

- 2013/1 Harsh occupations, health status and social security  
Pierre PESTIEAU and Maria RACIONERO

We study the optimal design of a social security system when individuals differ in health status and occupation. Health status is private information but is imperfectly correlated with occupation: individuals in harsh occupations are more likely to be in poor health. We explore the desirability of letting the social security policy differ by occupation and compare the results with those obtained when disability tests are used instead. We show that tagging by occupation is preferable to testing when the audit technology is relatively expensive and/or the proportion of disabled workers differs markedly across occupations. We also study the implications of imposing horizontal equity among disabled workers and show that those in the harsh occupation may be induced to retire later.

**JEL Classification:** H21, H55

**Keywords:** health status, retirement age, tagging, disability tests.

- 2013/2 Climate policies: a burden, or a gain?  
Thierry BRECHET and Henry TULKENS

That climate policies are costly is evident and therefore often creates major fears. But the alternative (no action) also has a cost. Mitigation costs and damages incurred depend on what the climate policies are, and in addition, they are substitutes. This brings climate policies naturally in the realm of benefit-cost analysis. In this paper we illustrate the "direct" cost components of various policies, and then confront them with the benefits generated, that is, the damage cost avoided. However, the sheer benefit-cost criterion is not a sufficient incentive to induce cooperation among countries, a necessary condition for an effective global climate policy. Thus, we also explore how to make use of this criterion in the context of international climate cooperation.

**JEL Classification:** Q2, D9

**Keywords:** climate policy, integrated assessment, cost-benefit analysis, climate coalitions.

- 2013/3 Unobserved heterogeneous effects in the cost efficiency analysis of electricity distribution systems  
Per J. AGRELL, Mehdi FARSI, Massimo FILIPPINI and Martin KOLLER

The purpose of this study is to analyze the cost efficiency of electricity distribution systems in order to enable regulatory authorities to establish price- or revenue cap regulation regimes. The increasing use of efficiency analysis in the last decades has raised serious concerns among regulators and companies regarding the reliability of efficiency estimates. One important dimension affecting the reliability is the presence of unobserved factors. Since these factors are treated differently in various models, the resulting estimates can vary across methods. Therefore, we decompose the benchmarking process into two steps. In the first step, we identify classes of similar companies with comparable network and structural characteristics using a latent class cost model. We obtain cost best practice within each class in the second step, based on deterministic and stochastic cost frontier models. The results of this analysis show that the decomposition of the benchmarking process into two steps has reduced unobserved heterogeneity within classes and, hence, reduced the unexplained variance previously claimed as inefficiency.

**JEL Classification:** L92, L50, L25

**Keywords:** efficiency analysis, cost function, electricity sector, incentive regulation.

2013/4 Imprecise data envelopment analysis for the two-stage process  
Adel HATAMI-MARBINI, Per J. AGRELL and Nazila AGHAYI

The aggregate black-box approach of conventional Data Envelopment Analysis (DEA) limits its usefulness in situations where the observation is the result of independent decision making in sub-units (sub-DMUs), sequentially linked through processes or semi-finished products. The situation is commonly found in e.g supply chain management, health care provision and environmental management (waste water treatment). Alternative approaches for sublevel evaluations include two-stage or multi-stage models, where intermediate outputs or inputs are identified to span local production possibility spaces. However, the reliance upon numeric values for such intermediate inputs or outputs adds an additional difficulty that may lower the value of the assessment. In this paper, we present an approach for two-stage evaluation with interval data to resolve this problem. The results show that ignoring the interval quality of the data leads to distorted evaluations, both for the subunit and the system efficiency. The proposed method obtains an efficiency interval consisting in an upper and a lower bound for the system efficiency and the sub-DMU efficiency. In order to link two stages, we consider the interval intermediate measures that are outputs and inputs for the first stage and the second stage, respectively. The derived interval metric, along with its mean, provides a more informative basis for multi-stage evaluation in the presence of imprecise data. The ranks of DMUs and sub-DMUs are obtained based on their interval efficiencies.

**JEL Classification:** C14, M11, C61

**Keywords:** data envelopment analysis, two-stage process, interval data, interval efficiency, ranking.

2013/5 Centralized resource reduction and target setting under DEA control  
Farhad HOSSEINZADEH LOTFI, Adel HATAMI-MARBINI, Per J. AGRELL,  
Kobra GHOLAMI and Zahra GHELEJ BEIGI

Data envelopment analysis (DEA) is a powerful tool for measuring the relative efficiencies of a set of decision making units (DMUs) such as schools and bank branches that transform multiple inputs to multiple outputs. In centralized decision-making systems, management normally imposes common resource constraints such as fixed capital, budgets for operating capital and staff count. In consequence, the profit or net value added of the units subject to resource reductions will decrease. In terms of performance evaluation combined with resource allocation, the interest of central management is to restore the general efficiency value of the DMUs. The paper makes four contributions to the literature: (1) we take into consideration the performance evaluation of the centralized budgeting of hierarchical organizations along with sales and market allocation within manufacturing and distribution organizations; (2) we address the evaluation problems that the central decision maker does not desire to deteriorate the efficiency score of the DMUs after input and/or output reduction; (3) we develop a common set of weights (CSW) method based on the goal program (GP) concept to control the total weight flexibility in the conventional DEA models; (4) we extend a new approach to optimize the inputs and/or outputs contraction such that the efficiency of all DMUs will get bigger than or equal to the efficiency of previous change. We ultimately present a numerical example involving with three inputs and two outputs to illustrate the applicability

and efficacy of the proposed approach.

**JEL Classification:** C14, M11, C61

**Keywords:** data envelopment analysis, inputs and outputs deterioration, common set of weights.

2013/6 A three-stage supply chain investment model under asymmetric information  
Per J. AGRELL and Peter BOGETOFT

Specific supply-chain investments are vital in achieving faster lead-time performance and more competitive costs. In practice, such as in the highly leveraged telecom sector, the coordinating original equipment manufacturers (OEM) often delegate the upstream coordination of suppliers to contract manufacturers. This can be justified by informational advantages or economies of scale. However, the rationale of such schemes has also been challenged by analytical work on three-stage chains, leading to open questions. In this paper, we study the organizational and contractual choice of a supply chain coordinator (say an OEM) to either control or delegate the investment decision of some shared resource (say dedicated machines, information or product standards, etc) to a contract manufacturer (CM) or to an upstream supplier in a three-stage supply chain. The analysis derives closed-form results for the economic performance of three scenarios under asymmetric information on investment cost: direct contracting with an integrated CM-supplier, decentralized contracting to tier-1 suppliers and centralized contracting to tier-1 and tier-2 suppliers. The results show that the observed practice to delegate investments to tier-1 and possibly tier-2 suppliers leads to relatively poor performance due to under-investments. The superior arrangement is the centralized conditional model, where the OEM forces coordination among upstream suppliers by offering conditional financing. We close the paper with an analogy to the Boeing 787 supply chain and some discussion about the assumptions and applicability of the model.

**Keywords:** supply chain, coordination, investments, contracts, organization.

2013/7 Robustness, outliers and Mavericks in network regulation  
Per J. AGRELL and Pooria NIKNAZAR

Benchmarking methods, primarily non-parametric techniques such as Data Envelopment Analysis, have become well-established and informative tools for economic regulation, in particular in energy infrastructure regulation. The axiomatic features of the non-parametric methods correspond closely to the procedural and economic criteria for good practice network regulation. However, critique has been voiced against the robustness of best-practice regulation in presence of uncertainty regarding model specification, data definition and collection. This paper investigates the foundation of the critique both conceptually and by describing the actual state-of-the-art used in energy network regulation using frontier analysis models in Sweden (2000-2003) and in Germany (2007-). A principal component of the applied frontier regulation is the systematic use of outlier detection models to define homogeneous reference sets and to exclude maverick reports. We review two families of outlier detection methods in terms of their function and application using a data set from Swedish electricity distribution, illustrating the different types of outliers. Finally, the paper concludes on the role of outlier detection as a mean to implement regulation with higher robustness.

**Keywords:** regulation, energy networks, outlier detection.

- 2013/8 Benchmarking and regulation  
Per J. AGRELL and Peter BOGETOFT

Benchmarking methods, and in particular Data Envelopment Analysis (DEA), have become well-established and informative tools for economic regulation. DEA is now routinely used by European regulators to set reasonable revenue caps for energy transmission and distribution system operators. The application of benchmarking in regulation, however, requires specific steps in terms of data validation, model specification and outlier detection that are not systematically documented in open publications, leading to discussions about regulatory stability and economic feasibility of these techniques. In this paper, we review the modern foundations for frontier-based regulation and we discuss its actual use in several jurisdictions.

**Keywords:** agency theory, regulation, energy networks.

**JEL classification:** Q40, L59, C51, C24

- 2013/9 When Borch's Theorem does not apply: some key implications of market incompleteness, with policy relevance today  
Jacques DREZE

Markets are incomplete when the assets available to the agents do not span the space of future contingencies. Efficiency is then assessed by the weak criterion of "constrained efficiency" (efficiency relative to the set of allocations compatible with the asset structure). That criterion requires firms to optimise relative to shadow-prices reflecting shareholders' preferences. Yet, even when firms do so, competitive equilibria on the markets for assets and commodities fail (generically) to be constrained efficient (section 3). Pareto-superior allocations can be implemented through price/wage rigidities and quantity constraints (section 4). But nominal rigidities are conducive to multiple equilibria, implying endogenous macroeconomic uncertainties that compound the primitive (exogenous) uncertainties (section 5). Various policy implications can be drawn, which are of some relevance to the current crisis.

**JEL Classification:** D50, D52, D82

**Keywords:** general equilibrium, incomplete markets, temporary equilibrium, constrained efficiency, price rigidities, multiple equilibria, coordination failures, Phillips curve.

- 2013/10 Existence and multiplicity of temporary equilibria under nominal price rigidities  
Jacques DREZE

This paper proves existence of a multiplicity of equilibria in a 2-period TGE model with money and nominal rigidities. Households have incomplete preferences and firms reach decisions through the "control principle" (cf. Dreze 1989).

**JEL Classification:** D51, D52

**Keywords:** temporary general equilibrium, incomplete preferences, price rigidities.

- 2013/11 Local taxation of global corporation: a simple solution  
Jean HINDRIKS, Susana PERALTA and Shlomo WEBER

The explosion of globalization has increased firms incentives to exploit international tax differentials to their benefit. In this paper we consider a simple world with two countries with different market sizes and two multinationals with a division in each country. Both countries use a source-based profit tax on

multinationals, who compete a la Cournot in each local market and use profit shifting based on the tax differential. We assess policies aimed to mitigate inefficient tax choices and show that tax harmonization cannot benefit the small country which adopts a lower tax rate to channel a tax revenue from the large country. We propose a simple revenue sharing mechanism in which countries share equal proportion of their own revenue with each other. It is shown that revenue sharing increases equilibrium tax rates in each country, reduces the tax differential, and benefits both countries despite of reallocation of resources from the high tax to the low tax country.

**JEL Classification:** F23, F68, H25, H70

**Keywords:** Heterogeneous countries, Profit Shifting, Tax Competition Revenue Sharing.

- 2013/12 The Shapley value as a guide to FRAND licensing agreements  
Pierre DEHEZ and Sophie POUKENS

We consider the problem of specifying *Fair, Reasonable And Non-Discriminatory* agreements faced by standard-setting organizations. Along with Layne-Farrar, Padilla and Schmalensee (2007), we model the problem as a cooperative game with transferable utility, allowing for patents to be *weak* in the sense that they have substitutes. Assuming that a value has been assigned to weak patents, we obtain a formula for the Shapley value that gives an insight into what FRAND agreements should look like.

**Keywords:** patent licensing, Shapley value, core.

- 2013/13 Fiscal integration and growth stimulation in Europe  
Jacques DREZE and Alain DURRE

With the current sovereign debt crisis, the incompleteness of economic integration in the Economic and Monetary Union (EMU) has become patent leading to an intense debate among academics and policy makers. Most of the debate focuses on the needs to strengthen fiscal rules and to restore fiscal imbalances through austerity measures which weigh on growth prospects. In this paper we analyse current economic developments within the euro area through the lens of general equilibrium theory. We address two issues (international sharing of macroeconomics risks and coordinated growth stimulation) which are essential to guarantee the sustainability of the EMU. More specifically, we propose mechanisms to cope with intergenerational and interregional risks while focusing on (fiscally neutral) investments meeting social needs and apt to break the vicious circle between fiscal imbalances and stagnation.

**JEL Classification:** E24, E63, H63

**Keywords:** general equilibrium model, risk sharing, growth stimulation, fiscal integration, EMU, indexed bonds.

- 2013/14 Modeling the dependence of conditional correlations on volatility  
Luc BAUWENS and Edoardo OTRANTO

Several models have been developed to capture the dynamics of the conditional correlations between time series of financial returns, but few studies have investigated the determinants of the correlation dynamics. A common opinion is that the market volatility is a major determinant of the correlations. We extend some models to capture explicitly the dependence of the correlations on the volatility of the market of interest. The models differ in the way by which the

volatility influences the correlations, which can be transmitted through linear or nonlinear, and direct or indirect effects. They are applied to different data sets to verify the presence and possible regularity of the volatility impact on correlations.

**JEL Classification:** C32, C58

**Keywords:** volatility effects, conditional correlation, DCC, Markov switching.

2013/15

Assigning agents to a line

Jens L. HOUGAARD, Juan D. MORENO-TERNERO and Lars P. OSTERDAL

We consider the problem of assigning agents to slots on a line, where only one agent can be served at a slot and each agent prefers to be served as close as possible to his target. Our focus is on utilitarian methods, i.e., those that minimize the total gap between targets and assigned slots. We first consider deterministic assignment of agents to slots, and provide a direct method for testing if a given deterministic assignment is utilitarian. We then consider probabilistic assignment of agents to slots, and make use of the previous method to propose a utilitarian modification of the classic random priority method to solve this class of problems. We also provide some logical relations in our setting among standard axioms in the literature on assignment problems.

**JEL Classification:** C78, D61, D63

**Keywords:** probabilistic assignment, random priority, utilitarianism, sd-efficiency, bottleneck.

2013/16

First-order methods with inexact oracle: the strongly convex case

Olivier DEVOLDER, François GLINEUR and Yu. NESTEROV

The goal of this paper is to study the effect of inexact first-order information on the first-order methods designed for smooth strongly convex optimization problems. It can be seen as a generalization to the strongly convex case of our previous paper [1].

We introduce the notion of  $(\delta, L, \mu)$ -oracle, that can be seen as an extension of the  $(\delta, L)$ -oracle (previously introduced in [1]), taking into account strong convexity. We consider different examples of  $(\delta, L, \mu)$ -oracle: strongly convex function with first-order information computed at a shifted point, strongly convex function with approximate gradient and strongly convex max-function with inexact resolution of subproblems.

The core of this paper is devoted to the behavior analysis of three first-order methods, respectively the primal, the dual and the fast gradient method, when used with a  $(\delta, L, \mu)$ - oracle. As in the smooth convex case (studied in [1]), we obtain that the simple gradient methods can be seen as robust but relatively slow, whereas the fast gradient method is faster but more sensitive to oracle errors. However, the strong convexity leads to much faster convergence rates (linear instead of sublinear) for every method and to a reduced sensitivity with respect to oracle errors.

We also prove that the notion of  $(\delta, L, \mu)$ -oracle can be used in order to model exact first-order information but for functions with weaker level of smoothness and different level of convexity. This observation allows us to apply methods, originally designed for smooth strongly convex function, to weakly smooth uniformly convex functions and to derive corresponding performance guarantees.

- 2013/17 Intermediate gradient methods for smooth convex problems with inexact oracle  
Olivier DEVOLDER, François GLINEUR and Yu. NESTEROV

Between the robust but slow (primal or dual) gradient methods and the fast but sensitive to errors fast gradient methods, our goal in this paper is to develop first-order methods for smooth convex problems with intermediate speed and intermediate sensitivity to errors.

We develop a general family of first-order methods, the Intermediate Gradient Method (IGM), based on two sequences of coefficients. We prove that the behavior of such kind of method is directly governed by the choice of coefficients and that the existing dual and fast gradient methods can be retrieved with particular choices for the coefficients. Moreover, the degree of freedom in the choice of these coefficients can be also used in order to generate intermediate behaviors.

We propose a switching policy for the coefficients that allows us to see the corresponding IGM as a smart switching between fast and dual gradient methods and to reach target accuracies, unreachable by the fast gradient methods, in a significantly smaller number of iterations compared to what is needed using the slow gradient methods. With another choice for the coefficients, we are also able to generate methods exhibiting the full spectrum of convergence rates, corresponding to every possible trade off between fastness of the method and robustness to errors.

- 2013/18 The systemic risk of energy markets  
Diane PIERRET

This paper investigates the meaning of systemic risk in energy markets and proposes a methodology to measure it. Energy Systemic Risk is defined by the risk of an energy crisis raising the prices of all energy commodities with negative consequences for the real economy. Measures of the total cost (EnSysRISK) and the net impact ( $\Delta MES$ ) of an energy crisis on the rest of the economy are proposed. The measures are derived from the Marginal Expected Shortfall (MES) capturing the tail dependence between the asset and the energy market factor. The adapted MES accounts for causality and dynamic exposure to common latent factors. The methodology is applied to the European Energy Exchange and the DAX industrial index, where a minor decline in industrial productivity is observed from recent energy shocks.

**JEL Classification:** C32, C58, Q43

**Keywords:** energy crisis, factor models, marginal expected shortfall, market integration.

- 2013/19 Spatial segregation and urban structure  
Pascal MOSSAY and Pierre M. PICARD

In this paper, we study social interactions between two populations of individuals living in a city. Agents consume land and benefit from intra- and inter-group social interactions. We show that in equilibrium segregation arises: populations get separated in distinct spatial neighborhoods. Two- and three-district urban structures are characterized. For high population ratios or strong inter-group interactions, only a three-district city exists. In other cases, multiplicity of equilibria arises. Moreover, for sufficiently low population ratios or very weak inter-group interactions, all individuals agree on which spatial equilibrium is best.

**JEL Classification:** R12, R14, R31

**Keywords:** social interaction, segregation, multiple centers, urban districts.

- 2013/20 Behavioral biases and long term care insurance: A political economy approach  
Philippe DE DONDER and Marie-Louise LEROUX

We develop a model where individuals all have the same probability of becoming dependent and vote over the social long term care insurance contribution rate before buying additional private insurance and saving. We study three types of behavioral biases, all having in common that agents under-weight their dependency probability when taking private decisions. Sophisticated procrastinators anticipate their mistake when voting, while optimistic and myopic agents have preferences that are consistent across choices. Optimists under-estimate their own probability of becoming dependent but know the average probability while myopics underestimate both. Sophisticated procrastinators attain the first-best allocation while myopics and optimists insure too little and save too much. Myopics and optimists more (resp., less) biased than the median are worse off (resp., better off), at the majority voting equilibrium, when private insurance is available than when it is not.

**JEL Classification:** H55, I13, D91

**Keywords:** majority voting, myopia, optimism, sophisticated procrastinators, complementary private insurance, dependency linked annuity.

- 2013/21 On implicit functions in nonsmooth analysis  
Dominik DORSCH, Hubertus Th. JONGEN, Jan RÜCKMANN and Vladimir SHIKHMAN

We study systems of equations,  $F(x) = 0$ , given by piecewise differentiable functions  $F: \mathbf{R}^n \rightarrow \mathbf{R}^k$ ,  $k \leq n$ . The focus is on the representability of the solution set locally as an  $(n - k)$ -dimensional Lipschitz manifold. For that, nonsmooth versions of inverse function theorems are applied. It turns out that their applicability depends on the choice of a particular basis. To overcome this obstacle we introduce a strong full-rank assumption (SFRA) in terms of Clarke's generalized Jacobians. The SFRA claims the existence of a basis in which Clarke's inverse function theorem can be applied. Aiming at a characterization of SFRA, we consider also a full-rank assumption (FRA). The FRA insures the full rank of all matrices from the Clarke's generalized Jacobian. The article is devoted to the conjectured equivalence of SFRA and FRA. For min-type functions, we give reformulations of SFRA and FRA using orthogonal projections, basis enlargements, cross products, dual variables, as well as via exponentially many convex cones. The equivalence of SFRA and FRA is shown to be true for min-type functions in the new case  $k = 3$ .

**Keywords:** Clarke's inverse function theorem, strong full-rank assumption, full-rank assumption, full-rank conjecture, Lipschitz manifold.

- 2013/22 An almost closed form estimator for the EGARCH model  
Christian M. HAFNER and Oliver LINTON

The EGARCH is a popular model for discrete time volatility since it allows for asymmetric effects and naturally ensures positivity even when including exogenous variables. Estimation and inference is usually done via maximum likelihood. Although some progress has been made recently, a complete distribution theory of MLE for EGARCH models is still missing. Furthermore, the estimation procedure itself may be highly sensitive to starting values, the choice of numerical optimization algorithm, etc. We present an alternative estimator that is available in a simple closed form and which could be used, for example, as starting values for MLE. The estimator of the dynamic parameter is independent of the innovation distribution.

For the other parameters we assume that the innovation distribution belongs to the class of Generalized Error Distributions (GED), profiling out its parameter in the estimation procedure. We discuss the properties of the proposed estimator and illustrate its performance in a simulation study.

**JEL Classification:** C12, C13, C14

**Keywords:** autocorrelations, generalized error distribution, method of moments estimator, Newton-Raphson.

- 2013/23 Large elections with multiple alternatives: a Condorcet Jury Theorem and inefficient equilibria  
Johanna M. GOERTZ and François MANIQUET

We investigate whether the plurality rule aggregates information efficiently in large elections with multiple alternatives, in which voters have common interests. Voters' preferences depend on an unknown state of nature, and they receive imprecise private signals about the state of nature prior to the election. Similar to two-alternative elections (e.g., Myerson (1998)), there always exists an informationally efficient equilibrium in which the correct alternative is elected. However, we identify new types of coordination failures in elections with more than two alternatives that lead to new types of inefficient equilibria. These can have interesting new properties: Voters may vote informatively, but the correct alternative is not elected.

**JEL Classification:** C72, D71, D72, D82

**Keywords:** efficient information aggregation, simple plurality rule, Poisson games, Condorcet Jury Theorem.

- 2013/24 Reforming the postal universal service  
Axel GAUTIER and Jean-Christophe POUDOU

The postal sector has undergone dramatic changes over the recent years under the double effect of ongoing liberalization and increased competition with alternative communication channels (e-substitution). As a result, the mail volume handled by the historical operator has declined sharply while the latter's ability to match the same standard of universal service may be under threat. Thus, a reform of the postal universal service is on the agenda. This paper examines possible reforming options ranging from keeping universal service within the postal sector to redefining universal service as spanning postal and electronic technologies.

**JEL Classification:** L51, L86, L87

**Keywords:** universal service, postal market, digitalization.

- 2013/25 Fair re-valuation of wine as an investment  
Fabian Y.R.P. BOCART and Christian M. HAFNER

The prices of wine is a key topic for market participants interested in valuing their stock, including dealers, restaurants or consumers who may be interested in optimizing their purchases. As a closely related issue, re-valuation is the need to regularly update the value of a stock. This need is especially met by fund managers in the growing industry of wine as an investment. In this case, fair-value measurement is compulsory by law. We briefly review methods available to funds and introduce a new quantitative method aimed at meeting IFRS 13 compliance for fair valuation. Using auction data, we apply our method to compute current fair value of a basket of wines.

**JEL Classification:** C14, C43, M40, G12

**Keywords:** IFRS13, hedonic regression, repeated sales, wine investment.

- 2013/26 Universal gradient methods for convex optimization problems  
Yu. NESTEROV

In this paper, we present new methods for black-box convex minimization. They do not need to know in advance the actual level of smoothness of the objective function. The only essential input parameter is the required accuracy of the solution. At the same time, for each particular problem class they automatically ensure the best possible rate of convergence. We confirm our theoretical results by encouraging numerical experiments, which demonstrate that the fast rate of convergence, typical for the smooth optimization problems, sometimes can be achieved even on nonsmooth problem instances.

**Keywords:** convex optimization, black-box methods, complexity bounds, optimal methods, weakly smooth functions.

- 2013/27 Sufficiency of cut-generating functions  
Gérard CORNUEJOLS, Laurence WOLSEY and Sercan YILDIZ

This note settles an open problem about cut-generating functions, a concept that has its origin in the work of Gomory and Johnson from the 1970's and has received renewed attention in recent years.

**Mathematics Subject Classification:** 90C11, 90C26

**Keywords:** mixed integer programming, separation, corner polyhedron, intersection cuts.

- 2013/28 Anonymous social influence  
Manuel FORSTER, Michel GRABISCH and Agnieszka RUSINOWSKA

We study a stochastic model of influence where agents have “yes” or “no” inclinations on some issue, and opinions may change due to mutual influence among the agents. Each agent independently aggregates the opinions of the other agents and possibly herself. We study influence processes modelled by ordered weighted averaging operators, which are anonymous: they only depend on how many agents share an opinion. For instance, this allows to study situations where the influence process is based on majorities, which are not covered by the classical approach of weighted averaging aggregation. We find a necessary and sufficient condition for convergence to consensus and characterize outcomes where the society ends up polarized. Our results can also be used to understand more general situations, where ordered weighted averaging operators are only used to some extent. We provide an analysis of the speed of convergence and the possible outcomes of the process. Furthermore, we apply our results to fuzzy linguistic quantifiers, i.e., expressions like “most” or “at least a few”.

**JEL Classification:** C7, D7, D85

**Keywords:** influence, anonymity, ordered weighted averaging operator, convergence, consensus, speed of convergence, fuzzy linguistic quantifier.

- 2013/29 Can federal reserve policy deviation explain response patterns of financial markets over time?  
Kent WANG, Shin-Huei WANG and Zheyao PAN

Yes. By using real-time structure break monitoring techniques we find evidence against monotonic response pattern, specifically three response structures of US stock market to the federal monetary policy actions based on a sample from 1989-2010. We re-estimate the market response in each of the three structures and find

results stronger than previously documented especially in 2001-2008. We propose a “FedGap” variable which measures the deviation of Fed policy from the “Taylor Rule” in explanation and find it to be significant with economic meaning. We conclude that market responses proportionally to the size of the FedGap and it thus serves as a new “macro-state” factor which can explain the dynamic response patterns of financial markets. We also examine the issue from the bond market, and find similar results.

**JEL Classification:** E44, G12, G14, G28

**Keywords:** real-time structure breaks, dynamic market response, monetary policy, Taylor Rule, FedGap.

- 2013/30 Can geography lock a society in stagnation  
Nguyen Than DAO and Julio DAVILA

We extend Galor and Weil (2000) by including geographical factors in order to show that under some initial conditions, an economy may be locked in Malthusian stagnation and never take off. Specifically, we characterize the set of geographical factors for which this happens, and this way we show how the interplay of the available “land”, its suitability for living, and its degree of isolation, determines whether an economy can escape stagnation.

**JEL Classification:** O11, O33

**Keywords:** geographical factors, loss of technology, human capital.

- 2013/31 Contractually stable alliances  
Ana MAULEON, Jose SEMPERE-MONERRIS and Vincent VANNETELBOSCH

We analyze how different rules for exiting an alliance (simple majority, unanimity or unanimity with side payments) will affect the formation of strategic alliances. We find that no alliance structure is contractually stable under the simple majority rule. Once unanimous consent is required, asymmetric alliance structures consisting of two alliances are contractually stable. In addition, the grand alliance which is the efficient structure is stable. Allowing for side payments to compensate former partners improves efficiency. Finally, we show that different rules of exit may coexist in different alliances in the long run.

**JEL Classification:** C70, L13

**Keywords:** strategic alliances, coalition formation, contractual stability, exit rules.

- 2013/32 Allocation rules for coalitional network games  
Jean-François CAULIER, Ana MAULEON and Vincent VANNETELBOSCH

Coalitional network games are real-valued functions defined on a set of players organized into a network and a coalition structure. We adopt a flexible approach assuming that players organize themselves the best way possible by forming the efficient coalitional network structure. We propose two allocation rules that distribute the value of the efficient coalitional network structure: the atom-based flexible coalitional network allocation rule and the player-based flexible coalitional network allocation rule.

**JEL Classification:** A14, C71, D85

**Keywords:** networks, coalition structures, allocation rules.

- 2013/33 Limited farsightedness in 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 perfectly farsighted, related stability concepts have been proposed. We design a simple network formation experiment to test these extreme theories, but find evidence against both of them: the subjects are consistent with an intermediate rule of behavior, which we interpret as a form of limited farsightedness. On aggregate, the selection among multiple pairwise stable networks (and the performance of farsighted stability) crucially depends on the level of farsightedness needed to sustain them, and not on efficiency or cooperative considerations. Individual behavior analysis corroborates this interpretation, and suggests, in general, a low level of farsightedness (around two steps) on the part of the agents.

**JEL Classification:** D85, C91, C92

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

- 2013/34 Relative concerns and delays in bargaining with private information  
Ana MAULEON and Vincent VANNETELBOSCH

We consider Rubinstein's two-person alternating-offer bargaining model with two-sided incomplete information. We investigate the effects of one party having relative concerns on the bargaining outcome and the delay in reaching an agreement. We find that facing an opponent having stronger relative concerns only hurts the bargainer when she is stronger than her opponent. In addition, we show that an increase of one party's relative concerns will decrease the maximum delay in reaching an agreement.

**JEL Classification:** C70, D60, J50

**Keywords:** relative concerns, alternating-offer bargaining, private information, maximal delays.

- 2013/35 What do normative indices of multidimensional inequality really measure?  
Kristof BOSMANS, Koen DECANCO and Erwin OOGHE

We argue that normative indices of multidimensional inequality do not only measure a distribution's extent of inequity (i.e., the gaps between the better-off and the worse-off), but also its extent of inefficiency (i.e., the non-realized mutually beneficial exchanges of goods). We provide a decomposition that allows quantifying these two parts of inequality. Exact formulas of the inequity and inefficiency components are provided for a generic class of social welfare functions. The inequity component turns out to be a two-stage measure, which applies a unidimensional inequality measure to the vector of well-being levels. We critically discuss two prominent transfer principles, viz., uniform majorization and correlation increasing majorization, in the light of the decomposition. A decomposition of inequality in human development illustrates the analysis.

**JEL Classification:** D31, D63, I31

**Keywords:** multidimensional inequality measurement, efficiency, uniform majorization, correlation increasing majorization.

- 2013/36 Spatial issues on a hedonic estimation of rents in Brussels  
Alain PHOLO BALA, Dominique PEETERS and Isabelle THOMAS

Using Belgian microdata, we assess the impact, on a hedonic regression, of the distortions arising from the choice of either a specific zoning system or the delineation of the study area. We also evaluate the biases that arise when spatial effects are not accounted for. Given that the dependent variable is interval-coded, controlling for spatial dependence in this context is challenging. We address this problem with two alternative strategies. Firstly, we use the Gibbs Sampling algorithm to estimate spatial econometric models which extends the interval regression model. A major drawback of this approach is that the implied estimation is prone to the endogeneity biases inherent to our hedonic regression model. To circumvent the endogeneity issues triggered by the first estimation strategy, we also use a two-stage estimation procedure with locational fixed effects. In all specifications, results are sensitive to the Modifiable Areal Unit Problem (MAUP) and to the choice of the delineation of the study area. Moreover, they confirm the existence of substantive spatial dependence. Conversely to the previous results with a negative elasticity for the percentage of the area covered by agriculture and a positive elasticity for the potential accessibility to jobs, the second approach implies opposite effects for those two variables. This indicates that dwellings close to agricultural areas and with a lower accessibility to the main employment centers are highly demanded and that endogeneity biases are not negligible.

**JEL Classification:** C21, C24, C25, C34, Q53, R21

**Keywords:** MAUP, interval regression, spatial dependence, spatial heterogeneity, Brussels.

- 2013/37 Social security and economic integration  
Lionel ARTIGE, Antoine DEDRY and Pierre PESTIEAU

The purpose of this letter is to analyze the impact of economic integration when countries differ in their social security systems, more specifically in the degree of funding of their pensions, and in the regulation of the retirement age. Funding and mandatory early retirement are two features which foster capital accumulation relative to pay-as-you-go pensions with flexible retirement. In case of economic integration they both imply some capital outflow and may lead to some utility losses.

**JEL Classification:** H2, F42, H8

**Keywords:** economic union, tax competition, social security.

- 2013/38 Differing types of medical prevention appeal to different individuals  
Nicolas BOUCKAERT and Erik SCHOKKAERT

We analyse participation in medical prevention with an expected utility model that is sufficiently rich to capture diverging features of different prevention procedures. We distinguish primary and secondary prevention (with one or two rounds) for both fatal or non-fatal diseases. Moreover, we introduce a flexible relationship between the specific disease for which the prevention procedure is set up and the general background health of the individual. We show how these various possibilities change the comparative statics of the prevention decision and we test the differential predictions with data from SHARE (Survey of Health, Ageing and Retirement in Europe) about participation in mammography, dental caries screening and flu vaccination.

**JEL Classification:** D81, I12

**Keywords:** screening, vaccination, expected utility, behavioral economics.

- 2013/39 Trade, economic geography and the choice of product quality  
Pierre M. PICARD

The present paper studies the effect of the choice of product quality on trade and location of firms. We discuss a model where consumers have preferences for the quality of a set of differentiated varieties. Firms do not only develop and sell manufacturing varieties in a monopolistic competitive market but also determine the quality level of their varieties by investing in research and development. We explore the price and quality equilibrium properties when firms are immobile. We then consider a footloose capital model where capital is allocated to the manufacturing firms in the region offering the highest return. We show that the larger region produces varieties of higher quality and that the quality gap increases with larger asymmetries in region sizes and with larger trade costs. Finally, the home market effect is mitigated when firms choose their product quality.

**Keywords:** monopolistic competition, endogenous quality, economic geography.

- 2013/40 Pooling in manufacturing: do opposites attract?  
Tanja B. MLINAR and Philippe CHEVALIER

In a stochastic environment pooling naturally leads to economies of scale, but heterogeneity can also create variability. In this article, we investigate this trade-off in the case of a manufacturing environment. Pooling for queueing systems has been widely investigated while much less attention has been given to manufacturing systems where jobs are given a due date upon arrival. In such system it is not the elapsed time until the actual completion of the job that counts, but rather the lead time that can be promised to the customer in order to guarantee a high service level. In this paper, we study the benefits of pooling stochastic systems in such manufacturing setting with multiple customer types. Our results demonstrate that, in stark contrast with what was previously observed in service environments, heterogeneity is generally not deteriorating performance. Furthermore, our analytical and simulation studies reveal that the benefits of pooling in terms of the expected sojourn time can serve as a good prediction for the benefits of pooling on the average due-date lead time in a wide range of situations.

**Keywords:** manufacturing, resource pooling, queueing, due dates.

- 2013/41 Public and private hospitals, congestion, and redistribution  
Chiara CANTA and Marie-Louise LEROUX

This paper studies how congestion in the public health sector can be used as a redistributive tool. In our model, agents differ in income and they can obtain a health service either from a congested public hospital or from a non congested private one at a higher price. With pure in-kind redistribution, agents fail to internalize their impact on congestion, and the demand for the public hospital is higher than optimal. We show that under full information, the optimal redistribution and sorting across hospitals can be obtained using a lump-sum tax and a subsidy on the private hospital. If income is not observable but the social planner can assign agents across hospitals, the optimal congestion is higher than in the first best in order to relax incentive constraints. Finally, if agents can freely choose across hospitals, the optimal subsidy on the private hospital price may be negative or positive depending on the relative importance of redistribution and efficiency concerns.

**JEL Classification:** H21, H23, H44, I11

**Keywords:** optimal taxation, mixed health care systems, waiting times, income redistribution.

- 2013/42 FGT poverty measures and the mortality paradox: Theory and evidence  
Mathieu LEFEBVRE, Pierre PESTIEAU and Grégory PONTIERE

Income-differentiated mortality, by reducing the share of poor persons in the population, leads to what can be called the "Mortality Paradox": the worse the survival conditions of the poor are, the lower the measured poverty is. We show that the extent to which FGT measures (Foster Greer Thorbecke 1984) underestimate old-age poverty under income-differentiated mortality depends on whether the prematurely dead would have, in case of survival, suffered from a more severe poverty than the average surviving population. Taking adjusted FGT measures with ex- tended lifetime income profiles as a benchmark, we identify conditions under which the selection bias induced by income-differentiated mortality is higher for distribution-sensitive measures than for headcount measures. Finally, we show, on the basis of data on poverty in 11 European economies, that the size of the selection bias varies across different sub-classes of FGT measures and across countries.

**JEL Classification:** I32

**Keywords:** income-differentiated mortality, FGT poverty measures.

- 2013/43 Social awareness and duopoly competition  
Nada BELHADJ, Jean GABSZEWICZ and Ornella TAROLA

Human actions are often guided both by individual rationality and by social norms. In this paper we explore how duopoly market competition values the variants of a product, when these variants embody at different levels the requirements derived from some social norm. In a model where preferences of consumers depend partially on the levels of compliance of the variants with the social norm, we characterize the equilibrium path along which firms choose sequentially their level of compliance and their price.

**JEL Classification:** D11, L13, Q58

**Keywords:** social norms, others regarding preferences, vertical product differentiation.

- 2013/44 On the convergence to the Nash bargaining solution for action-dependent bargaining protocols  
Volker BRITZ, Jean-Jacques HERINGS and Arkadi PREDTETCHINSKI

We consider a non-cooperative multilateral bargaining game and study an action-dependent bargaining protocol, that is, the probability with which a player becomes the proposer in a round of bargaining depends on the identity of the player who previously rejected. An important example is the frequently studied rejector-becomes-proposer protocol. We focus on subgame perfect equilibria in stationary strategies which are shown to exist and to be efficient. Equilibrium proposals do not depend on the probability to propose conditional on the rejection by another player, though equilibrium acceptance sets do depend on these probabilities. Next we consider the limit, as the bargaining friction vanishes. In case no player has a positive probability to propose conditional on his rejection, each player receives his utopia payoff conditional on being recognized and equilibrium payoffs are in general Pareto inefficient. Otherwise, equilibrium proposals of all players converge to a weighted Nash Bargaining Solution, where the weights are determined by the probability to propose conditional on a rejection.

**JEL Classification:** C78

**Keywords:** strategic bargaining, subgame perfect equilibrium, stationary strategies, Nash bargaining solution.

- 2013/45 Single item reformulations for a vendor managed inventory routing problem:  
computational experience with benchmark instances  
Pasquale AVELLA, Maurizio BOCCIA and Laurence WOLSEY

The Inventory Routing Problem (IRP) involves the distribution of one or more products from a supplier to a set of customers over a discrete planning horizon. The version treated here, the so-called Vendor Managed Inventory Routing Problem (VMIRP), is the Inventory Routing problem arising when the replenishment policy is decided a priori. We consider two replenishment policies. The first is known as Order-Up (OU): if a client is visited in a period, then the amount shipped to the client must bring the stock level up to the upper bound. The latter is called Maximum Level (ML): the maximum stock level in each period cannot be exceeded. The objective is to find replenishment decisions minimizing the sum of the storage and distribution costs.

VMIRP contains two important subproblems: a lot-sizing problem for each customer and a classical vehicle routing problem for each time period. In this paper we present a-priori reformulations of VMIRP-OU and VMIRP-ML derived from the single-item lot-sizing substructure. In addition we introduce two new cutting plane families - the Cut Inequalities - deriving from the interaction between the Lot-Sizing and the Routing substructures.

A Branch-and-Cut algorithm has been implemented to demonstrate the effectiveness of Single-Item reformulations. Computational results on the benchmark instances with 50 customers and 6 periods with a single product and a single vehicle are presented.

**Mathematics Subject Classification:** 90C11, 90C57, 90C90

**Keywords:** mixed integer programming, inventory routing, lot-sizing, reformulations, vendor management.

- 2013/46 Revenue management for operations with urgent orders  
Alejandro LAMAS, Tanja MLINAR, Liang LU and Philippe CHEVALIER

This article is motivated by the case of a company manufacturing industrial equipment that faces two types of demand: on the one hand there are the so-called regular orders for installations or refurbishing of existing facilities, these orders have a relatively long lead time; on the other hand there are urgent orders mostly related to spare parts when a facility has a breakdown, the delay in such case is much shorter but higher margins can be obtained. We study the order acceptance problem for a firm that serves two classes of demand over an infinite horizon. The firm has to decide whether to accept a regular order (or equivalently how much capacity to set aside for urgent orders) in order to maximize its profit. We formulate this problem as a multi-dimensional Markovian Decision Process (MDP). We propose a family of approximate formulations to reduce the dimension of the state space via aggregation. We show how our approach can be used to compute bounds on the profit associated with the optimal order acceptance policy. Finally, we show that the value of revenue management is commensurate with the operational flexibility of the firm.

**Keywords:** order acceptance, revenue management, Markov decision process, heuristics, flexibility.

- 2013/47 Uncertain altruism and the provision of long term care  
Helmuth CREMER, Firouz GAHVARI and Pierre PESTIEAU

This paper studies the role of private and public long term care (LTC) insurance programs in a world in which family assistance is uncertain. Benefits are paid in

case of disability but cannot be conditioned (directly), due to moral hazard problems, on family aid. Under a topping up scheme, when the probability of altruism is high, there is no need for insurance. At lower probabilities, insurance is required, though not full insurance. This can be provided either privately or publicly if insurance premiums are fair, and publicly otherwise. Moreover, the amount of LTC insurance varies negatively with the probability of altruism. With an opting out scheme, there will be three possible equilibria depending on the children's degree of altruism being "low," "moderate," or "very high". These imply: full LTC insurance with no aid from children, less than full insurance just enough to induce aid, and full insurance with aid. Fair private insurance markets can support the first equilibrium, but not the other two equilibria. Only a public opting-out scheme can attain them by creating incentives for self-targeting and ensuring that only dependent parents who are not helped by their children seek help from the government.

**JEL Classification:** H2, H5

**Keywords:** long term care, uncertain altruism, private insurance, public insurance, topping up, opting out.

- 2013/48 Self-assessed health of elderly people in Brussels: does the built environment matter?  
Claire DUJARDIN, Vincent LORANT and Isabelle THOMAS

The built environment plays a key role in the strategy of "Aging in Place". Here, we study the influence of the built environment on the health status of elderly people living in Brussels. Using census and geocoded data, we analysed if built environment factors were associated with poor self-assessed health status and functional limitations of elderly aged 65+. We concluded that the evidence of the built-environment hypothesis is weak and vulnerable to the composition of the neighborhood.

**JEL Classification:** I10, I14, R23

**Keywords:** built urban environment, subjective health, elderly, GIS-based measures, logistic regressions, Brussels.

- 2013/49 Fair retirement under risky lifetime  
Marc FLEURBAEY, Marie-Louise LEROUX, Pierre PESTIEAU and Grégory PONTIÈRE

A premature death unexpectedly brings a life and a career to their end, leading to substantial welfare losses. We study the retirement decision in an economy with risky lifetime, and compare the laissez-faire with egalitarian social optima. We consider two social objectives: (1) the maximin on expected lifetime welfare (ex ante), allowing for a compensation for unequal life expectancies; (2) the maximin on realized lifetime welfare (ex post), allowing for a compensation for unequal lifetimes. The latter optimum involves, in general, decreasing lifetime consumption profiles, as well as raising the retirement age, unlike the ex ante egalitarian optimum. This result is robust to the introduction of unequal life expectancies and unequal productivities. Hence, the postponement of the retirement age can, quite surprisingly, be defended on egalitarian grounds - although the conclusion is reversed when mortality strikes only after retirement.

**JEL Classification:** I14, I18, J10, J22

**Keywords:** risky lifetime, mortality, labour supply, retirement, compensation.

- 2013/50 Trust and manipulation in social networks  
Manuel FORSTER, Ana MAULEON and Vincent VANNETELBOSCH

We investigate the role of manipulation in a model of opinion formation where agents have opinions about some common question of interest. Agents repeatedly communicate with their neighbors in the social network, can exert some effort to manipulate the trust of others, and update their opinions taking weighted averages of neighbors' opinions. The incentives to manipulate are given by the agents' preferences. We show that manipulation can modify the trust structure and lead to a connected society, and thus, make the society reaching a consensus. Manipulation fosters opinion leadership, but the manipulated agent may even gain influence on the long-run opinions. In sufficiently homophilic societies, manipulation accelerates (slows down) convergence if it decreases (increases) homophily. Finally, we investigate the tension between information aggregation and spread of misinformation. We find that if the ability of the manipulating agent is weak and the agents underselling (overselling) their information gain (lose) overall influence, then manipulation reduces misinformation and agents converge jointly to more accurate opinions about some underlying true state.

**JEL Classification:** D83, D85, Z13

**Keywords:** social networks, trust, manipulation, opinion leadership, consensus, wisdom of crowds.

- 2013/51 Self-commitment of combined cycle units under electricity price uncertainty  
Anthony PAPAVASILIOU, Yi HE and Alva SVOBODA

Day-ahead energy market clearing relies on a deterministic equivalent model with a limited time horizon, which may lead to inefficient scheduling of generating units from the point of view of generators. For this reason, generators may wish to forgo the profit hedging offered by day-ahead electricity markets and assume the risk of self-committing their units with the hope of securing greater profits. This phenomenon may undermine the depth of the day-ahead market, especially in conditions of high price volatility due to deep renewable energy integration. In this paper we investigate the influence of risk aversion and price volatility on the decision of generators to self-commit units. We present a stochastic programming model for self-committing combined cycle units under price uncertainty with a conditional value at risk risk criterion. We use Bender's decomposition to solve the problem and present results on a case study to draw conclusions.

**JEL Classification:** C61, C63

- 2013/52 Dominance invariant one-to-one matching problems  
Ana MAULEON, Elena MOLIS, Vincent VANNETELBOSCH and Wouter VERGOTE

Solution concepts in social environments use either a direct or indirect dominance relationship, depending on whether it is assumed that agents are myopic or farsighted. 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 dominance invariant one-to-one matching problems when preferences are strict. That is, we obtain the conditions on preference profiles such that indirect dominance implies direct dominance in these problems and give them an intuitive interpretation. Whenever some of the conditions are not satisfied, it is important to know the kind of agents that are being investigated in order to use the appropriate stability

concept. Furthermore, we characterize dominance invariant one-to-one matching problems having a non-empty core. Finally, we show that, if the core of a dominance invariant one-to-one matching problem is not empty, it contains a unique matching, the dominance invariant stable 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:** marriage problems, roommate problems, direct dominance, indirect dominance.

- 2013/53 (Un)stable vertical collusive agreements  
Jean GABSZEWICZ and Skerdilajda ZANAJ

In this paper, we extend the concept of stability to vertical collusive agreements, involving downstream and upstream firms, using a setup of successive Cournot oligopolies. We show that a stable vertical agreement always exists: the unanimous vertical agreement involving all downstream and upstream firms. Thus, stable vertical collusive agreements exist even for market structures in which horizontal cartels would be unstable. We also show that there are economies for which the unanimous agreement is not the only stable one. Furthermore, Stigler statement according to which the only ones who benefit from a collusive agreement are the outsiders need not be valid in vertical agreements.

**JEL Classification:** D43, L13

**Keywords:** collusion, stability, vertical agreement.

- 2013/54 Approval quorums dominate participation quorums  
François MANIQUET and Massimo MORELLI

We study direct democracy with population uncertainty. Voters' participation is often among the desiderata by the election designer. We show that with a participation quorum, i.e. a threshold on the fraction of participating voters below which the status quo is kept, the status quo may be kept in situations where the planner would prefer the reform, or the reform is passed when the planner prefers the status quo. On the other hand, using an approval quorum, i.e. a threshold on the number of voters expressing a ballot in favor of the reform below which the status quo is kept, we show that those drawbacks of participation quorums are avoided. Moreover, an electoral system with approval quorum performs better than one with participation quorum even when the planner wishes to implement the corresponding participation quorum social choice function.

**Keywords:** participation quorum, approval quorum, preference aggregation, information aggregation, implementation.

- 2013/55 Intermediaries, transport costs and interlinked transactions  
Mélanie LEFÈVRE and Joe THARAKAN

Farmers in developing countries often encounter difficulties selling their products on local markets. Inadequate transport infrastructure and large distances between areas of production and consumption mean that farmers find it costly to bring their produce to the market and this very often results in small net margins and poverty amongst farmers who are geographically isolated. Agriculture in developing countries is characterized by the presence of intermediaries that have a transport cost advantage over farmers. Because of their market power, these intermediaries are able to impose interlinked contracts and are free to choose a spatial pricing

policy. In this paper, we develop a model of input-output interlinked contracts between a trader and geographically dispersed farmers. We analyze what the welfare implications are as well as the effect on the trader's profit of imposing the use by the trader of either uniform or mill pricing policies, as opposed to spatial discriminatory pricing. We establish under what conditions public authorities can increase farmers' income and reduce poverty in rural areas by restricting the spatial pricing policies that intermediaries can use.

- 2013/56 Trade integration and trade imbalances in the European Union: a network perspective  
Gautier M. KRINGS, Jean-François CARPANTIER and Jean-Charles DELVENNE

We study the ever more integrated and ever more unbalanced trade relationships between European countries. To better capture the complexity of economic networks, we propose two global measures that assess the trade integration and the trade imbalances of the European countries. These measures are the network (or indirect) counterparts to traditional (or direct) measures such as the trade-to-GDP (Gross Domestic Product) and trade deficit-to-GDP ratios. Our indirect tools account for the European inter-country trade structure and follow (i) a decomposition of the global trade flow into elementary flows that highlight the long-range dependencies between exporting and importing economies and (ii) the commute-time distance for trade integration, which measures the impact of a perturbation in the economy of a country on another country, possibly through intermediate partners by domino effect. Our application addresses the impact of the launch of the Euro. We find that the indirect imbalance measures better identify the countries ultimately bearing deficits and surpluses, by neutralizing the impact of trade transit countries, such as the Netherlands. Among others, we find that ultimate surpluses of Germany are quite concentrated in only three partners. We also show that for some countries, the direct and indirect measures of trade integration diverge, thereby revealing that these countries (e.g. Greece and Portugal) trade to a smaller extent with countries considered as central in the European Union network.

**JEL Classification:** F14, F15, F32, C45

**Keywords:** trade network, integration, Euro, Rose effect, flow decomposition, commute-time distance.

- 2013/57 Do we go shopping downtown or in the 'burbs'? Why not both?  
Philip USHCHEV, Igor SLOEV and Jacques-François THISSE

We combine spatial and monopolistic competition to study market interactions between downtown retailers and an outlying shopping mall. Consumers shop at either marketplace or at both, and buy each variety in volume. The market solution stems from the interplay between the market expansion effect generated by consumers seeking more opportunities, and the competition effect. Firms' profits increase (decrease) with the entry of local competitors when the former (latter) dominates. Downtown retailers swiftly vanish when the mall is large. A predatory but efficient mall need not be regulated, whereas the regulator must restrict the size of a mall accommodating downtown retailers.

**JEL Classification:** D43, L81, R10

**Keywords:** shopping behavior, retailers, shopping mall, spatial competition, monopolistic competition.

- 2013/58 Large and small firms in a global market: David vs. Goliath  
Mathieu PARENTI

This paper studies the impact of trade liberalization when monopolistically competitive and oligopolistic firms coexist in the same market. The model is characterized by a group of multi-product firms which behave strategically and take their impact on market aggregates into account (e.g. the average price, and total output) and by a monopolistically competitive fringe. This difference in behavior leads large firms to charge higher markups. Conditions are derived for the coexistence of both types of firms: heterogeneity in production efficiency, captured by economies of scope for large firms, appears as a necessary condition for them to coexist at equilibrium. Turning to international trade, free trade increases social welfare, as both large and small firms become more competitive. However, when only large firms are able to cover the fixed costs to export, bilateral trade liberalization fosters the exit of small firms, and increases product variety, but it also lowers consumer surplus through a higher average price. Social welfare increases under linear or isoelastic demand but is generally ambiguous.

**JEL Classification:** D4, L10, F11

**Keywords:** monopolistic competition, oligopolistic market structure, large firms, international trade.

- 2013/59 Dynamic protection of innovations through patents and trade secrets  
Paul BELLEFLAMME and Francis BLOCH

This paper analyzes the optimal protection strategy for an innovator of a complex innovation who faces the risk of imitation by a competitor. We suppose that the innovation can be continuously fragmented into sub-innovations. We characterize the optimal mix of patent and trade secrets when the innovator faces a strict novelty requirement and can only patent a fraction of the innovation once. We also study the optimal dynamic patenting policy in a soft novelty regime, when the innovator can successively patent different fragments of the process. We compare a regime with prior user rights, when the innovator can use the secret part of the process, even when it is patented by an imitator with a regime without prior user rights.

**JEL Classification:** O31, O34

**Keywords:** patents, trade secrets, dynamic protection of innovation, intellectual property rights.

- 2013/60 Specialized agglomerations with areal data: model and detection  
Christian HAEDO and Michel MOUCHART

This paper develops new statistical and computational methods for the automatic detection of spatial clusters displaying an over- or under- relative specialization spatial pattern. A probability model provides a space partition into clusters representing homogenous portions of space as far as the probability of locating a primary unit is concerned. A cluster made of contiguous regions is called an agglomeration. A greedy algorithm detects specialized agglomerations through a model selection criteria. A random permutation test evaluates whether the contiguity property is significant. Finally this algorithm is run on Argentinean data. Evaluating the proposed methodology concludes the paper.

**Keywords:** relative specialization, specialized agglomeration, areal (lattice) data, spatial clustering, spatial cluster detection, permutation bootstrap.

- 2013/61 High-end variety exporters defying distance: micro facts and macroeconomic implications  
Julien MARTIN and Florian MAYNERIS

We develop a new methodology to identify high-end variety exporters in French firm-level data. We show that they do not export to many more countries, but they export to more distant ones. This comes with a greater geographic diversification of their aggregate exports. These facts are explained by a lower sensitivity to distance of high-end variety export(er)s. We also show that high-end export(er)s are more sensitive to the average income of the destination country. Because of this different sensitivity to gravity variables, the within-product specialization of a country in the production of high-end varieties is likely to affect its export growth and volatility. We show that a higher sensitivity to per capita income tends to increase the volatility of high-end variety exports. However, a lower sensitivity to distance reduces volatility through a greater geographic diversification. Furthermore, we point out that a lower sensitivity to distance allows high-end varieties to benefit more from growth in more distant markets.

**JEL Classification:** F14, F43, L15

**Keywords:** gravity, distance, firm-level data, growth, volatility.

- 2013/62 Wage premia, education race, and supply of educated workers  
Luca G. DEIDDA and Dimitri PAOLINI

We model a labor market in which workers' level of education might be a signal of skills. We show that whenever the wage premium for education increases over time – as it might happen under skill biased technological progress – the investment in education needed to sustain a separating equilibrium in which skilled workers perfectly signal their type, also increases. Hence, an increase in the education wage premium induces an education race. If the borrowing capacity of poor workers is lower than that of rich ones due to capital market imperfections, poor-skilled workers will finally fall behind in this race – and pool together with some unskilled ones – as the investment they would have to undertake to signal their type eventually becomes unaffordable to them. Such mechanism supports a supply side explanation for the joint long run trends of (i) the education wage premia, and (ii) the relative supply, of postgraduates and college graduates in the US labor market, which complements the demand based explanation for wage skill premia based on skill bias technological change hypothesis.

**JEL Classification:** D4, D8, L15

**Keywords:** education race, skills, signaling, supply of educated workers, wage education premium.

- 2013/63 Continuous knapsack sets with divisible capacities  
Laurence A. WOLSEY and Hande YAMAN

We study two continuous knapsack sets  $Y_{\geq}$  and  $Y_{\leq}$  with  $n$  integer, one unbounded continuous and  $m$  bounded continuous variables in either  $\geq$  or  $\leq$  form. When the coefficients of the integer variables are integer and divisible, we show in both cases that the convex hull is the intersection of the bound constraints and  $2m$  polyhedra arising from a continuous knapsack set with a single unbounded continuous variable. The latter polyhedra are in turn completely described by an exponential family of partition inequalities. A polynomial size extended formulation is known in the  $\geq$  case. We provide an extended formulation for the  $\leq$  case. It follows that, given a specific objective function, optimization over both  $Y_{\geq}$  and  $Y_{\leq}$  can be carried out by solving a polynomial size linear program. A consequence of these

results is that the coefficients of the continuous variables all take the values 0 or 1 (after scaling) in any non-trivial facet-defining inequality.

**Mathematical Subject Classification:** 90C11, 90C26

**Keywords:** continuous knapsack set, splittable flow arc set, divisible capacities, partition inequalities, convex hull.

- 2013/64 Verti-zontal differentiation in export markets  
 Francesco DI COMITE, Jacques-François THISSE  
 and Hylke VANDENBUSSCHE

Many trade models of monopolistic competition identify cost efficiency as the main determinant of firm performance in export markets. To date, the analysis of demand factors has received much less attention. We propose a new model where consumer preferences are asymmetric across varieties and heterogeneous across countries. The model generates new predictions and allows for an identification of horizontal differentiation (taste) clearly distinguished from vertical differentiation (quality). Data patterns observed in Belgian firm-product level exports by destination are congruent with the predictions and seem to warrant a richer modelling of consumer demand.

**JEL Classification:** D43, F12, F14, L16

**Keywords:** heterogeneous firms, heterogeneous consumers, horizontal differentiation, vertical differentiation, asymmetric preferences, monopolistic competition.

- 2013/65 How to make the metropolitan area work? Neither big government, nor laissez-faire  
 Carl GAIGNE, Stéphane RIOU and Jacques-François THISSE

We study how political boundaries and tax competition among jurisdictions interact with the labor and land markets to determine the economic structure and performance of metropolitan areas. Contrary to general belief, institutional fragmentation and cross-border commuting need not be welfare-decreasing, but the size of the central city matters for welfare. Under tax competition the central business district is too small. Tax competition also prevents public policy enhancing global productivity to produce their full impact. Although our results support the idea of decentralizing the supply of local public services by independent jurisdictions, they also highlight the need of coordinating tax policies.

**JEL Classification:** H41, H71, R12

**Keywords:** metropolitan area, fiscal competition, local labor markets, suburbanization, administrative boundary, economic boundary.

- 2013/66 Algorithmic models of market equilibrium  
 Yu. NESTEROV and Vladimir SHIKHMAN

In this paper we suggest a new framework for constructing mathematical models of market activity. Contrary to the majority of the classical economical models (e.g. Arrow-Debreu, Walras, etc.), we get a characterization of general equilibrium of the market as a saddle point in a convex-concave game. This feature significantly simplifies the proof of existence theorems and construction of the adjustment processes both for producers and consumers. Moreover, we argue that the unique equilibrium prices can be characterized as a unique limiting point of some simple price dynamics. In our model, the equilibrium prices have natural explanation: they minimize the total excessive revenue of the market's participants.

Due to convexity, all our adjustment processes have unambiguous behavioral and

algorithmic interpretation. From the technical point of view, the most unusual feature of our approach is the absence of the budget constraint in its classical form.

**Keywords:** general equilibrium theory, convex optimization, price mechanism, budget constraint.

- 2013/67 Equilibrium mergers in a composite good industry with efficiencies  
Cristina PARDO-GARCIA and Jose J. SEMPERE-MONERRIS

This paper studies equilibrium merging behavior in composite good industries. Component producers face the option to either merge with a similar component producer (horizontal merger) or a complementary one (complementary merger) of a composite good. Focusing only on strategic reasons, complementary mergers arise at equilibrium only when composite goods are very differentiated while horizontal mergers otherwise. Next, when efficiencies are considered, the level of marginal cost saving required for a horizontal merger in a composite industry to result in a non-increase in the upward price pressure index (UPPI) is greater as compared with the one in a regular industry. This result can be used by antitrust authorities to be more demanding when dealing with horizontal mergers in composite goods industries.

**JEL Classification:** L13, L41

**Keywords:** composite goods, substitutes, complements, horizontal merger, complementary merger, efficiency effects, UPPI, diversion ratio.

- 2013/68 Confounding and control in a multivariate system. An issue in causal attribution  
Federica RUSSO, Michel MOUCHART and Guillaume WUNSCH

It is widely agreed that, in establishing whether variable  $X$  causes variable  $Y$ , a third variable  $Z$  may confound the relation and thus hinder causal assessment. The solution developed within the ‘traditional’ framework is to control for any third variable, susceptible of confounding the relation between  $X$  and  $Y$ . This paper examines complex systems of variables, characterised by multiple causes and multiple effects. The paper advances the view that in such contexts confounding is a moot issue, under a suitable specification of the causal model. When networks of causal relations are considered, possible confounders are included in the appropriate causal paths from the causes to the outcome. The challenge for the model builder then amounts to developing a structural model that specifies the role of variables in each path, rather than just controlling for possible confounders.

**Keywords:** causality, confounding, control, structural modelling.

- 2013/69 The convex hull of the all-different system with the inclusion property: a simple proof  
Marco DI SUMMA

An all-different constraint for a given family of discrete variables imposes the condition that no two variables in the family are allowed to take the same value. Magos et al. [Mathematical Programming, 132 (2012), pp. 209–260] gave a linear-inequality description of the convex hull of solutions to a system of all-different constraints, under a special assumption called inclusion property. The convex hull of solutions is in this case the intersection of the convex hulls of each of the all-different constraints of the system. We give a short and simple proof of this result, that in addition shows the total dual integrality of the linear system.

**Mathematics Subject Classification:** 90C10, 90C27

**Keywords:** all-different constraint, convex hull, integral polyhedron, total dual integrality.

- 2013/70 Lobbying, family concerns and the lack of political support for estate taxation  
Philippe DE DONDER and Pierre PESTIEAU

We provide an explanation for why estate taxation is surprisingly little used over the world, given the skewness of the estate distribution. Taxing estates implies meddling with intra-family decisions, which may be frowned upon by many. At the same time, the concentration of estates means that a low proportion of the population stands to gain a lot by decreasing estate taxation. We provide an analytical model, together with numerical simulations, where agents bequeathing large estates make monetary contributions that are used to play up the salience of the encroachment aspects of estate taxation on family decisions in order to decrease its political support.

**JEL Classification:** D72, H31

**Keywords:** estate taxation, family values, political economy, lobbying, Kantian equilibrium.

- 2013/71 Monopolistic competition and income dispersion  
Alexander OSHARIN, Jacques-François THISSE, Philip USHCHEV and Valery VERBUS

We develop a model of monopolistic competition that accounts for consumers' heterogeneity in both incomes and preferences. This model makes it possible to study the implications of income redistribution on the toughness of competition. We show how the market outcome depends on the joint distribution of consumers' tastes and incomes and obtain a closed-form solution for a symmetric equilibrium. Competition toughness is measured by the weighted average elasticity of substitution. Income redistribution generically affects the market outcome, even when incomes are redistributed across consumers with different tastes in a way such that the overall income distribution remains the same.

**JEL Classification:** D43, L11, L13

**Keywords:** heterogeneous consumers, income redistribution, toughness of competition, monopolistic competition.

- 2013/72 Imperfect resource substitution and optimal transition to clean technologies  
N. Baris VARDAR

Non-renewable and renewable resources are imperfect substitutes due to technical and geographical constraints. What is the role of imperfect substitution on the optimal transition path to the clean technologies? We address this question by characterizing the optimal growth path and resource use of an economy. We show that the economy initially starts with using the non-renewable and renewable resources simultaneously and gradually increases the share of renewable. The outcome can be either (i) the economy switches to a backstop at a certain date or (ii) the initial regime lasts forever. The results show that the economy converges to a steady state even if the backstop is too costly and a green, zero-carbon economy is the optimal final state in any case. We also present some simulation results to illustrate the shapes of the optimal paths. This analysis allows us to discuss the policy implications and question the existence of the Green Paradox.

**JEL Classification:** Q43, Q42, Q30, Q20

**Keywords:** imperfect substitution, optimal transition, non-renewable resource, renewable resource, backstop, simultaneous use, switching, Green Paradox.

- 2013/73      Jumping the hurdles for collaboration: fairness in operations pooling in the absence of transfer payments  
Alejandro LAMAS and Philippe CHEVALIER

Independent firms may be interested in collaborative alliances in order to reduce their costs and risks, among others benefits. Particularly in operations, different firms can gain from economies of scale by pooling their production resources. Even though there may be a significant reduction of the overall cost, the success of the partnership may generally depend on the fairness of the agreement. With this in mind, the firms can utilize transfer payments with the aim to achieve a balanced allocation of benefits. The implementation of such payments, however, could be difficult in practice, because of the presence of legal constraints or additional contracts that make such agreements more complicated. Therefore, the partners should jointly plan operations as to deal with the trade-off between the efficiency and the fairness. We propose a novel methodology to guide joint operations based on the Rawls' theory of justice, such that we prioritize improving the firm that tends to benefit less from the collaboration. When comparing the quality of such approach with other notions of fairness, we pay particular attention to the effect of the uncertainty on the collaboration. We prove that agreements based on basic notions of fairness have a positive impact on the risk reduction of the firms. Furthermore, our numerical results show that the firms can reduce even more their risk when the agreement is based on more advanced notions of fairness. In particular, our proposed methodology outperforms other approaches of collaboration in terms of risk, while the efficiency is not significantly damaged.

**Keywords:** supply chain collaboration, fairness, lot sizing problem, group decisions, bargaining.

- 2013/74      A new formulation of the European day-ahead electricity market problem and its algorithmic consequences  
Mehdi MADANI and Mathieu VAN VYVE

A new formulation of the optimization problem implementing European market rules for non-convex day-ahead electricity markets is presented, that avoids the use of complementarity constraints to express market equilibrium conditions, and also avoids the introduction of auxiliary binary variables to linearise these constraints. Instead, we rely on strong duality theory for linear or convex quadratic optimization problems to recover equilibrium constraints imposed by most of European power exchanges facing indivisible orders. When only so-called stepwise preference curves are considered to describe continuous bids, the new formulation allows to take full advantage of state-of-the-art solvers, and in most cases, an optimal solution together with market clearing prices can be computed for large-scale instances without any further algorithmic work. The new formulation also suggests a very competitive Benders-like decomposition procedure, which helps to handle the case of interpolated preference curves that yield quadratic primal and dual objective functions, and consequently a dense quadratic constraint. This procedure essentially consists in strengthening classical Benders cuts locally. Computational experiments on real data kindly provided by main European power exchanges (Apx-Endex, Belpex and Epex spot) show that in the linear case, both approaches are very efficient, while for quadratic instances, only the decomposition procedure is tractable and shows very good results. Finally, when most orders are block orders, and instances are combinatorially very hard, the new MILP approach is substantially more efficient.

**JEL Classification:** C61, D44

**Keywords:** Auctions/bidding, market coupling, equilibrium prices, mixed integer programming, large scale optimization.