

- 2011/1 Random gradient-free minimization of convex functions
Yu. NESTEROV

In this paper, we prove the complexity bounds for methods of Convex Optimization based only on computation of the function value. The search directions of our schemes are normally distributed random Gaussian vectors. It appears that such methods usually need at most n times more iterations than the standard gradient methods, where n is the dimension of the space of variables. This conclusion is true both for nonsmooth and smooth problems. For the later class, we present also an accelerated scheme with the expected rate of convergence $O(n^2/k^2)$, where k is the iteration counter. For Stochastic Optimization, we propose a zero-order scheme and justify its expected rate of convergence $O(n/k^{1/2})$. We give also some bounds for the rate of convergence of the random gradient-free methods to stationary points of nonconvex functions, both for smooth and nonsmooth cases. Our theoretical results are supported by preliminary computational experiments.

Keywords: convex optimization, stochastic optimization, derivative-free methods, random methods, complexity bounds.

- 2011/2 First-order methods of smooth convex optimization with inexact oracle
Olivier DEVOLDER, François GLINEUR and Yu. NESTEROV

In this paper, we analyze different first-order methods of smooth convex optimization employing inexact first-order information. We introduce the notion of an approximate first-order oracle. The list of examples of such an oracle includes smoothing technique, Moreau-Yosida regularization, Modified Lagrangians, and many others. For different methods, we derive complexity estimates and study the dependence of the desired accuracy in the objective function and the accuracy of the oracle. It appears that in inexact case, the superiority of the fast gradient methods over the classical ones is not anymore absolute. Contrary to the simple gradient schemes, fast gradient methods necessarily suffer from accumulation of errors. Thus, the choice of the method depends both on desired accuracy and accuracy of the oracle. We present applications of our results to smooth convex-concave saddle point problems, to the analysis of Modified Lagrangians, to the prox-method, and some others.

Keywords: smooth convex optimization, first-order methods, inexact oracle, gradient methods, fast gradient methods, complexity bounds.

- 2011/3 A comparison of forecasting procedures for macroeconomic series: the contribution of structural break models
Luc BAUWENS, Gary KOOP, Dimitris KOROBILIS and Jeroen V.K. ROMBOUTS

This paper compares the forecasting performance of different models which have been proposed for forecasting in the presence of structural breaks. These models differ in their treatment of the break process, the parameters defining the model which applies in each regime and the out-of-sample probability of a break occurring. In an extensive empirical evaluation involving many important macroeconomic time series, we demonstrate the presence of structural breaks and their importance for forecasting in the vast majority of cases. However, we find no single forecasting model consistently works best in the presence of structural breaks. In many cases, the formal modeling of the break process is important in achieving good forecast performance. However, there are also many cases where simple, rolling OLS forecasts perform well.

JEL Classification: C11, C22, C53

Keywords: forecasting, change-points, Markov switching, Bayesian inference.

2011/4 Nonparametric Beta kernel estimator for long memory time series
Taoufik BOUEZMARNI and Sébastien VAN BELLEGEM

The paper introduces a new nonparametric estimator of the spectral density that is given in smoothing the periodogram by the probability density of Beta random variable (Beta kernel). The estimator is proved to be bounded for short memory data, and diverges at the origin for long memory data. The convergence in probability of the relative error and Monte Carlo simulations suggest that the estimator automatically adapts to the long- or the short-range dependency of the process. A cross-validation procedure is also studied in order to select the nuisance parameter of the estimator. Illustrations on historical as well as most recent returns and absolute returns of the S&P500 index show the reasonable performance of the estimation, and show that the data-driven estimator is a valuable tool for the detection of long-memory as well as hidden periodicities in stock returns.

JEL Classification: primary C14, secondary C22, C58

Keywords: spectral density, long range dependence, nonparametric estimation, periodogram, kernel smoothing, Beta kernel, cross-validation.

2011/5 The complementarity foundations of industrial organization
Filippo L. CALCIANO

In this paper we review the state of the art of Games with Strategic Complementarities (GSC), which are fundamental tools in modern Industrial Organization. The originality of the paper lies in the way the material is presented. Indeed, the mathematical aspects of GSC are complex and scattered in a literature which spans a long time period and a variety of research fields such as economics, applied mathematics and operations research. We organize a large amount of material in a unified and self-contained way, and concentrate on the intuitions and conceptual points that lie in the background of the mathematical modeling, with special emphasis on the modeling of complementarity. On the technical side, we investigate in details the choice and content of the assumptions. The scope of the paper is to allow the applied researcher to understand the theory, so that she may rapidly develop her own ability to deal with concrete problems.

JEL Classification: C60, C70, C72

Keywords: strategic complementarity, oligopoly theory, supermodularity, Nash equilibria, lattices.

2011/6 Real exchanges rates in commodity producing countries: a reappraisal
Vincent BODART, Bertrand CANDELON and Jean-François CARPANTIER

Commodity currency literature recently stressed the importance of commodity prices as a determinant of real exchange rates in developing countries (Cashin, Cespedes and Sahay 2004). We provide new empirical evidence on this issue by focusing on countries which are specialized in the ex-port of one leading commodity. For those countries, we investigate to which extent their real exchange rate is sensitive to price fluctuations of their dominant commodity. By using non-stationary panel techniques robust to cross-sectional-dependence, we find that the price of the dominant commodity has a significant long-run impact on the real exchange rate when the exports of the leading commodity have a share of at least 20 percent in the country's total exports of merchandises. Our results also show

that the larger the share, the larger the size of the impact.

JEL Classification: C32, C33, E31, F32, O11

Keywords: real exchange rates, commodity prices, non-stationary panel.

- 2011/7 Myopic or farsighted? An experiment on network formation
Georg KIRCHSTEIGER, Marco MANTOVANI, Ana MAULEON and Vincent VANNETELBOSCH

Pairwise stability (Jackson and Wolinsky, 1996) is the standard stability concept in network formation. It assumes myopic behavior of the agents in the sense that they do not forecast how others might react to their actions. Assuming that agents are farsighted, related stability concepts have been proposed. We design a simple network formation experiment to test these theories. Our results provide support for farsighted stability and strongly reject the idea of myopic behavior.

JEL Classification: C91, C92, D85

Keywords: experiment, myopic and farsighted stability and network formation.

- 2011/8 Export performance of Chinese domestic firms: the role of foreign export spillovers
Florian MAYNERIS and Sandra PONCET

We investigate how the proximity to multinational exporters influences the creation of new export linkages (extensive margin of trade) by domestic firms in China. Using panel data from Chinese customs for 1997-2007, we show that domestic firms' capacity to start exporting new varieties to new markets positively responds to the export activity of neighboring foreign firms for that same product-country pair. We find that foreign export spillovers are limited to ordinary trade activities. No foreign export spillovers are found for processing trade. More, export spillovers are stronger for sophisticated products indicating that proximity to foreign exporters may help domestic exporters to upgrade their exports. However we observe that foreign export spillovers are weaker when the technology gap between foreign and domestic firms is large, suggesting that upgrading may not occur when foreign firms have already a strong edge.

JEL Classification: F1, R12, L25

Keywords: export performance, spillovers, FDI, sophistication.

- 2011/9 Nested potentials and robust equilibria
Hiroshi UNO

This paper introduces the notion of nested best-response potentials for complete information games. It is shown that a unique maximizer of such a potential is a Nash equilibrium that is robust to incomplete information in the sense of Kajii and Morris (1997, mimeo).

JEL Classification: C72, C73

Keywords: incomplete information, potential games, robustness, refinements.

- 2011/10 Monopolistic competition in general equilibrium: beyond the CES
Evgeny ZHELOBODKO, Sergey KOKOVIN, Mathieu PARENTI and Jacques-François THISSE

We propose a general model of monopolistic competition and derive a complete characterization of the market equilibrium using the concept of Relative Love for Variety. When the RLV increases with individual consumption, the market

generates pro-competitive effects. When it decreases, the market mimics anti-competitive behavior. The CES is a borderline case. We extend our setting to heterogeneous firms and show that the cutoff cost decreases (increases) when the RLV increases (decreases). Last, we study how combining vertical, horizontal and cost heterogeneity affects our results.

JEL Classification: D43, F12, L13

Keywords: monopolistic competition, additive preferences, love for variety, heterogeneous firms.

- 2011/11 Multivariate volatility modeling of electricity futures
Luc BAUWENS, Christian HAFNER and Diane PIERRET

The deregulation of European electricity markets has led to an increasing need in understanding the volatility and correlation structure of electricity prices. We model a multivariate futures series of the European Energy Exchange (EEX) index, using an asymmetric GARCH model for volatilities and augmented dynamic conditional correlation (DCC) models for correlations. In particular, we allow for smooth changes in the unconditional volatilities and correlations through a multiplicative component that we estimate non-parametrically. We also introduce exogenous variables in our new multiplicative DCC model to account for congestion in short-term conditional volatilities. We find different correlation dynamics for long and short-term contracts and the new model achieves higher forecasting performance compared to a standard DCC model.

JEL Classification: C32, C53, C58

Keywords: dynamic conditional correlation, electricity futures, forecasting.

- 2011/12 Geographical economics: a historical perspective
Jacques-François THISSE

This paper provides a bird-eye overview of the history of spatial economic theory. It is organized around three main ideas (and authors): (i) land use and urban economics (Thünen), (ii) the nature of competition across space (Hotelling), and (iii) new economic geography and the emergence of economic agglomerations (Krugman).

Keywords: urban economics, spatial competition, economic geography.

- 2011/13 Marginal likelihood for Markov-switching and change-point GARCH models
Luc BAUWENS, Arnaud DUFAYS and Jeroen V.K. ROMBOUTS

GARCH models with fixed parameters are too restrictive for long time series due to breaks in the volatility process. Flexible alternatives are Markov-switching GARCH and change-point GARCH models. They require estimation by MCMC methods due to the path dependence problem. An unsolved difficult issue is the computation of their marginal likelihood by Chib's method, which is essential for determining the number of regimes or change-points. We solve the problem by using particle MCMC, a technique proposed by Andrieu, Doucet and Holenstein (2010). We examine the performance of this new method by a simulation study, and we illustrate its use on long series of index returns.

JEL Classification: C11, C15, C22, C58

Keywords: Bayesian inference, simulation, GARCH, Markov-switching model, change-point model, marginal likelihood, particle MCMC.

- 2011/14 Risk-sharing networks and farsighted stability
Gilles GRANDJEAN

Evidence suggests that in developing countries, agents rely on mutual insurance agreements to deal with income or expenditure shocks. This paper analyzes which risk-sharing networks can be sustained in the long run when individuals are farsighted, in the sense that they are able to forecast how other agents would react to their choice of insurance partners. In particular, we study whether the farsightedness of the agents leads to a reduction of the tension between stability and efficiency that arises when individuals are myopic. We find that for extreme values of the cost of establishing a mutual insurance agreement, myopic and farsighted agents form the same risk-sharing networks. For intermediate costs, farsighted agents form efficient networks while myopic agents don't.

JEL Classification: C70, D85, O17

Keywords: risk-sharing, networks, farsighted agents, stability, efficiency.

- 2011/15 Vertical integration and exclusivities in maritime freight transport
Pedro CANTOS-SANCHEZ, Rafael MONER-COLONQUES, José J. SEMPERE-MONERRIS and Oscar ALVAREZ-SANJAIME

A key recent theme in maritime freight transport is the involvement of shipping lines in terminal management. Such investments are costly but allow liners to provide better service. Most of these new terminals are dedicated terminals but some are non-exclusive and let rivals access them for a fee. In this paper, we show that a shipping line that builds its own terminal finds it strategically profitable i) to continue routing part of its cargo through the open port facilities, and ii) to keep its terminal non-exclusive. In this way, the liner investor pushes part of the rival's freight from the open to the new terminal. Besides, under non-exclusivities, the shipping lines offer a wider variety of services, total freight increases and the resulting equilibrium fares are higher than with a dedicated terminal.

JEL Classification: L13, L91, R40

Keywords: freight transport, shipping lines, vertical integration.

- 2011/16 Comparison of heuristic procedures for an integrated model for production and distribution planning in an environment of shared resources
Géraldine STRACK, Bernard FORTZ, Fouad RIANE and Mathieu VAN VYVE

In this paper, we present a mathematical model which integrates tactical-operational production and distribution decisions in a shared resources environment. More precisely, we integrate lot sizing production and distribution decisions with vehicle routing decisions. We obtain a global multi-period multi-item multi-vehicle model where a capacity constraint models the link between production and distribution decisions. Three heuristics are presented in order to solve this global model. The first two ones are based on a decomposition approach of the global model in production and distribution submodels. The third heuristic offers a higher level of integration by taking into account transportation decisions in the production planning problem. Computational tests show that the performance of the heuristic depends on the amount of shared resources in the system, the type of customer demand but not on the weight of the production cost against the distribution cost. The three heuristics allow to tackle problems of larger size than an optimal solution approach.

Keywords: integrated model, production, distribution, shared resources.

- 2011/17 Price differentials among brands in retail distribution: product quality and service quality
Juan A. MAÑEZ, Rafael MONER-COLONQUES, José J. SEMPERE-MONERRIS and Amparo URBANO

We develop a theoretical model of retail competition that include two sources of quality, one inherently linked to brand characteristics and the other linked to the retailer level of service. We then measure their contribution in explaining the observed price differentials for a sample of U.K. grocery retailer prices in the south of Coventry during the period November 1995 to March 1997. We find that retailers that offer a higher quality service sell same quality brands at higher prices. These price premia are explained solely by differences in service quality levels. We find econometric evidence that they amount to 6 percent for national brands and to a range between 9 percent and 15 percent for low-quality store brands. Besides, at a given store, the price premia paid for the national brand is positive. These differentials are very large: around 150 percent between national brands and low-quality store brands, around 40 percent between national brands and high-quality store brands. Also, the price differential between the national brand and the low-quality store brand does not increase with its service quality. Besides, the price of the high-quality store brand approaches the price of the national brand when service quality increases. Thus suggesting that stores that offer high quality service uses the level of service as a strategic tool to target the leading national brand consumers.

JEL Classification: C70, L13, J50, J52

Keywords: store brands, brand quality, service quality.

- 2011/18 Patent office governance and patent system quality
Pierre M. PICARD and Bruno VAN POTTELSBERGHE DE LA POTTERIE

The present paper discusses the role of quality in patent systems from the perspective of patent offices' behavior and organization. After documenting original stylized facts, the paper presents a model in which patent offices set patent fees and the quality level of their examination processes. Various objectives of patent offices' governors are considered. We show that the quality of the patent system is maximal for the patent offices that maximises either the social welfare or its own profit. Quality is lower for the self-funded patent office maximizing the number of patent applications and even smaller for the self-funded patent office maximizing the number of granted patents. A labor union improves examination quality and may compensate for the potentially inappropriate objectives of patent office management.

JEL Classification: L30, O30, O31, O34, O38

Keywords: patent system, quality, intellectual property, public firm organization.

- 2011/19 A theory of BOT concession contracts
Emmanuelle AURIOL and Pierre M. PICARD

In this paper, we discuss the choice for build-operate-and-transfer (BOT) concessions when governments and firm managers do not share the same information regarding the operation characteristics of a facility. We show that larger shadow costs of public funds and larger information asymmetries entice governments to choose BOT concessions. This result stems from a trade-off between the government's shadow costs of financing the construction and the operation of the facility and the excessive usage price that the consumer may face

during the concession period. The incentives to choose BOT concessions increase as a function of informational asymmetries between governments and potential BOT concession holders and with the possibility of transferring the concession project characteristics to the public authority at the termination of the concession.

JEL Classification: L43, L51, D82, L33

Keywords: public-private-partnership, privatization, adverse selection, regulation, natural monopoly, infrastructure, facilities.

- 2011/20 Attitudes towards income risk in the presence of quantity constraints
Fred SCHROYEN

Considering a consumer with standard preferences, I trace out the consequences for risk aversion and prudence of quantity constraints on markets. I first show how the effect can be decomposed into a price risk effect and an endogenously changing risk aversion/prudence effect. Next, I calibrate locally both effects on relative risk aversion and prudence, using estimates on household demand for durables and labour supply. Finally, I perform a global numerical analysis of these effects. I conclude that quantity constraints have counter-intuitive and pronounced non-linear effects on risk attitudes.

JEL Classification: D11, D81

Keywords: household demand, income risk aversion, prudence, quantity constraints, labour supply.

- 2011/21 Hierarchical shrinkage priors for dynamic regressions with many predictors
Dimitris KOROBILIS

This paper builds on a simple unified representation of shrinkage Bayes estimators based on hierarchical Normal-Gamma priors. Various popular penalized least squares estimators for shrinkage and selection in regression models can be recovered using this single hierarchical Bayes formulation. Using 129 U.S. macroeconomic quarterly variables for the period 1959 – 2010 I exhaustively evaluate the forecasting properties of Bayesian shrinkage in regressions with many predictors. Results show that for particular data series hierarchical shrinkage dominates factor model forecasts, and hence is a valuable addition to existing methods for handling large dimensional data.

JEL Classification: C11, C22, C52, C53, C63, E37

Keywords: forecasting, shrinkage, factor model, variable selection, Bayesian LASSO.

- 2011/22 VAR forecasting using Bayesian variable selection
Dimitris KOROBILIS

This paper develops methods for automatic selection of variables in Bayesian vector autoregressions (VARs) using the Gibbs sampler. In particular, I provide computationally efficient algorithms for stochastic variable selection in generic linear and nonlinear models, as well as models of large dimensions. The performance of the proposed variable selection method is assessed in forecasting three major macroeconomic time series of the UK economy. Databased restrictions of VAR coefficients can help improve upon their unrestricted counterparts in forecasting, and in many cases they compare favorably to shrinkage estimators.

JEL Classification: C11, C32, C52, C53, E37

Keywords: forecasting, variable selection, time-varying parameters.

- 2011/23 Inequality aversion and separability in social risk evaluation
Marc FLEURBAEY and Stéphane ZUBER

This paper examines how to satisfy a separability condition related to “independence of the utilities of the dead” (Blackorby et al., 1995; Bommier and Zuber, 2008) in the class of “expected equally distributed equivalent” social orderings (Fleurbaey, 2010). It also inquires into the possibility to keep some aversion to inequality in this context. It is shown that the social welfare function must either be utilitarian or take a special multiplicative form. The multiplicative form is compatible with any degree of inequality aversion, but only under some constraints on the range of individual utilities.

JEL Classification: D63, D71, D81

Keywords: risk, ex post equity, independence of the utilities of the dead.

- 2011/24 Social long term care insurance and redistribution
Helmuth CREMER and Pierre PESTIEAU

We study the role of social long term care (LTC) insurance when income taxation and private insurance markets are imperfect. Policy instruments include public provision of LTC as well as a subsidy on private insurance. The subsidy scheme may be linear or nonlinear. For the linear part we consider a continuous distribution of types, characterized by earnings and survival probabilities. In the nonlinear part, society consists of three types: poor, middle class and rich. The first type is too poor to provide for dependence; the middle class type purchases private insurance and the high income type is self-insured. The main questions are at what level LTC should be provided to the poor and whether it is desirable to subsidize private LTC for the middle class. Interestingly, the results are similar under both linear and nonlinear schemes. First, in both cases, a (marginal) subsidy of private LTC insurance is not desirable. As a matter of fact, private insurance purchases should typically be taxed (at least at the margin). Second, the desirability of public provision of LTC services depends on the way the income tax is restricted. In the linear case, it may be desirable only if no demogrant (uniform lump-sum transfer) is available. In the nonlinear case, public provision is desirable when the income tax is sufficiently restricted. Specifically, this is the case when the income is subject only to a proportional payroll tax while the LTC reimbursement policy can be nonlinear.

JEL Classification: H50, G22

Keywords: long term care, social insurance.

- 2011/25 Sustainable growth and modernization under environmental hazard and adaptation
Natali HRITONENKO and Yuri YATSENKO

We develop an aggregated model to study rational environmental adaptation policies that compensate negative consequences of certain environmental hazards and changes. The model distinguishes three categories of adaptation measures that (a) compensate the decrease of the environmental amenity value, (b) compensate the decrease of total productivity, (c) develop and introduce new hazard-protected capital and technology. We analyze the optimal balance among investment, consumption, and different categories of adaptation investments. It appears that the environmental hazard and subsequent adaptation do not lead in the long run to a higher level of capital modernization compared to the benchmark case with no hazard. A synergism between productivity-related and amenity-related adaptation activities arises because the productivity-related adaptation positively impacts the

economy and creates better possibilities for the amenity adaptation.

JEL Classification: C00, O11, O13, Q01, Q54, Q57

Keywords: environmental hazard, environmental adaptation, capital modernization, optimization.

- 2011/26 Equity in health and health care
Marc FLEURBAEY and Erik SCHOKKAERT

We discuss the conceptual foundations of measuring (in)equity in health and health care. After an overview of the recent developments in the measurement of socio-economic inequalities and in racial disparities, we show how these partial approaches can be seen as special cases of the more general social choice approach to fair allocation and equality of opportunity. We suggest that this latter framework offers many new analytical possibilities and is sufficiently rich to accommodate various ethical views. We emphasize that horizontal and vertical equity are intricately linked to each other. We then argue that a focus on overall well-being is necessary to put the partial results on health (care) inequity into a broader perspective and we discuss the pros and cons of various methods to evaluate the joint distribution of health and income: multidimensional inequality indices, dominance approaches, the use of happiness measures and finally the concept of equivalent income. Throughout the chapter the theoretical analysis is complemented with an overview of recent empirical results.

JEL Classification: D630, I140, J150

Keywords: equity, racial disparities, equality of opportunity, equivalent income, dominance.

- 2011/27 The natalist bias of pollution control
David DE LA CROIX and Axel GOSSERIES

For a given technology, two ways are available to achieve low polluting emissions: reducing production per capita or reducing population size. This paper insists on the tension between the former and the latter. Controlling pollution either through Pigovian taxes or through tradable quotas schemes encourages agents to shift away from production to tax free activities such as procreation and leisure. This natalist bias will deteriorate the environment further, entailing the need to impose ever more stringent pollution rights per person. However, this will in turn gradually impoverish the successive generations: population will tend to increase further and production per capita to decrease as the generations pass. One possible solution consists in capping population too.

JEL Classification: Q58, Q56, J13, O41

Keywords: overlapping generations, environmental policy, endogenous fertility, quantity – quality tradeoff, population control.

- 2011/28 Effects of the uncertainty about global economic recovery on energy transition and CO₂ price
Olivier DURAND-LASSERVE, Axel PIERRU and Yves SMEERS

This paper examines the impact that uncertainty over economic growth may have on global energy transition and CO₂ prices. We use a general-equilibrium model derived from MERGE, and define several stochastic scenarios for economic growth. Each scenario is characterized by the likelihood of a rapid global economic recovery. More precisely, during each decade, global economy may - with a given probability - shift from the EIA's (2010) low-economic-growth path to the EIA's

(2010) high-economic-growth path. The climate policy considered corresponds in the medium term to the commitments announced after the Copenhagen conference, and in the long term to a reduction of 25% in global energy-related CO₂ emissions (with respect to 2005). For the prices of CO₂ and electricity, as well as for the implementation of CCS, the branches of the resulting stochastic trajectories appear to be heavily influenced by agents' initial expectations of future economic growth and by the economic growth actually realized. Thus, in 2040, the global price of CO₂ may range from \$21 (when an initially-anticipated economic recovery never occurs) to \$128 (in case of non-anticipated rapid economic recovery). In addition, we show that within each region, the model internalizes the constraints limiting the expansion of each power-generation technology through the price paid by the power utility for the acquisition of new production capacity. As a result, in China, the curves of endogenous investment costs for onshore and offshore wind are all bubble-shaped centered on 2025, a date which corresponds to the establishment of a global CO₂ cap-and-trade market in the model.

JEL Classification: C68, H23, Q41, Q43

Keywords: energy transition, CO₂, economic growth, uncertainty, investment cost, MERGE.

2011/29 Absolutely stable roommate problems
Ana MAULEON, Elena MOLIS, Vincent J. VANNETELBOSCH and Wouter VERGOTE

Different solution concepts (core, stable sets, largest consistent set, ...) can be defined using either a direct or an indirect dominance relation. Direct dominance implies indirect dominance, but not the reverse. Hence, the predicted outcomes when assuming myopic (direct) or farsighted (indirect) agents could be very different. In this paper, we characterize absolutely stable roommate problems when preferences are strict. That is, we obtain the conditions on preference profiles such that indirect dominance implies direct dominance in roommate problems. Furthermore, we characterize absolutely stable roommate problems having a non-empty core. Finally, we show that, if the core of an absolutely stable roommate problem is not empty, it contains a unique matching in which all agents who mutually top rank each other are matched to one another and all other agents remain unmatched.

JEL Classification: C71, C78

Keywords: roommate problems, direct dominance, indirect dominance.

2011/30 Accelerated multiplicative updates and hierarchical als algorithms for nonnegative matrix factorization
Nicolas GILLIS and François GLINEUR

Nonnegative matrix factorization (NMF) is a data analysis technique used in a great variety of applications such as text mining, image processing, hyperspectral data analysis, computational biology, and clustering. In this paper, we consider two well-known algorithms designed to solve NMF problems, namely the multiplicative updates of Lee and Seung and the hierarchical alternating least squares of Cichocki et al. We propose a simple way to significantly accelerate their convergence, based on a careful analysis of the computational cost needed at each iteration. This acceleration technique can also be applied to other algorithms, which we illustrate on the projected gradient method of Lin. The efficiency of the accelerated algorithms is empirically demonstrated on image and text datasets, and compares favorably with a state-of-the-art alternating nonnegative least squares

algorithm. Finally, we provide a theoretical argument based on the properties of NMF and its solutions that explains in particular the very good performance of HALS and its accelerated version observed in our numerical experiments.

- 2011/31 Implementing steady state efficiency in overlapping generations economies with environmental externalities
Nguyen Thang DAO and Julio DAVILA

We consider in this paper overlapping generations economies with pollution resulting from both consumption and production. The competitive equilibrium steady state is compared to the optimal steady state from the social planner's viewpoint. We show that the dynamical inefficiency of competitive equilibrium steady state with capital-labor ratio exceeding the golden rule ratio still holds. Moreover, the range of dynamically efficient steady state capital ratios increases with the effectiveness of the environment maintenance technology, and decreases for more polluting production technologies. We characterize some tax and transfer policies that decentralize as a competitive equilibrium outcome the transition to the social planner's steady state.

JEL Classification: D62, E21, H21, H41

Keywords: overlapping generations, environmental externality, tax and transfer policy.

- 2011/32 Crowdfunding: tapping the right crowd
Paul BELLEFLAMME, Thomas LAMBERT and Armin SCHWIENBACHER

The basic idea of crowdfunding is to raise external finance from a large audience (the "crowd"), where each individual provides a very small amount, instead of soliciting a small group of sophisticated investors. The paper develops a model that associates crowdfunding with pre-ordering and price discrimination, and studies the conditions under which crowdfunding is preferred to traditional forms of external funding. Compared to traditional funding, crowdfunding has the advantage of offering an enhanced experience to some consumers and, thereby, of allowing the entrepreneur to practice menu pricing and extract a larger share of the consumer surplus; the disadvantage is that the entrepreneur is constrained in his/her choice of prices by the amount of capital that he/she needs to raise: the larger this amount, the more prices have to be twisted so as to attract a large number of "crowdfunders" who pre-order, and the less profitable the menu pricing scheme.

JEL Classification: G32, L11, L13, L15, L21, L31

Keywords: crowdfunding, pre-ordering, menu pricing.

- 2011/33 Optimal fertility along the lifecycle
Pierre PESTIEAU and Grégory PONTIERE

We explore the optimal fertility age-pattern in a four-period OLG economy with physical capital accumulation. For that purpose, we firstly compare the dynamics of two closed economies, Early and Late Islands, which differ only in the timing of births. On Early Island, children are born from parents in young adulthood, whereas, on Late Island, children are born from parents in older adulthood. We show that, unlike on Early Island, there exists no stable stationary equilibrium on Late Island, which exhibits cyclical dynamics. We also characterize the social optimum in each economy, and show that Samuelson's Serendipity Theorem still holds. Finally, we study the dynamics and social optimum of an economy with interior fertility rates during the reproduction period. It is shown that various

fertility age-patterns are compatible with the social optimum, as long as these yield the optimal cohort growth rate. The Serendipity Theorem remains valid in that broader demographic environment.

JEL Classification: E13, E21, J13

Keywords: childbearing ages, early and late motherhoods, fertility, overlapping generations, social optimum.

- 2011/34 Optimal time to invest when the price processes are geometric Brownian motions. A tentative based on smooth fit.
Joachim GAHUNGU and Yves SMEERS

This paper considers the problem of the optimal timing of the exchange of the sum of n geometric Brownian motions for the sum of m others. We propose a closed form determinable stopping time based on the heuristic principle of smooth fit. We cannot prove that this stopping time is optimal. However, we show numerically on examples that it is a potentially useful candidate: letting S^\diamond denote the stopping region induced by our stopping time we show that (i) $S^- \subset S^\diamond \subset S^+$ where S^- and S^+ are well-known subset and superset of the optimal stopping region; (ii) stopping at the first entry time of S^\diamond offers a better payoff than stopping at the first entry time of S^- or S^+ , especially when assets are correlated.

JEL Classification: D81, G11

Keywords: optimal stopping, geometric Brownian motion, smooth fit.

- 2011/35 Sufficient and necessary conditions for perpetual multi-assets exchange options
Joachim GAHUNGU and Yves SMEERS

This paper considers the general problem of optimal timing of the exchange of the sum of n Ito-diffusions for the sum of m others (e.g., the optimal time to exchange a geometric Brownian motion for a geometric mean reverting process). We first contribute to the literature by providing analytical sufficient conditions and necessary conditions for optimal stopping (i.e. sub- and super- sets of the stopping region) for some sub-cases of the general problem. We then exhibit a connection between the problem of finding sufficient conditions for optimal stopping and linear programming. This connection provides a unified approach which does not only allow to recover previous analytically determinable subsets of the stopping region, but also allows to characterize (more complex) subsets of the stopping region that do not have an analytical expression. In the particular case where all assets are geometric Brownian motions, this connection gives us new insights. In particular, it simplifies the expression of the subset of the stopping region identified by Nishide and Rogers (2011). Our numerical examples finally confirms the good behavior of the candidate investment rule introduced by Gahungu and Smeers (2011) for this particular case, which seems to comfort a conjecture that their rule might be optimal.

JEL Classification: D81, G11

Keywords: optimal stopping, stopping region, geometric Brownian motion, geometric mean reverting process, Schwartz process.

- 2011/36 Hierarchical shrinkage in time-varying parameter models
Miguel A.G. BELMONTE, Gary KOOP and Dimitris KOROBILIS

In this paper, we forecast EU-area inflation with many predictors using time-varying parameter models. The facts that time-varying parameter models are parameter-rich and the time span of our data is relatively short motivate a desire for

shrinkage. In constant coefficient regression models, the Bayesian Lasso is gaining increasing popularity as an effective tool for achieving such shrinkage. In this paper, we develop econometric methods for using the Bayesian Lasso with time-varying parameter models. Our approach allows for the coefficient on each predictor to be: i) time varying, ii) constant over time or iii) shrunk to zero. The econometric methodology decides automatically which category each coefficient belongs in. Our empirical results indicate the benefits of such an approach.

JEL Classification: C11, C52, E37, E47

Keywords: forecasting, hierarchical prior, time-varying parameters, Bayesian Lasso.

- 2011/37 Benders decomposition for the hop-constrained survivable network design problem
 Quentin BOTTON, Bernard FORTZ, Luis GOUVEIA and Michael POSS

Given a graph with nonnegative edge weights and node pairs Q , we study the problem of constructing a minimum weight set of edges so that the induced subgraph contains at least K edge-disjoint paths containing at most L edges between each pair in Q . Using the layered representation introduced by Gouveia (1998), we present a formulation for the problem valid for any $K, L \geq 1$. We use a Benders decomposition method to efficiently handle the big number of variables and constraints. We show that our Benders cuts contain the constraints used by Huygens *et al.* to formulate the problem for $L = 2, 3, 4$, as well as new inequalities when $L \geq 5$. While some recent works on Benders decomposition study the impact of the normalization constraint in the dual subproblem, we focus here on when to generate the Benders cuts. We present a thorough computational study of various branch-and-cut algorithms on a large set of instances including the real based instances from *SNDlib*. Our best branch-and-cut algorithm combined with an efficient heuristic is able to solve the instances significantly faster than CPLEX 12 on the extended formulation.

Mathematics Subject Classification (2000): 90C27, 68M10, 90C57, 49M27, 90C10

Keywords: network design, survivability, hop-constraints, benders decomposition, branch-and-cut algorithms.

- 2011/38 International trade with endogenous mode of competition in general equilibrium
 J. Peter NEARY and Joe THARAKAN

This paper endogenizes the extent of intra-sectoral competition in a multi-sectoral general-equilibrium model of oligopoly and trade. Firms choose capacity followed by prices. If the benefits of capacity investment in a given sector are below a threshold level, the sector exhibits Bertrand behaviour, otherwise it exhibits Cournot behaviour. By endogenizing the threshold parameter in general equilibrium, we show how exogenous shocks such as globalization and technological change alter the mix of sectors between “more” and “less” competitive, or Bertrand and Cournot, and affect the relative wages of skilled and unskilled workers, even in a “North-North” model with identical countries.

JEL Classification: F10, F12, L13

Keywords: Bertrand and Cournot competition; GOLE (General Oligopolistic Equilibrium); Kreps-Scheinkman; market integration; trade, technology and wages.

- 2011/39 Stable and efficient coalitional networks
Jean-François CAULIER, Ana MAULEON, Jose J. SEMPERE-MONERRIS and Vincent VANNETELBOSCH

We develop a theoretical framework that allows us to study which bilateral links and coalition structures are going to emerge at equilibrium. We define the notion of coalitional network to represent a network and a coalition structure, where the network specifies the nature of the relationship each individual has with her coalition members and with individuals outside her coalition. To predict the coalitional networks that are going to emerge at equilibrium we propose the concepts of strong stability and of contractual stability. Contractual stability imposes that any change made to the coalitional network needs the consent of both the deviating players and their original coalition partners. Requiring the consent of coalition members under the simple majority or unanimity decision rule may help to reconcile stability and efficiency. Moreover, this new framework can provide insights that one cannot obtain if coalition formation and network formation are tackled separately and independently.

JEL Classification: A14, C70

Keywords: networks, coalition structures, stability, efficiency.

- 2011/40 Sustainable migration policies
Pierre M. PICARD and Tim WORRALL

This paper considers whether countries might mutually agree a policy of open borders, allowing free movement of workers across countries. For the countries to agree, the short run costs must outweighed by the long term benefits that result from better labor market flexibility and income smoothing. We show that such policies are less likely to be adopted when workers are less risk averse workers and when countries trade more. More surprisingly, we find that some congestion costs can help. This reverses the conventional wisdom that congestion costs tend to inhibit free migration policies.

JEL Classification: F22, J61, R23

Keywords: migration, self-enforcing mechanism, repeated games.

- 2011/41 Locally stationary volatility modelling
Sébastien VAN BELLEGEM

The increasing works on parameter instability, structural changes and regime switches lead to the natural research question whether the assumption of stationarity is appropriate to model volatility processes. Early econometric studies have provided testing procedures of covariance stationarity and have shown empirical evidence for the unconditional time-variation of the dependence structure of many financial time series.

After a review of several econometric tests of covariance stationarity, this survey paper focuses on several attempts in the literature to model the time-varying second- order dependence of volatility time series. The approaches that are summarized in this discussion paper propose various specification for this time-varying dynamics. In some of them an explicit variation over time is suggested, such as in the spline GARCH model. Larger classes of nonstationary models have also been proposed, in which the variation of the parameters may be more general such as in the so-called locally stationary models. In another approach that is called “adaptive”, no explicit global model is assumed and local parametric model are adaptively fitted at each point over time. Multivariate extensions are also visited. A

comparison of these approaches is proposed in this paper and some illustrations are provided on the two last decades of data of the Dow Jones Industrial Average index.

JEL Classification: Primary C14, secondary C22, C58

Keywords: volatility, locally stationary time series, multiplicative model, adaptive estimation.

- 2011/42 Tax treaties and the allocation of taxing rights with developing countries
Dimitri PAOLINI, Pasquale PISTONE, Giuseppe PULINA and Martin ZAGLER

Global income taxation in the country of residence is a legal dogma of international taxation. We question this dogma from the perspective of relations with developing countries from a legal and economic perspective, and make a modern and fair proposal for tax treaties. We will show under which conditions a developing and a developed country will voluntarily sign a tax treaty where information is exchanged truthfully and whether they should share revenues. Moreover, we will demonstrate how the conclusion of a tax treaty can assist in the implementation of a tax audit system.

JEL Classification: F53, H25, H87, D82

Keywords: international corporate income taxation, tax treaties, revenue sharing, asymmetric information, uncertainty, locational decisions, principal-agent models.

- 2011/43 Behavioral fair social choice
Marc FLEURBAEY and Erik SCHOKKAERT

Behavioral economics has shaken the view that individuals have well-defined, consistent and stable preferences. This raises a challenge for welfare economics, which takes as a key postulate that individual preferences should be respected. We agree with Bernheim (2009) and Bernheim and Rangel (2009) that behavioral economics is compatible with consistency of partial preferences and that subjective welfare measures do not offer an attractive way out of the impasse. However, their analysis which rests on traditional concepts like Pareto optimality and compensation tests, is not adequate to introduce distributional considerations. We explore how partial preferences can be introduced in the recent theory of welfare that has developed from the theory of fair allocation. We revisit the key results of that theory in a framework with partial preferences and show how one can derive partial orderings of individual and social situations.

JEL Classification: D60, D71

Keywords: behavioral economics, preferences, welfare economics, psychology, social choice, fairness.

- 2011/44 A real options model for electricity capacity expansion
Joachim GAHUNGU and Yves SMEERS

This paper proposes a real option capacity expansion model for power generation with several technologies that differ in operation and investment costs. The economy is assumed perfectly competitive and the instantaneous payoff accruing from the generation system is the instantaneous welfare defined as the usual sum of consumer and producer surplus. The computation of this welfare requires the solution of a multi-technology optimization problem and the obtained optimal function value is not additively separable in generation capacities, contrary to what is generally assumed in multi asset real option models to prove the optimality of a myopic behavior. Using the geometric Brownian motion as uncertainty driver we

propose two regression models to approximate the instantaneous welfare. A first, additively separable approximation implies the optimality of myopia. The second approximation is non separable and hence forces to take myopic behavior as an assumption. Using myopia as an assumption, we propose a semi-analytic method which combines Monte Carlo simulations (used to compute the value of the marginal capacity) and analytical treatment (to solve an optimal stopping problem on a regression scheme).

JEL Classification: L11, L94, C61

Keywords: real options, capacity expansion, power investment, optimal dispatch.

2011/45 Social security and family support
Marie-Louise LEROUX and Pierre PESTIEAU

This paper shows how the role of the market, the state and the family in providing financial support at old age has evolved over time with changes in factors such as the reliability and the effectiveness of family support, the rate of interest, the cost of public funds and earning inequality. We model a society in which agents with different productivity are asked to vote over the existence of a Beveridgian pension system. We show that when children assistance is certain and large, agents may rely exclusively on family to finance old-age consumption and prefer to vote for a zero tax rate. Only if income inequalities are very large, a majority will be in favor of a pension system. However, when the size and the likelihood of family generosity decreases, a pension system is more likely to emerge. In that case, agents supplement children assistance with pension benefits. A pension system is also more likely to emerge when the cost of public fund is small and the return from private savings is high.

JEL Classification: D64, H55, J13

Keywords: social security, hold-age security, family solidarity.

2011/46 Efficiency, access and the mixed delivery of health care services
Chiara CANTA

The focus of this paper is on the trade-off between cost efficiency and access in the choice of the optimal mix of public and private provision in universal health systems. We model a simple health care market in which the regulator acts as a third payer. Patients need one unit of medical service and differ in the severity of illness. A private and a public hospital are available. The private manager internalizes profits, and has an incentive both to refuse to treat costly patients and to exert effort in cost reduction. The public manager does not internalize profits, and has no incentive to reduce costs or to dump costly patients. We show that, when a relatively efficient effort in cost reduction is available, it is optimal to buy part of the services from the private hospital. This may be the case for procedures that are easier to standardize, such as elective surgery. Since the regulator acts as an insurer for the whole population, a public hospital has to be used as a last resort facility. Imposing a no-dumping constraint on the private hospital is not always optimal since eliciting effort and truthful revelation of costs may become more difficult.

JEL Classification: I18, L33, L51

Keywords: health care, regulation, dumping, public and private hospitals.

- 2011/47 Migrations, public goods and taxes
Jean J. GABSZEWICZ, Salome GVETADZE and Skerdilajda ZANAJ

This paper examines how and why people migrate between two regions with asymmetric size. The agglomeration force comes from the scale economies in the provision of local public goods, whereas the dispersion force comes from congestion in consumption of public goods. Public goods considered resemble club goods (or public goods with congestion) and people are heterogeneous in their migration costs.

We find that the large countries can be destination of migrants for sufficiently high provision of public goods, even when the large country taxes too much. The high provision of public good offsets the congestion effect. While, the small country can be the destination of migrants for two reasons. Firstly, when public good supply is intermediate, people move to avoid congestion in the large country and to benefit from low taxation in the small one. Finally, when the provision of public goods is low, people move towards the small countries just to avoid congestion.

JEL Classification: H0, F3

Keywords: migration, public goods, congestion.

- 2011/48 Credence goods and product differentiation
Jean J. GABSZEWICZ and Joana RESENDE

This paper analyses price competition between two firms producing horizontally and vertically differentiated goods. These are assumed to be credence goods, as consumers can hardly ascertain the quality of the commodities. We provide sufficient conditions for the existence of a unique price equilibrium and we characterize it. To illustrate the model, we adapt it to represent a newspapers' industry with two outlets, when the population of readers have preferences both on the political stance of the newspapers and on the accuracy of news they dispatch.

JEL Classification: L1; L13, L15

Keywords: credence goods, horizontal differentiation, vertical differentiation, newspaper industry.

- 2011/49 Does the seller of a house facing a large number of buyers always decrease its price when its first offer is rejected?
Jean J. GABSZEWICZ, Tanguy VAN YPERSELE and Skerdilajda ZANAJ

This paper identifies the optimal two-period price sequence in the attempt for selling a good, with take-it-or-leave-it offers, when the seller faces ambiguity about the buyers' willingness to pay. If the first round fails, the seller updates its beliefs on the state of the market in accordance with Bayes rule and quotes a second and final price. We show that the optimal sequence of prices can be increasing. Furthermore, we describe the optimal sequence of prices with a myopic seller who does not update his beliefs in the second period. In this case, the optimal price sequence is always decreasing.

JEL Classification: D8, D82, D89

Keywords: ambiguity, sequential bilateral trade, Bayesian vs myopic behaviour.

- 2011/50 Linear prices for non-convex electricity markets: models and algorithms
Mathieu VAN VYVE

Strict Linear Pricing in non-convex markets is a mathematical impossibility. In the context of electricity markets, two different classes of solutions have been

proposed to this conundrum on both sides of the Atlantic. We formally describe these two approaches in a common framework, review and analyze their main properties, and discuss their shortcomings.

In US, some orders are not settled at the market price, but at their bidding price, deviating from uniform pricing (all orders are financially settled at the same prices). This creates a disincentive to bid one's own true cost, and creates a missing money problem for the clearing house of the market. In Europe, all accepted orders are in-the-money are settled at the uniform market price. This implies that the welfare-maximizing solution is considered infeasible and also that the optimization problem is much less convex and more difficult to solve. This also creates fairness issues for orders of small volume, and the solution obtained does not implement a Walrasian equilibrium.

Based on this analysis we propose a new model that draws on both approaches and retains their best theoretical properties. We also show how the different approaches compare on classical toy problem.

Keywords: electricity markets, non-convexities, pricing.

- 2011/51 The Kyoto *Protocol*, the Copenhagen *Accord*, the Cancun *Agreements*, and beyond: An economic and game theoretical exploration and interpretation
Parkash CHANDER and Henry TULKENS

The paper is not intended for game theorists – unless they are interested in learning how their theories, and the theory of environmental games as developed in a forthcoming book, are being used for studying the current problem of climate change. Similarly for economists. In general, the presentation is addressed to those who have an interest in seeing how theory can shape policy in the area of climate change.

After a summary presentation of the relevant features of the Protocol, followed by the sketching out of an economic model serving as support for the theoretical construct, we consider a series of aspects of it – such as reference emissions, efficiency and stability, competitive trading, desirability of free trade in emissions and the clean development mechanism –, not to defend it and independently of the subsequent developments, but rather as a benchmark for understanding the various issues concerning the climate change problem in general. Then, we extend this exercise to an appraisal of the situation of the world climate regime that is currently prevailing, after the Protocol has entered into force. Finally, we discuss four aspects of the world climate regime that is likely to prevail after the expiry of the Kyoto commitment period 2008-2012.

Our message is a non-conventional one, compared with the common wisdom of commentaries of the Kyoto Protocol and of its follow-ups. It is inspired by research on the foundations of international cooperation in general and on climate change in particular.

JEL Classification: Q540, Q58, F020, D7, C7

Keywords: international environmental agreements, climate change, Kyoto Protocol, applied game theory, applied microeconomics.

- 2011/52 Econometric analysis of volatile art markets
Fabian Y.R.P. BOCART and Christian M. HAFNER

A new heteroskedastic hedonic regression model is suggested. It takes into account time-varying volatility and is applied to a blue chips art market. Furthermore, a nonparametric local likelihood estimator is used. This estimator is more precise than the often used dummy variables method. The empirical analysis reveals that

errors are considerably non-Gaussian, and that a student distribution with time-varying scale and degrees of freedom does well in explaining deviations of prices from their expectation. The art price index is a smooth function of time and has a variability that is comparable to the volatility of stock indices.

Keywords: volatility, art markets, hedonic regression, semiparametric estimation.

- 2011/53 Private, social and self insurance for long-term care: A political economy analysis
Philippe DE DONDER and Pierre PESTIEAU

We analyze the determinants of the demand for social, private and self-insurance for long-term care in an environment where agents differ in income, probability of becoming dependent and of receiving family help. Uniform social benefits are financed with a proportional income tax and are thus redistributive, while private insurance is actuarially fair. We obtain a rich pattern of insights, depending on whether private insurance is available or not, on its loading factor, and on the correlation between, on the one hand, income and risk, and, on the other hand, income and family help. Although the availability of private insurance decreases the demand for social insurance, it only affects a minority of agents so that the majority-chosen social insurance level remains unaffected. Family support crowds out the demand for both private and social insurance, and may even suppress any demand for private insurance. Family help crowds out self-insurance only for agents whose demand for both social and private insurance is nil. A general increase in the probability of becoming dependent need not increase the demand for social insurance, since it decreases its return.

JEL Classification: H24, H31, H42, I11

Keywords: long-term care, social insurance, family help, correlation between risk and income, voting.

- 2011/54 Oligopolistic competition with general complementarities
Filippo L. CALCIANO

In this paper we extend the basic model of Cournot competition to the case where both the demand function and the cost functions of each firm depend on the amounts produced by competitors. In this modified setting, proving existence of equilibria becomes harder. We develop a generalization of the theory of supermodular games in the context where individual decision variables take values in a totally ordered set to prove existence of equilibria in this generalized Cournot setting.

JEL Classification: C60, C70, C72

Keywords: Cournot oligopoly, complementarity, generalized modularity, generalized increasing differences, supermodular games.

- 2011/55 Estimating and forecasting structural breaks in financial time series
Luc BAUWENS, Anaud DUFAYS and Bruno DE BACKER

We present an algorithm, based on a differential evolution MCMC method, for Bayesian inference in AR-GARCH models subject to an unknown number of structural breaks at unknown dates. Break dates are directly treated as parameters and the number of breaks is determined by the marginal likelihood criterion. We prove the convergence of the algorithm and we show how to compute marginal likelihoods. We allow for both pure change-point and recurrent regime specifications and we show how to forecast structural breaks. We illustrate the efficiency of the algorithm through simulations and we apply it to eight financial

time series of daily returns over the period 1987-2011. We find at least three breaks in all series.

JEL Classification: C11, C15, C22, C58

Keywords: Bayesian inference, structural breaks, differential evolution, change-point, recurrent states, break forecasting, marginal likelihood.

- 2011/56 Multidimensional screening in a monopolistic insurance market
Pau OLIVELLA and Fred SCHROYEN

In this paper, we consider a population of individuals who differ in two dimensions: their risk type (expected loss) and their risk aversion. We solve for the profit maximizing menu of contracts that a monopolistic insurer puts out on the market. First, we find that it is never optimal to fully separate all the types. Second, if heterogeneity in risk aversion is sufficiently high, then some high-risk individuals (the risk-tolerant ones) will obtain lower coverage than some low-risk individuals (the risk-averse ones). Third, we show that when the average man and woman differ only in risk aversion, gender discrimination may lead to a Pareto improvement.

JEL Classification: D82, G22

Keywords: insurance markets, asymmetric information, screening, gender discrimination, positive correlation test.

- 2011/57 Optimal taxation in the presence of a congested public good and an application to transport policy
Knud J. MUNK

In this paper we demonstrate that even if policies prior to reform have been rational, it is possible, in fact in certain policy areas likely, that a *green tax reform*, contrary to the perceived wisdom among economists, will be associated with a *double-dividend*, i.e. with both environmental and fiscal benefits. We first establish this theoretically by avoiding imposing potentially unrealistic separability assumptions, and by recognising that taxation involves administrative costs. To illustrate our theoretical results, we use graphical tools well-known from fishery economics to assess the effects of the introduction of a tax on road transport.

JEL Classification: H2, H29

Keywords: optimal taxation, congested public goods, externalities, administrative costs, green tax reform, double-dividend, transport policy, cost-benefit criteria.

- 2011/58 Volatility models
Luc BAUWENS, Christian HAFNER and Sébastien LAURENT

Chapter written for the Handbook of Volatility Models and their Applications, edited by Luc Bauwens, Christian Hafner, and Sébastien Laurent, forthcoming in 2012 (John Wiley & sons). This chapter presents an introductory review of volatility models and some applications. The review is linked with the other chapters that contain more detailed presentations.

JEL Classification: C32, C58

Keywords: volatility, ARCH, realized volatility, stochastic volatility.

- 2011/59 Childbearing age, family allowances and social security
Pierre PESTIEAU and Grégory PONTIERE

Although the optimal policy under endogenous fertility has been widely studied,

the optimal public intervention under endogenous childbearing age has remained largely unexplored. This paper examines the optimal family policy in a context where the number and the timing of births are chosen by individuals who differ as to how early fertility can weaken future earnings growth. We analyze the design of a policy of family allowances and of public pensions in such a setting, under distinct informational environments. We show how endogenous childbearing ages affect the optimal policy, through the redistribution across the earnings dimension and the internalization of fertility externalities. It is also shown that, contrary to common practice, children benefits differentiated according to the age of parents can, under some conditions, be part of the optimal family policy.

JEL Classification: J13, D10, H21, H55

Keywords: endogenous fertility, childbearing age, pensions, family benefits.

2011/60 Optimal population and education
Julio DÁVILA

If raising and educating children is a private cost to households, while the availability of skilled labor supply resulting from the households' fertility and education choices is a public good, then competitive equilibria typically deliver a suboptimal mix of size and skills of the population. In particular, households would underinvest in their children education compared to the optimal level. This is the case even if households are aware of the increase in savings returns implied by a higher supply of skilled labor and manage to coordinate to try to exploit this effect. In a setup devoid of altruistic motives, this paper shows that a tax-financed compulsory education is unlikely to implement the optimal steady state, even if the mandatory level of education is the optimal one (the system of equations is overdetermined). Nevertheless, a pensions scheme that makes payments contingent to the household fertility and investment in its children's education can implement the first-best steady state. The pension scheme is balanced period by period by financing pensions through a payroll tax on the increase in children's labor income resulting from their parents' human capital investment.

2011/61 Bayesian methods
Luc BAUWENS and Dimitris KOROBILIS

Chapter written for the Handbook of Research Methods and Applications on Empirical Macroeconomics, edited by Nigar Hashimzade and Michael Thornton, forth- coming in 2012 (Edward Elgar Publishing). This chapter presents an introductory review of Bayesian methods for research in empirical macroeconomics.

JEL Classification: C11

Keywords: Bayesian inference, dynamic regression model, prior distributions, MCMC methods.

2011/62 A new perspective on the firm size-growth relationship: shape of profits,
investment and heterogeneous credit constraints
Florian MAYNERIS

This paper shows that the diverging results obtained in the literature on the firm size-growth relationship can be reconciled in a very general theoretical framework featuring firm-level heterogeneity and investment decision. Three main elements determine the nature and the intensity of the relationship between firm-level size and investment: the shape of operating profits with respect to size, the shape of

marginal returns to investment (in terms of size) with respect to initial size and the shape of marginal cost of investment with respect to size. Any difference across countries, industries or periods in one of these three dimensions can modify the sign and the intensity of the firm size-investment and the firm size-growth relationship at equilibrium. As an example, I show that in France, heterogeneous credit constraints, which affect the shape of the marginal cost of investment, can explain cross-sectoral variations in the firm size-investment and firm size-growth relationship over the 1996-2002 period. As a consequence, from a macroeconomic viewpoint, firm size distribution is, all else equal, more right-skewed in sectors where small firms are disproportionately credit constrained and small firms participate less to sectorial growth in these sectors. The analytical framework proposed in this paper is general enough to apply to the analysis of any heterogeneous response of economic agents.

JEL Classification: D21, D22, L11, L25

Keywords: investment, size, firm size-growth, relationship, financial constraints.

2011/63 Entry on difficult export markets by Chinese domestic firms: the role of foreign export spillovers
Florian MAYNERIS and Sandra PONCET

In this study, we explore how the intensity of foreign export spillovers in China varies depending on the difficulty of entry on export markets. We rely on different proxies to define what a "difficult" country is and we find that the presence of surrounding foreign exporting firms helps domestic ones to start exporting, especially when destination countries are difficult. While on average exposure to foreign exporters is associated with a 10% increase of the probability that domestic firms from the same province start exporting the year after, the figure is around 50% higher when the targeted destination country is identified as difficult. Our results are consistent with the idea that exposure to foreign exporters helps to reduce the fixed cost of creating new trade linkages. Our finding hence suggests that the increasing presence of foreign exporting firms in China might contribute to the diversification of Chinese domestic firms' exports towards more difficult and previously inaccessible destinations.

JEL Classification: F1, R12, L25

Keywords: foreign export spillovers, difficult markets, China.

2011/64 French firms at the conquest of Asian markets: the role of export spillovers
Florian MAYNERIS and Sandra PONCET

In this study, we explore the role of export spillovers on the capacity of French firms to conquer Asian markets. We confirm, in the context of France, previous results emphasizing the positive impact of surrounding exporters on the probability that a firm starts exporting a given product to a given country. We find that export spillovers are more important for export starts to Asia than for export starts to other countries. Moreover, for the specific Asian destinations, we find evidence of a heterogeneous effect of export spillovers. The presence of surrounding exporting firms appears especially beneficial to small and less productive firms, and more intense for export starts to Asian countries characterized by low GDP per capita and tough administrative procedures on imports. Hence, export spillovers may help small firms to enter on the most difficult Asian markets.

JEL Classification: F1, R12, L25

Keywords: export spillovers, Asia, new trade linkages.

- 2011/65 Migration, wage differentials and fiscal competition
Jean J. GABSZEWICZ and Ornella TAROLA

We analyze the effects, on nonredistributive taxation and on migrations, of wage differentials existing between two countries (regions) differing by the size of their population. Residents, otherwise identical, are heterogeneous because they incur different migration costs. Each resident compares the post-tax amount of money at home with the one obtained abroad, including the cost of migration. The government in each country maximizes the tax product in order to provide the largest possible amount of public good. We first assume that the income of citizens are identical across countries. Then, we assume that wages differ from one country to the other. We prove the existence of an equilibrium for any configuration of wage and any different relative size of the countries (regions). Then, we compute and characterize the equilibrium for any set of parameters, size and wage differential.

Keywords: migration, taxation, wage differentials.

- 2011/66 Indirect taxes for redistribution: Should necessity goods be favored?
Robin BOADWAY and Pierre PESTIEAU

The Atkinson-Stiglitz Theorem shows that with weakly separable preferences, differential commodity taxes are not needed if an optimal nonlinear income tax is imposed. Redistributive objectives can be achieved with the income tax alone even if goods differ considerably in their income elasticities of demand. Deaton showed that if the government is restricted to a linear progressive income tax along with commodity taxes, the latter are superfluous if preferences are not only weakly separable but also yield linear Engel curves whose slopes are common to all households. These have potentially strong policy implications since they suggest that the common practice of giving preferential commodity tax treatment to necessities is not warranted. Using the linear progressive income tax as an example and assuming the Deaton conditions are satisfied, we derive two contradictory results. First, if the income tax is less progressive than optimal, necessities should be taxed preferentially relative to luxuries. Second, if low-income households are income-constrained so are unable to afford any luxury goods, it may be optimal to tax necessity goods at higher rates than luxuries, depending on whether labor supply varies along the intensive or extensive margin. The analysis is extended to allow for nonlinear taxes and endogenous demand for a public good.

JEL Classification: H21, H23

Keywords: optimal income tax, Atkinson-Stiglitz Theorem, indirect taxes.

- 2011/67 Moving up the quality ladder? EU-China trade dynamics in clothing
Hylke VANDENBUSSCHE, Francesco DI COMITE, Laura ROVEGNO and Christian VIEGELAHN

We apply a simple method to study the relative quality of Chinese versus European products exported in the clothing sector after the end of the Multi-Fiber Arrangement. Based on the model of Foster et al (2008), we interpret the relative change of export prices and quantities sold in narrowly defined product categories as an indicator of quality shifts. Using UN Comtrade data we find that European varieties exported to the US typically sell for a higher price than identical Chinese varieties exported to the US, but this price gap is narrowing. Despite rising prices, Chinese varieties are gaining market share. This opposite movement of relative prices and quantities sold in the same destination market are a strong indication of

China moving up the quality ladder in its clothing exports relative to the EU. While European “core” products in clothing are stable over time, Chinese exports show strong product dynamics with exit and entry of new “core” products every year and “core” products changing rapidly. Both China and the EU export in every product category, resulting in an almost perfect product overlap with almost no products being exported by only one of the two.

- 2011/68 Measuring poverty without the mortality paradox
Mathieu LEFEBVRE, Pierre PESTIEAU and Grégory PONTIERE

Under income-differentiated mortality, poverty measures reflect not only the "true" poverty, but, also, the interferences or noise caused by the survival process at work. Such interferences lead to the Mortality Paradox: the worse the survival conditions of the poor are, the lower the measured poverty is. We examine several solutions to avoid that paradox. We identify conditions under which the extension, by means of a fictitious income, of lifetime income profiles of the prematurely dead neutralizes the noise due to differential mortality. Then, to account not only for the "missing" poor, but, also, for the "hidden" poverty (premature death), we use, as a fictitious income, the welfare-neutral income, making indifferent between life continuation and death. The robustness of poverty measures to the extension technique is illustrated with regional Belgian data.

JEL Classification: I32

Keywords: premature mortality, income-differentiated mortality, poverty measurement, censored income profile.

- 2011/69 Frontier-based performance analysis models for supply chain management: state of the art and research directions
Per J. AGRELL and Adel HATAMI-MARBINI

Effective supply chain management relies on information integration and implementation of best practice techniques across the chain. Supply chains are examples of complex multi-stage systems with temporal and causal interrelations, operating multi-input and multi-output production and services under utilization of fixed and variable resources as well as potentially environmental exposure. Acknowledging the lack of system's view, the need to identify system-wide as well as individual effects, as well as the incorporation of a coherent set of performance metrics, the recent literature reports on an increasing, but yet limited, number of applications of frontier analysis models (e.g. DEA) for the performance assessment of supply chains or networks. The relevant models in this respect are multi-stage models with various assumptions on the intermediate outputs and inputs, enabling the derivation of metrics for technical and cost efficiencies for the system as well as the autonomous links. This paper reviews the state of the art in multi-stage or network DEA modeling, along with a critical review of the advanced applications that are reported in terms of the consistency of the underlying assumptions and the results derived. Consolidating the current work in this range using a unified notation and by comparing the properties of the models presented, the paper is closed with recommendations for future research in terms of both theory and application.

JEL Classification: C14, M11, C79

Keywords: supply chain management, data envelopment analysis, two-stage, game theory, bi level programming.

- 2011/70 Stochastic first order methods in smooth convex optimization
Olivier DEVOLDER

In this paper, we are interested in the development of efficient first-order methods for convex optimization problems in the simultaneous presence of smoothness of the objective function and stochasticity in the first-order information. First, we consider the Stochastic Primal Gradient method, which is nothing else but the Mirror Descent SA method applied to a smooth function and we develop new practical and efficient stepsize policies. Based on the machinery of estimates sequences functions, we develop also two new methods, a Stochastic Dual Gradient Method and an accelerated Stochastic Fast Gradient Method. Convergence rates on average, probabilities of large deviations and accuracy certificates are studied. All of these methods are designed in order to decrease the effect of the stochastic noise at an unimprovable rate and to be easily implementable in practice (the practical efficiency of our method is confirmed by numerical experiments). Furthermore, the biased case, when the oracle is not only stochastic but also affected by a bias is considered for the first time in the literature.

Keywords: stochastic optimization, stochastic approximation methods, smooth convex optimization, first-order methods, fast gradient method, complexity bounds, probability of large deviations.

- 2011/71 A unifying framework for the problem of adjudicating conflicting claims
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In a recent paper, Thomson and Yeh [Operators for the adjudication of conflicting claims, *Journal of Economic Theory* 143 (2008) 177-198] introduced the concept of operators on the space of rules for the problem of adjudicating conflicting claims. They focussed on three operators in order to uncover the structure of such a space. In this paper, we generalize their analysis upon presenting and studying a general family of operators inspired by three apparently unrelated approaches to the problem of adjudicating conflicting claims. We study the structural properties of this family and show, in particular, that most of Thomson and Yeh's results are specific cases of our study.

JEL Classification: D63

Keywords: rationing, operators, baselines, composition, claims.

- 2011/72 Smart-grid investments, regulation and organization
Per J. AGRELL and Peter BOGETOFT

Worldwide, but in particular in North America and Europe, the grid infrastructure managers are facing demands for reinvestments in new assets with higher on-grid and off-grid functionality in order to promote energy efficiency and low-carbon conversion of the energy sector. To meet societal policy objectives in terms of carbon dioxide emissions, both the composition of the generators in favor of distributed energy resources (DER) and the load, promoting integration with downstream energy useage, will change. In this paper, we characterize some of the effects of new asset investments policy on the network tasks, assets and costs and contrast this with the assumptions implicit or explicit in current economic network regulation. The resulting challenge is identified as the change in the direction of higher asymmetry of information and higher capital intensity, combined with ambiguities in terms of task separation. To provide guidance, we present a model of investment provision under regulation between a distribution system operator (DSO) and a potential investor-generation. The results from the model confirm the

hypothesis that network regulation should find a focal point, should integrate externalities in the performance assessment and should avoid wide delegation of contracting-billing for smart-grid investments.

JEL Classification: D72, L51

Keywords: regulation, energy, networks, investments.