79 Optimal education and pensions in an endogenous growth model
Elena DEL REY and Miguel Angel LOPEZ-GARCIA

It is well known that, in OLG economies with life-cycle saving and exogenous growth, competitive equilibria will in general fail to achieve optimality and may even be dynamically inefficient. This is a consequence of individuals accumulating amounts of physical capital that differ from the level which would maximize welfare along a balanced growth path (the Golden Rule). With human capital, a second potential source of departure from optimality arises, to wit: individuals may not choose the correct amount of education investment. However, the Golden Rule concept, widely used in exogenous growth frameworks, has not found its way into endogenous growth models. In this paper, we propose to recover the Golden Rule of physical and also human capital accumulation. The optimal policy to decentralize the Golden Rule balanced growth path when there are no constraints for individuals to finance their education investments is also characterized. It is shown that it involves positive pensions and negative education subsidies (i.e., taxes).

JEL Classification: D90, H21, H52, H55

Keywords: endogenous growth, human capital, intergenerational transfers, education policy.

- 2009/80 Strategic complementarities and nested potential games
Hiroshi UNO

This note shows that every finite game of strategic complementarities is a nested pseudo-potential game defined in Uno (2007, *Economics Bulletin* **3** (17)) if the action set of each player is one-dimensional, except possibly for one player.

JEL Classification: C72

Keywords: Strategic complementarities, potential games, existence of a pure strategy Nash equilibrium.

- 2009/81 Market coverage and the nature of product differentiation: a note
Xavier WAUTHY

In this note, we analyze the equilibrium outcomes of pricing games with product differentiation in relation with the extent of market coverage. It is a received idea in the IO literature that the horizontal and vertical models of product differentiation are almost formally equivalent. We show that this idea turns out to be wrong when the full market coverage assumption is relaxed. We then argue that there exist two fundamentally different classes of address-models of differentiation, although their difference is not perfectly captured by the standard horizontal/vertical typology.

JEL Classification: L13

Keywords: price competition, product differentiation.

- 2009/82 Nash equilibria of games with increasing best replies
Filippo L. CALCIANO

The intuitive idea of two activities being complements, for example tea and lemon, is that increasing the level of one makes somehow desirable to increase the level of the other (Samuelson, 1974). Hence complementarity, in its very nature, is a sensitivity property of the set of solutions to an optimization problem. In the context of games, complementarity should then be captured by properties of the joint best reply. We introduce notions of increasingness for the joint best reply which capture properly this intuitive idea of complementarity among players' strategies. We show, by generalizing the fixpoint theorems of Veinott (1992) and Zhou (1994), that the Nash sets of our games are nonempty complete lattices. Hence we extend the class of games with strategic complementarities.

JEL Classification: C60, C70, C72

Keywords: strategic complementarity, supermodular games, quasisupermodular games, fixpoint theorem, Nash equilibria.

- 2009/83 Stock prices, anticipations and investment in general equilibrium
Jacques H. DRÈZE, Oussama LACHIRI and Enrico MINELLI

We propose an objective for the firm in a model of production economies extending over time under uncertainty and with incomplete markets. We derive the objective of the firm from the assumption of initial-shareholders efficiency. Each shareholder is assumed to communicate to the firm her marginal valuation of profits at all future events (expressed in terms of initial resources). In defining her own marginal valuation of the firm's profits, a shareholder takes into consideration the direct impact of a change in the value of dividends but also the impact of future dividends on the firm's stock price when she trades shares. To predict the impact on the stock price, she uses a state price process, her price theory. The firm computes its own shadow prices for profits at all date-events by simply adding up the marginal valuations of all its initial shareholders. If no restrictions are placed on individual price theories, the existence of equilibria may require financial constraints on a firm's investment when its shareholders are more optimistic than the market about the profitability of such investment. We then impose that price theories be compatible with the observed equilibrium: they should satisfy a no-arbitrage condition. We show by means of an example that, with incomplete markets and no-short selling constraints, this restriction on price theories is not enough to bring consistency in the individuals' marginal evaluations: a financial constraint on the firm's investment may still be needed to obtain an equilibrium.

JEL Classification: D2, D51, D52, D53, G11, G12, G32, M20, P12

Keywords: general equilibrium, incomplete markets, stock prices, anticipations, investment constraints, arbitrage.

- 2009/84 Neighborhood effects on unemployment? A test *à la* Altonji
Claire DUJARDIN and Florence GOFFETTE-NAGOT

The aim of this paper is to test for the influence of neighborhood deprivation on individual unemployment probability in the case of Lyon (France). We estimate a bivariate probit model of unemployment and location in a deprived neighborhood. Our identification strategy is twofold. First, we instrument neighborhood type by

the gender composition of household's children and the spouse's workplace. Second, we use the methodology proposed by Altonji et al. (2005), that in our case consists in making hypotheses as to the correlation between the unobservables that determine unemployment and the unobservables that influence the selection into neighborhood types. Our results show that the effect of neighborhood deprivation is not significantly different from zero in the bivariate probit with exclusion restrictions. We also show that a correlation of the unobservables as low as ten percent of the correlation of observables is sufficient to explain the positive neighborhood effect that is observed when endogeneity is not accounted for.

JEL Classification: R2, I32

Keywords: neighborhood effects, unemployment, simultaneous probit models, instrumental variables, selection on unobservables.

- 2009/85 School accountability: (how) can we reward schools and avoid cream-skimming
Erwin OOGHE and Erik SCHOKKAERT

Introducing school accountability may create incentives for efficiency. However, if the performance measure used does not correct for pupil characteristics, it will lead to an inequitable treatment of schools and create perverse incentives for cream-skimming. We apply the theory of fair allocation to show how to integrate empirical information about the educational production function in a coherent theoretical framework. The requirements of rewarding performance and correcting for pupil characteristics are incompatible if we want the funding scheme to be applicable for all educational production functions. However, we characterize an attractive subsidy scheme under specific restrictions on the educational production function. This subsidy scheme uses only information which can be controlled easily by the regulator. We show with Flemish data how the proposed funding scheme can be implemented. Correcting for pupil characteristics has a strong impact on the subsidies (and on the underlying performance ranking) of schools.

- 2009/86 Product and process innovation and the decision to export: firm-level evidence for Belgium
Ike VAN BEVEREN and Hylke VANDENBUSSCHE

Using data from the Community Innovation Survey for Belgium in two consecutive periods, this paper explores the relationship between firm-level innovation activities and the propensity to start exporting. To measure innovation, we include indicators of both innovative effort (R&D activities) as well as innovative output (product and process innovation). Our results suggest that the combination of product and process innovation, rather than either of the two in isolation, increases a firm's probability to enter the export market. After controlling for potential endogeneity of the innovation activities, only firms with a sufficiently high probability to start exporting engage in product and process innovation prior to their entry on the export market, pointing to the importance of self-selection into innovation.

JEL Classification: D24, F14, L25, O31, O33

Keywords: exports, product innovation, process innovation, self-selection, firm heterogeneity.