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- TRAINING** Postdoctoral Fellowship in Mathematical Economics, Cowles Foundation, Yale University, 2005.
Ph.D. in Economics, Brown University, 2003.
M.Sc. in Economics, Brown University, 2000.
M.A. in Economics, Universidad de los Andes, Colombia, 1996.
B.A. in Economics, Pontificia Universidad Javeriana, Colombia, 1995.
- CAREER** Associate Professor, University of California, Davis, 2015 – present.
Adjunct Associate Professor, EPGE—Fundação Getulio Vargas, 2018 – present.
Adjunct Associate Professor, University of Western Ontario, 2015 – 2017.
Associate Professor, EPGE—Fundação Getulio Vargas, 2015.
Associate Professor, University of Western Ontario, 2012 – 2015.
Associate Professor, University of Warwick, 2008 – 2012.
Visiting Fellow, CORE, Université Catholique de Louvain, 2010 – 2011.
Director, Center for Research in Economic Theory and Applications, University of Warwick, 2008 – 2012.
Assistant Professor, University of Warwick, 2006 – 2008.
Lecturer, Royal Holloway College, University of London, 2005 – 2006.
Senior Researcher, Banco de la República, Colombia, 2002 – 2004.
Financial System Chief Supervisor, Banco de la República, 1996 – 1998.
Junior Economist, Banco de la República, 1996.
- RESEARCH** *Arbitrage pricing in non-Walrasian financial markets.* This paper presents conditions under which a model of non-Walrasian trading in financial markets separates the real equilibrium outcomes from the details of the financial structure, and hence permits the pricing of non-traded derivatives by means of no-arbitrage formulæ. I demonstrate that these conditions hold in a number of standard models, including the canonical settings of Cournot and Stackelberg. In contrast, Nash equilibrium in the model of strategic market games proposed by Shapley and Shubik does not allow for the pricing of non-traded derivatives, and I explain why this is the case. *Economic Theory* 66, 951-78, 2018.

Risk externalities: when financial imperfections are not the problem, but part of the solution. We model an economy with complete financial markets where one agent's actions impose an externality on other agents by altering the probability distribution of their risks, and show that limiting the ability of that agent to diversify his risks creates incentives for him to internalize the welfare effects of his decisions, leading to a welfare improvement. Hence, in the presence of risk externalities, disturbing the functioning of perfect financial markets can be socially beneficial. An important implication is, for instance, that allowing oil companies to diversify their exploration risks may result in an inefficiently high risk of environmental catastrophes. *Journal of Mathematical Economics* 77, 87-100, 2018 (with M. Arvaniti).

Information design and capital formation. Could a firm benefit from not disclosing all of its private information before its stock is traded in public financial markets? So long as the investors' marginal utility function is convex and the investors differ only in their risk-sharing needs, three substantive results hold: (1) a full disclosure policy *minimizes* the value of the firm; (2) lifting a mandate of full disclosure does *not* imply that firms will necessarily choose to withhold information maximally; and (3) with many firms that strategically choose disclosure policies, all Nash equilibria display only partial disclosure. Our insight is based on the role that the firm's equity can play as a risk-sharing device: if the firm chooses to keep some information private, its stock can be used by investors to hedge against risk. *Journal of Economic Theory* 176, 255-92, 2018 (with M. Rostek and G. Sublet).

Testing Pareto efficiency and competitive equilibrium in economies with public goods. We characterize the nonparametric testable implications of Pareto efficiency and competitive equilibrium in economies with public goods, with and without warm-glow preferences, using mixed integer programming. Compared with tests based on the Tarski-Seidenberg algorithm, our tests are linear with respect to real and integer variables, and therefore applicable to real data with multiple individuals and multiple observations. Monte Carlo simulation shows our tests can be implemented within reasonable time and have reasonable power when individual consumption can be (partially) observed. *Journal of Mathematical Economics* 75, 19-30, 2018 (with X. Song).

Non-parametric analysis of multi-product oligopolies. This paper develops revealed preference tests for multi-product oligopoly markets. We first analyze a Cournot model with multiple goods and show that it has testable restrictions when at least one good is produced by two or more firms. We also develop a revealed preference test for Bertrand oligopoly in a setting where each firm produces a single differentiated good and the prices charged by different firms are strategic complements. *Economic Theory* 57, 253-77, 2014 (with R. Deb, J. Fenske and J. Quah).

On refutability of the Nash bargaining solution. Empirical tests of the Nash bargaining solution are developed in this paper, under different hypotheses about

the behaviour of disagreement utility levels. *Journal of Mathematical Economics* 50, 177-186, 2014 (with N. González).

Revealed preference tests of the Cournot model. The aim of this paper is to develop revealed preference tests for Cournot equilibrium. The tests are akin to the widely-used revealed preference tests for consumption, but have to take into account the presence of strategic interaction in a game-theoretic setting. The tests take the form of linear programs, the solutions to which also allow us to recover cost information on the firms. To check that these nonparametric tests are sufficiently discriminating to reject real data, we apply them to the market for crude oil. *Econometrica* 81, 2351-79, 2013 (with R. Deb, J. Fenske and J. Quah).

Competition in financial innovation. This paper examines the incentives offered by frictionless markets for innovation in asset-backed securities. Assuming homogeneous preferences across investors and heterogeneous risk-sharing needs, and allowing for short-selling of securities, we characterize economies in which competition provides insufficient incentives to innovate so that, in equilibrium, asset markets are incomplete in all (pure strategy) equilibria, even when innovation is essentially costless. Thus, the paper provides an alternative to Allen and Gale's (1991) classical foundation for endogenous market incompleteness. *Econometrica* 80, 1895-936, 2012 (with M. Rostek and M. Weretka).

No-arbitrage, state prices and trade in thin financial markets. Assuming that potential arbitrage is conducted by a few highly specialized institutional investors who recognize and estimate the impact of their trades on financial prices, we apply a model of economic equilibrium in which price effects are determined endogenously as part of the equilibrium concept. For the case in which markets allow for perfect insurance, we argue that the principle of no-arbitrage asset pricing is consistent with non-competitive behavior of the arbitrageurs and extend the fundamental theorem of asset pricing to the non-competitive setting. *Economic Theory* 50, 223-68, 2012 (with M. Weretka).

Idiosyncratic risk and financial policy. In economies subject to uninsurable idiosyncratic risks, competitive equilibrium allocations are constrained inefficient: we argue that, typically, reallocations of assets support Pareto superior allocations. This is the case even if the asset market for the allocation of aggregate risks is complete, and importantly, holds in two period exchange economies as well as in economies with production and in economies of overlapping generations. *Journal of Economic Theory* 146, 1569-97, 2011 (with H. Polemarchakis).

The testable implications of competitive equilibrium in economies with externalities. If one has a data set consisting of prices and individual endowments of the economy, Brown and Matzkin (*Econometrica*, 1996) have shown that there are conditions that the data have to satisfy, if they are determined by the competitive equilibrium process, when there are no external effects in the economy. Here, I argue that the same conclusion does not apply if the economy exhibits externalities. On the other hand, some restrictions exist if there exist at least

two commodities on which preferences are weakly separable; and, importantly, restrictions exist when the externalities are in the form of a public good. *Economic Theory* 45, 349-78, 2010.

Statistical calibration: a simplification of Foster's proof. Foster (Games and Economic Behavior, 1999) gave a proof of the Calibration Theorem of Foster and Vohra (Biometrika, 1998), using Blackwell's Approachability Theorem. This note presents a simplified version of Foster's argument. *Mathematical Social Sciences* 58, 272-7, 2009.

On the existence of equilibrium with incomplete markets. We provide a simple proof of the existence of equilibrium in an incomplete financial markets economy with numéraire assets, under the assumption that asset returns are non-negative. Furthermore, we relax the strict monotonicity assumption on preferences and as an application we prove the existence of equilibrium when agents may disagree on zero probability events but do not plan to go bankrupt in any state. *Brazilian Review of Econometrics* 28, 239-47, 2008 (with J. Geanakoplos and A. Riascos).

Identification of Pareto-improving policies: information as the real invisible hand. Even in cases in which, due to a market failure, the social outcome implied by competitive markets is Pareto inefficient, the burden faced by a policy maker in the implementation of a Pareto superior allocation may be insurmountable, due to the informational requirements one such policy imposes: finite sets of market data may not suffice to determine Pareto-improving policies, in the sense that they can be consistent with two sets of economic fundamentals such that if a policy is Pareto-improving in one set, it leaves at least one individual worse off in the other. *Journal of Mathematical Economics* 44, 167-79, 2008 (with H. Polemarchakis).

Identification of individual demands from market data under uncertainty. Even under incomplete markets, the competitive equilibrium manifold identifies individual demands everywhere in their domains. Under partial observation of the manifold, we determine maximal subsets of the domains on which identification holds. As a by-product, we develop some duality theory under incomplete markets. *The B.E. Journal of Theoretical Economics (Topics)* 8, art 9, 2008 (with A. Riascos).

Individually-rational collective choice. There is a collection of exogenously given socially-feasible sets, and, for each one of them, each individual in a group chooses from an individually-feasible set. The fact that the product of the individually-feasible sets is larger than the socially-feasible set notwithstanding, there arises no conflict between individual choices. Assuming that individual preferences are random, this paper characterizes rationalizable collective choices. *Theory and Decision* 62, 355-74, 2007.

Identification of preferences from market data. Under complete markets, the competitive equilibrium manifold identifies individual demands in a unique

manner, which in turn suffices for the identification of individual preferences. The argument used in this paper weakens some of the assumptions made in existing work, and hence offers a stronger and cleaner result. *Advances in Theoretical Economics* 5, art. 3, 2005 (with A. Riasco).

Testable restrictions on the equilibrium manifold under random utility. Brown and Matzkin (*Econometrica*, 1996) show the existence of testable restrictions on the equilibrium manifold, under the assumption that individual preferences are invariant. I consider the Brown–Matzkin problem under random preferences: if for each profile of endowments one observes a distribution of prices, does there exist a probability distribution of preferences that explains the observed distributions of prices via Walrasian equilibria? I argue that even under random utilities general equilibrium theory is falsifiable. *Journal of Mathematical Economics* 40, 121-43, 2004.

SURVEYS

“Equilibrium behavior in markets and games: testing and identification,” *Journal of Mathematical Economics* 40, 1-40, 2004 (with I. Ray and S. Snyder).

“Preferences,” in W. Darity (Ed.) *IESS Encyclopedia*, 435-7, 2008.

“Manifolds,” in W. Darity (Ed.) *IESS Encyclopedia*, 585-6, 2008.

“Demand,” in W. Darity (Ed.) *IESS Encyclopedia*, 268-71, 2008.

BOOKS

“Essential mathematics for economic analysis,” Pearson Education, 2016 (with P. Hammond, K. Sydsæter and A. Strøm).

“Matemáticas para economía,” Pearson Education, 2012 (in Spanish, with P. Hammond and K. Sydsæter).

“Further mathematics for economic analysis,” forthcoming, (with P. Hammond, K. Sydsæter, A. Seierstad and A. Strøm).

SERVICE

Editor, *Journal of Mathematical Economics*, 2020–

North-American Standing Committee, The Econometric Society, 2016 – 2019.

Co-chair, North-American Summer Meetings, The Econometric Society, 2018.

Co-editor (Economic Theory), *Canadian Journal of Economics*, 2015 – 2017.

Co-organizer, Canadian Economic Theory Conference (Western, 2015).

Associate Editor, *Journal of Mathematical Economics*, 2012 – 2015.

ESRC Research Seminars Competition Panel, 2011 – 2012.

Co-organizer, ESRC Games and Economic Behavior Group (LSE–UCL–Warwick), 2010 – 2012.

ESRC Review College, 2011 – 2013.

Scientific Committee, XXXVI Simposio de la Asociación Española de Economía, SAEe, 2011 and 2012.

Scientific Committee, XVI, XX and XXI European Workshop on General Equilibrium (Warwick, 2007; Vigo, 2011; Exeter, 2012).

Scientific Committee, Dauphine Workshop on Economic Theory (Paris, 2010).

Session organizer, SAET Conference on Current Trends in Economics, 2007, 2009, 2011 and 2016.

Scientific Committee, Latin American Meeting of the Econometric Society, 2007, 2008 and 2016.

Guest Editor, *Journal of Mathematical Economics* issue on the General Equilibrium Conferences of 2007.

Editor, *Ensayos Sobre Política Económica*, 2003 – 2004.

Referee for *AEJ: Microeconomics*, *American Economic Review*, *BEPress Journals on Theoretical Economics*, *Econometrica*, *Economic Theory*, *Economics Letters*, *Games and Economic Behavior*, *International Economic Review*, *Journal of Economic Theory*, *Journal of Economic Dynamics and Control*, *Journal of Mathematical Economics*, *Mathematical Reviews*, *Mathematical Social Sciences*, *Quantitative Economics Review of Economics and Statistics*, *Review of Economic Studies*, *Theoretical Economics* and *Theory and Decision*.

DISTINCTIONS Member, GRES São Clemente, ranked 8th in the Special Category, Samba Parades of the 2015 Carnival of Rio de Janeiro.

Graduate Professor of the Year, Department of Economics, University of Western Ontario, 2014.

Abramson Award for Exceptional Dissertation, Brown University, 2002.

Volunteer of the Year, The Nature Conservancy, Rhode Island Field, 1999.

Letter of Congratulation, Universidad de los Andes, for “having obtained the highest GPA during the last 20 years in the Master’s program in economics,” 1996.

Honorary Mention, Universidad Javeriana, “for obtaining the highest GPA during the history of the undergraduate program in economics,” 1995.