

Peter Bossaerts

T: +61.3.903.53257/+61.40.8187672 E: peter.bossaerts@unimelb.edu.au

Brain, Mind and Markets Laboratory
 Room 12.040
 198 Berkeley Street
 Parkville, VIC 3010

Laboratory web site: <http://fbe.unimelb.edu.au/finance/bmmlab>

Honors

Fellow of *The Econometric Society* (Elected 2010)

Fellow of *The Society for the Advancement of Economic Theory* (Elected 2011)

Redmond Barry Distinguished Professor at *The University of Melbourne* (Elected 2016)

Academic Appointments – Primary

Professor, Experimental Finance & Decision Neuroscience, <i>The University of Melbourne</i>	2014 –
Honorary Professorial Fellow, <i>The Florey Institute of Neuroscience and Mental Health</i>	2014 –
David Eccles Professor of Finance & Adjunct Professor of Neurology, <i>University of Utah</i>	2013 – 2015
William D. Hacker Professor of Economics and Management, <i>Caltech</i>	2003 – 2013
Swiss Finance Institute Professor, <i>EPFL</i>	2007 - 2012
Professor of Finance, <i>Caltech</i>	1998 – 2013
Associate Professor of Finance, <i>Caltech</i>	1994 - 1998
Research Professor of Investments Analysis, <i>Tilburg University</i>	1994 - 1996
Assistant Professor of Finance, <i>Caltech</i>	1990 - 1994
Assistant Professor of Finance, <i>Carnegie Mellon University</i>	1987 - 1990

Academic Appointments – Secondary

Visiting Associate in Finance, <i>Caltech</i>	2013 – 2017
Visiting Professor, <i>Cambridge University</i>	2012 - 2014
Honorary Professorial Fellow, <i>University of Melbourne</i>	2012 – 2013
Fellow, <i>UTS Market Design Centre</i>	2014 -
Research Fellow, <i>Centre for Economic Policy Research</i>	1995 – 2014
Fellow, <i>University of Zurich Center for Engineering Social and Economic Institutions</i>	2012 - 2014
Affiliate, <i>USC Theoretical Research in Neuroeconomic Decision Making (TREND)</i>	2012 –
Member of the <i>Computation and Neural Systems</i> faculty, <i>Caltech</i>	2006 – 2013
Swiss Finance Institute Visiting Professor, <i>University of Lausanne</i>	2006 – 2007
Fellow, <i>Center of Excellence, Kobe University</i>	2006
Guest Professor, <i>University of Zurich</i>	2004
Leif Johansen Distinguished Visiting Scholar, <i>Norwegian School of Management</i>	1999
Visiting Associate Professor of Finance, <i>Yale University</i>	1998
Postdoctoral Research Fellow, <i>Carnegie Mellon University</i>	1986 – 1987

**Academic
 Appointments
 – Executive**

Director, *R. and M. Linde Institute of Economic and Management Sciences, Caltech* 2011-12
 Co-Dean, *College of Management, EPFL* 2008
 Founding Program Chair, Master in Financial Engineering, *EPFL* 2007-8
 Chair, Division of The Humanities and Social Sciences, *Caltech* 2006-7
 Executive Officer for the Social Sciences, *Caltech* 2002-5

**Industry
 Experience**

Executive Education, Behavioral Finance, *Foundation William E. Simon Graduate School of Business Administration in Switzerland* 2015 -
 Advisory Board, *Dysrupt Labs (Melbourne, Australia)* 2017 -

Education

Ph.D. (Management), *UCLA* 1983 – 1986
 Coursework, Master's Program in Statistics, *Free University Brussels* 1982 – 1982
 Doctorandus (Applied Economics), *UFSIA (Summa Cum Laude)* 1981 – 1982
 Licentiaat (Applied Economics), *UFSIA (Cum Laude)* 1977 – 1981

Grants

National Science Foundation, for the project "Price Quality in Dark Markets: Tests of the Duffie-Malamud-Manso Theory Using Controlled Experiments," 2014-6, with Elena Asparouhova (University of Utah)
 National Science Foundation, for the project "Workshop for the Promotion of Experimental Validation of the Theory of Asset Pricing," 2014-5, with Elena Asparouhova (University of Utah)
 Fondation Banque de France, for the project "Price Quality in Dark Markets," 2014-5, with Elena Asparouhova (University of Utah)
 National Science Foundation, for the project "US-German Collaboration: Computational and Neural Mechanisms of Inference over Decision-Structure," 2012-15, joint with John O'Doherty (Caltech) and Jan Gläscher (University Medical Center Hamburg).
 National Science Foundation, for the project "Market Bubbles As Expression Of Social Norms: Experiments," 2011-13, Grant #SES-1061824, with Elena Asparouhova (University of Utah)
 Swiss National Science Foundation, for the SystemX.ch project "Neural Correlates of Collective Decision Making: From Molecules to Minds," 2008-12 (co-PI)
 Swiss National Science Foundation, NCCR Firisk 3rd Phase, for the project "Behavioural Finance," 2008-13 (with Ernst Fehr and Thorsten Hens)
 AXA Foundation Grant For A Postdoctoral Student, 2006-8.
 Inquire Europe, for the project "Will Equilibrium-Induced Predictability Survive Undoing By The Uninitiated And Skeptical?" 2006-8.
 Co-Principal, Tamagawa University-Caltech Center of Excellence grant
 Moore Foundation grant to Caltech, for the project "Experimentation with Large, Diverse and Interconnected Socio-Economic Systems," 2006-11.
 National Science Foundation, for the project "Experiments on Information and Information Processing in Financial Markets," 2006-11, Grant #SES-0616431, with Elena Asparouhova (University

of Utah) and William Zame (UCLA)

National Science Foundation, for the project "How Asset Markets Assist Complex Problem Solving: Identifying The Cues Through Neurocorrelates," 2005-2010, Grant #SBE-0527491

National Science Foundation, for the project "The Evolution of Prices and Allocations in Markets: Theory and Experiment," 2003-2006, Grant #SES-0317715, with William Zame (UCLA)

National Science Foundation, for the project "Perfectly Rational Markets, Imperfectly Rational Traders: Theory and Experiment," 2000-2003, Grant #SES-0079374, with William Zame (UCLA)

Grant to support research on financial markets from the R.G. Jenkins Family Fund of the Fidelity Investments Charitable Gift Fund, 2000

Research Grant from State Street Bank to Caltech for the Proposal "Assessing The Severity of the Absence of 'Packaging' Possibilities At the NYSE Open," 1999

Research Grant, "Participation of Boundedly Rational Agents in Financial Markets: Effects on Speculation, Trading Volume and Price Volatility," European Union, Grant #ERB4001GT950936, 1995-6

Grant, "Local Parametric Analysis of Hedging In Discrete Time," Royal Dutch Academy of Sciences, 1995.

Research Grant from First Quadrant to Caltech for the Proposal "Forecasting Non-Stationary Financial Return Data," August 93-July 94

Standard Oil Research Chair Award, Summer 1987

Awards

2014 Pagano and Zechner Prize for Best Non-Investments Article Published in the Prior Year in the Review of Finance, for: "The Speed of Information Revelation and Eventual Price Quality in Markets with Insiders: Comparing Two Theories"

Doctoral Faculty 2014 Teaching Excellence Award, David Eccles School of Business, University of Utah

Best Paper Award, Behavioral Finance and Capital Markets Conference, Centre for Applied Financial Studies of The University of Adelaide, August 2013, for: "'Lucas' in the Laboratory"

Lloyd's Science of Risk 2011 Prize for "Hedging your bets by learning about reward correlations in the human brain," published in *Neuron*

Review of Finance 2004 Goldman Sachs Asset Management Best Research Paper Award for the paper "Basic Principles of Asset Pricing Theory: Evidence From Large-Scale Experimental Financial Markets"

Journal of Financial Markets 2003 Best Paper Award for the paper "Excess Demand and Equilibration in Multi-Security Financial Markets: The Empirical Evidence"

Mathematical Finance 1993 Best Paper Award (Third Prize) for the paper "A Test of a General Equilibrium Stock Option Pricing Model"

Keynote Lectures – Past Seven Years Only

"Human Reaction To Leptokurtosis and Its Biological Foundations," *2017 Conference of the Association for NeuroPsychoEconomics*, Antwerp (Belgium).

"How Do Humans Perceive Financial Risks?" *2017 North-American Meetings of the Society for Experimental Finance*, Tucson AR (USA).

"Neuro-biological Foundations of Financial Market Psychology," *Sixth Behavioural Finance and Capital Markets Conference*, Adelaide (Australia), September 2016

"Using Alpha to Generate Alpha," *CIFR Conference on Investment Management and Markets*, Sydney (Australia), May 2016.

"Neuro-biological Foundations of Financial Market Psychology," *Auckland Finance Meeting*,

December 2015

"Human Reaction To Leptokurtosis and Its Biological Foundations," *Australasian Society for Cognitive Science, Monash University, December 2014*

"Human Reaction To Leptokurtosis and Its Biological Foundations," *Financial Management Association European Meetings, Maastricht (The Netherlands), June 2014*

"Outlier Risks," *Third Behavioral Finance and Capital Markets Conference, Adelaide (Australia), August 2013*

"Outlier Risks," *World Meetings of the Economic Science Association, Zurich, July 2013*

"The Neurobiology Behind Human Decision Making," *2013 Finance Down Under Conference, Melbourne (Australia), March 2013*

"The human brain behind financial skill," *Joint Symposium, National Taiwan University, National Chengchi University, National Yang-Ming University, Taipei (Taiwan), March 2012*

"The human brain behind financial skill." *Second Miami Behavioral Finance Conference, December 2012*

"The human brain behind financial skill." *Swiss Finance Institute Annual Meeting, November 2011*

"Double-Sided Markets," *C-Suite Lunch Talk, Australian Graduate School of Management, University of New South Wales, April 2011*

"Neurobiological Foundations of Decision Making under Uncertainty," *Finance Down Under, University of Melbourne, March 2011*

"Experimental Finance," *Finance Down Under, University of Melbourne, March 2011*

"Market Bubbles and Crashes as an Expression of Tension between Social and Individual Rationality: Theory and Experiments," *WISE International Workshop on Experimental Economics and Finance, Xiamen University, China, December 2010*

"Experiments on Market Dynamics," *Experimental Finance 2010 Conference, University of Gothenburg, Sweden, October 2010*

"What Decision Neuroscience Teaches Us about Financial Decision Making," *Marian Miner Cook Athenaeum Lecture, Claremont McKenna College, March 2010*

"Neuroscience and Decision Making," at: *A Birdseye View of Finance: Past, Present, and Future Frontiers, Conference organized in honor of Haim Levy, Jerusalem, August 2009*

"Experimenting With Financial Markets," *Austrian Central Bank, June 2009*

"Strategic Uncertainty In Games and Markets: A Neuroeconomic Perspective," at: *5th International Meeting On Experimental And Behavioral Economics, Granada (Spain), April 2009*

"Potential Policy Implications of Neuroeconomics," at: *The Social Brain, symposium organized by the Royal Academy of Arts, Manufacture and Commerce (RSA) and the Wellcome Trust, London, January 2009*

"Decision Making under Uncertainty: Risk and Risk Learning," *Building Bridges in Medical Sciences, Cambridge University Medical School, November 2008*

"The Neuroeconomics of Decision Making," *World Economic Forum, Geneva, September 2008.*

"Neurobiological Foundations of Perception and Decision under Uncertainty," *2008 International Economic Science Association Conference, California Institute of Technology, June 2008*

"Neurobiological Foundations of Perception and Decision under Uncertainty," *Fourth Asia Pacific Meeting of the Economic Science Association, National University of Singapore, February 2008*

"Neurobiological Foundations of Perception and Decision under Uncertainty," *9th Biennial Symposium "Neuroeconomics: Decision Making and the Brain," New York University Center for Neural Science, January 2008*

"The Neuroeconomics of Decision Making," *30th Annual Meeting of Japan Neuroscience Society,*

September 2007

"The Neuroeconomics of Decision Making," *Second ESA Asia-Pacific Regional Meeting, Osaka (Japan)*, February 2007

Engagement

Workshop for the Promotion of Experimental Validation of the Theory of Asset Pricing, Sundance Resort, Utah, October 2015; co-organiser (with Elena Asparouhova); workshop funded by the U.S. National Science Foundation, Fondation Banque de France, a grant from the Moore Foundation to Caltech, and The University of Utah.

Society for Neuroeconomics, President (2011-2), Board member (2007-2014), Council member (2015-16)

Society for Experimental Finance, President (2016-7), Founding member (2011)

Co-Editor: Review of Finance (2005-2009)

Ad-hoc Acting Editor: Journal of Finance

Ad-hoc Acting Editor: Proceedings of The National Academy of Sciences (PNAS)

Associate Editor: Review of Financial Studies (1994-7), *Journal of Financial Markets* (1997-), *Journal of Financial Econometrics* (2001-2012), *Mathematical Finance* (2002-5), *Review of Finance* (2003-5; 2009-), *Annals of Finance* (2004-2007), *Foundations and Trends in Economic Theory* (2006-), *Journal of Neuroscience, Psychology and Economics* (2009-11), *Algorithmic Finance* (2010-), *Frontiers in Decision Neuroscience* (2010-), *Journal of Finance* (2015-)

Referee: American Economic Review, The American Journal of Psychiatry, Behavioral and Brain Sciences, Cerebral Cortex, Cognition, Current Biology, Econometrica, Economic Journal, Economics Letters, Economic Theory, European Economic Review, Finance, Frontiers in Behavioral Neuroscience, Frontiers in Decision Neuroscience, International Economic Review, Journal of The American Statistical Association, Journal of Business, Journal of Business and Economic Statistics, Journal of Econometrics, Journal of Economic Behavior and Organization, Journal of Economic Dynamics and Control, Journal of Empirical Finance, Journal of Experimental Psychology, Journal of Finance, Journal of Financial Economics, Journal of Financial and Quantitative Analysis, Journal of International Money and Finance, Journal of Money, Credit and Banking, Journal of Neuroscience, Psychology, and Economics, Journal of Political Economy, Management Science, Nature Neuroscience, NeuroImage, Neuron, PLoS (Biology; Computational Biology; Neuroscience and Psychiatry), Philosophical Transactions B of the Royal Society (Biological Sciences), Proceedings of the National Academy of Sciences, Psychological Science, Rand Journal of Economics, Review of Economics and Statistics, Review of Economic Studies, Review of Financial Studies, Science, Utah Winter Finance Conferences, Western Finance Association, Miami Behavioral Finance Conferences.

Neuroeconomics Symposium, Co-Organizer (APESA, Singapore, February 2008)

Neuro-Finance Symposium, Co-Organizer (Zurich, Switzerland, July 2007)

European Neuroeconomics Association, Member of the Scientific Council (2009-)

European Finance Association, Director, Executive Committee, 2010-12

Economic Science Association, Officer (Section Head, Finance; 2004-2005)

American Finance Association, member of the 2002 & 2016 Nominating Committees

Financial Management Association, Member of the Doctoral Consortium mentoring advanced Ph.D. students (2015)

Member of Review Panels (Committees of Experts), European Research Council Advanced Grants (2008-9); National Science Foundation (2010-12).

Reviewer of Grant Applications: national (U.S., Canada, Switzerland, U.K, Belgium, France, Germany) and international (European Union) public and private (e.g., AXA) foundations, including the U.S. NIH

Member: American Finance Association, Association for Psychological Science, Econometric Society, Economic Science Association, European Finance Association, Society for Neuroeconomics, Society for Neuroscience, Society for the Promotion of Financial Studies, Western Finance Association

**Asset Pricing
 Theory –
 Articles**

1. "Common Nonstationary Components of Asset Prices," *Journal of Economic Dynamics and Control* 12 (1988), 347-364.
2. "A General Equilibrium Model of Changing Risk Premia: Theory and Tests," with Richard C. Green, *Review of Financial Studies* 2 (1989), 467-493.
3. "A Test of a General Equilibrium Stock Option Pricing Model," with Pierre Hillion, *Mathematical Finance* 3 (1993), 311-347.
4. "Transaction Prices When Insiders Trade Portfolios," *Finance* 14 (1993); Summary appeared in *Journal of Finance* 48 (1993), 1069-1070.
5. "Tax-Induced Intertemporal Restrictions on Security Returns," with Robert Dammon, *Journal of Finance* 49 (1994):, 1347-1372.
6. "Asset Prices and Volume in a Beauty Contest," with Bruno Biais, *Review of Economic Studies* 65 (1998), 307-340; Summary appeared in *Journal of Finance* 49 (1994), reprinted in *Advances in Financial Modeling*, B. Biais and M. Pagano, eds., Oxford University Press, 2001.
7. "Speculative Behavior and the Functioning of Financial Markets: Discussion," (in Spanish), *Moneda y Credito* 200 (1995), 39-44.
8. "Expectations and Learning in Iowa," with Oleg Bondarenko, *Journal of Banking and Finance* 24 (2000), 1535-1555.
9. "An Exploration of Neo-Austrian Theory Applied To Financial Markets," with Harald Benink, *Journal of Finance* 54 (2001), 1011-1028.
10. "An Optimal IPO Mechanism," with Bruno Biais and Jean-Charles Rochet, *Review of Economic Studies* 69 (2002) 117-146.
11. "Filtering Returns for Unspecified Biases in Priors when Testing Asset Pricing Theory," *Review of Economic Studies* 70 (2003), 1-24.
12. "Asset Trading Volume in Infinite-Horizon Economies with Dynamically Complete Markets and Heterogeneous Agents: Comment," with William Zame, *Finance Research Letters* 3 (2006), 96-101.
13. "Prices and Allocations in Financial Markets: Theory, Econometrics, and Experiments," with Charles Plott and William Zame, *Econometrica* 75 (2007), 993-1038.
14. "Modeling Price Pressure in Financial Markets," with Elena Asparouhova, *Journal of Economic Behavior and Organization* 72 (2009), 119-130.
15. "Equilibrium Asset Pricing Under Heterogeneous Information," with Bruno Biais and Chester Spatt, *Review of Financial Studies* 23 (2010), 1503-43.
16. "Ambiguity in Asset Markets: Theory and Experiment," with Paolo Ghirardato, Serena Guarnaschelli and William Zame, *Review of Financial Studies* 23 (2010), 1325-59.
17. "Competition in Portfolio Management: Theory and Experiment," with Elena Asparouhova, Jernej Copic, Brad Cornell, Jaks Cvitanic and Debrah Meloso, *Management Science* 61 (2015), 1868-1888.
18. "Asset Pricing and Asymmetric Reasoning," with Elena Asparouhova, Jon Eguia and William Zame, *Journal of Political Economy* 123 (2015), 66-122.

**Asset Pricing
 Theory –
 Books**

1. *The Paradox of Asset Pricing* (Princeton: Princeton University Press, 2002; Paperback version appeared 2005; Asian version appeared 2007).
2. *Lecture Notes in Corporate Finance*, with Bernt Arne Ødegaard (Singapore: World Scientific

Publishing, 2001; Second, Revised Edition 2007).

**Asset Pricing
 Theory –
 Working
 Papers**

1. "Has the Cross-Section of Average Returns Always Been The Same? Evidence from Germany, 1881-1913," with Caroline Fohlin, Caltech Social Science Working Paper 1084: 2000.
2. "Rational Expectations Equilibria When Priors are Inconsistent," 1998 – In preparation for submission to *Critical Finance Review*.
3. "Arbitrage-Based Pricing When Volatility is Stochastic," with Eric Ghysels and Christian Gouriéroux, October 1997.
4. "Price Formation in Continuous Double Auctions, with Implications for Finance," with Elena Asparouhova and John Ledyard, 2011 (presented at 2009 SAET Conference, Ischia, Italy; presented at the Australian School of Business, University of New South Wales; revise-and-resubmit).
5. "Voting to ensure existence and Pareto-optimality of insurance and loan markets," with Michèle Itten (2009) (SURF project Summer 2011).
6. "Market Bubbles and Crashes as an Expression of Tension between Social and Individual Rationality: An Experiment," with Elena Asparouhova, and Anh Tran, 2013 (presented at the 2010 Conference in Experimental Finance, Gothenburg, Sweden, keynote presentation at the 2010 Conference in Experimental Economics and Finance, Xiamen, China, and presented at UCLA, the University of Technology Sydney and the University of Utah).
7. "Using Alpha To Generate Alpha," with Wenhao Yang, 2015.

**Experimental
 Finance –
 Articles**

1. "Price Discovery in Financial Markets: The Case of the CAPM," with D. Kleiman, and C. Plott, in Charles R. Plott, *Collected papers on the Foundations of Experimental Economics and Political Science: Information, Finance and General Equilibrium*, vol. 3, Edwin Elgar Publishers, 2004.
2. "Experiments With Financial Markets: Implications For Asset Pricing Theory," *The American Economist*, Spring 2001. Reprint in *Shifting Paradigms, New Directions in Economics*, Cambridge, UK: Cambridge University Press (2004).
3. "The CAPM in Thin Experimental Financial Markets," with Charles Plott, *Journal of Economic Dynamics and Control* 26 (2002), 1093-1112.
4. "Inducing Liquidity in Thin Financial Markets Through Combined-Value Trading Mechanisms," with Leslie Fine and John Ledyard, *European Economic Review* 46 (2002), 1671-95.
5. "Excess Demand and Equilibration In Multi-Security Financial Markets: The Empirical Evidence," with Elena Asparouhova and Charles Plott, *Journal of Financial Markets* 6 (2003), 1-22.
6. "Basic Principles of Asset Pricing Theory: Evidence From Large-Scale Experimental Financial Markets," with C. Plott, *Review of Finance* 8 (2004), 135-169.
7. "Asset Pricing," in *Handbook of Experimental Economics Results*, Charles R. Plott and Vernon L. Smith, eds., Amsterdam: North-Holland (2008).
8. "From Market Jaws to the Newton Method: The Geometry of How a Market Can Solve Systems of Equations," with Charles R. Plott; in *Handbook of Experimental Economics Results*, Charles Plott and Vernon L. Smith, eds, Amsterdam: North-Holland (2008).
9. "Risk Aversion in Laboratory Asset Markets," with William Zame, in: *Risk Aversion in Experiments*, Ed. J. Cox and G. Harrison, Greenwich, CT: JAI Press, Research in Experimental Economics, (12), 2008.
10. "Promoting Intellectual Discovery: Patents vs. Markets," with Jernej Copic and Debrah Meloso, *Science*, 323 (2009), 1335-1339.
11. "The Experimental Study of Asset Pricing Theory," *Foundations and Trends in Finance* 3 (2009), 289-361.
12. "Excessive Volatility Is Also A Feature Of Individual Level Forecasts," with A. Nursimuli, *Journal of*

Behavioral Finance 15 (2014), 16-29.

13. "The Speed of Information Revelation and Eventual Price Quality in Markets with Insiders," with Cary Frydman and John Ledyard, *Review of Finance* 18 (2014), 1-22.
14. "Lucas In The Laboratory," with Elena Asparouhova, Nilanjan Roy and William Zame, *Journal of Finance* 71 (2016) 2727-2780.
15. "Experiments on Percolation of Information in Dark Markets," with Elena Asparouhova, *The Economic Journal*, in press.

**Experimental
 Finance –
 Working
 Papers**

1. "Prices and Allocations in Dynamically Complete Markets: Experimental Evidence," with Debrah Meloso and William Zame, 2013 (Caltech SURF project Summer 2011).
2. "Gauging Financial Market Participants' Awareness of Imperfect Foresight," with Debrah Meloso, Wenhao Yang and William Zame, 2015
3. "Perception of Intentionality in Investor Attitudes towards Financial Risks," with S. Suzuki and J. O'Doherty, working paper, 2015.

**Decision
 Neuroscience
 – Articles**

1. "Neural Differentiation of Expected Reward and Risk in Human Subcortical Structures," with Kerstin Preuschoff and Steve Quartz, *Neuron* 51 (2006), 381-390.
2. "The Role of Ventromedial Prefrontal Cortex in Abstract State-Based Inference During Decision Making in Humans," with Alan Hampton and John O'Doherty, *The Journal of Neuroscience* 26 (2006), 8360-8367.
3. "Adding Prediction Risk to the Theory of Reward Learning," with Kerstin Preuschoff, *Annals of the New York Academy of Sciences* 1104 (2007), 135-146.
4. "Neural Antecedents of Financial Decisions," with B. Knutson, *Journal of Neuroscience* 27 (2007), 8174-8177.
5. "Towards a Mechanistic Understanding of Human Decision Making: Contributions of Functional Neuroimaging," with J. O'Doherty, *Current Directions in Psychological Science* (Special Issue on The Interface Between Neuroscience and Psychological Science), 17 (2008).
6. "Human Insula Activation Reflects Risk Predictions Errors As Well As Risk," with Kerstin Preuschoff and Steve Quartz, *Journal of Neuroscience*, 28 (2008), 2745-2752.
7. "Markowitz in the Brain?" with Kerstin Preuschoff and Steve Quartz, *Revue d' Economie Politique* 2008, 75-96.
8. "Investigating Signal Integration with Canonical Correlation Analysis of fMRI Brain Activation Data," with A. Bruguier, K. Preuschoff and S. Quartz, *NeuroImage* 41 (2008), 35-44.
9. "Neural Correlates of Mentalizing-Related Computations During Strategic Interactions in Humans," with A. Hampton and J. O'Doherty, *Proceedings of the National Academy of Sciences* 105 (2008), 6741-6746.
10. "The Neurobiological Foundations of Valuation in Human Decision Making under Uncertainty," with Ming Hsu and K. Preuschoff, in: *Neuroeconomics: Decision Making and the Brain*, Ed. P.W. Glimcher, C.F. Camerer, E.Fehr, R.A. Poldrack, New York: Academic Press (2008).
11. "Neurobiological Studies of Risk Assessment: A Comparison of Expected Utility and Mean-Variance Approaches," with M. d'Acromont, *Journal of Cognitive, Affective and Behavioral Neuroscience* 8 (2008), 363-374.
12. "Explicit Neural Signals Reflecting Reward Uncertainty," with W. Schultz, K. Preuschoff, C. Camerer, M. Hsu, C.D. Fiorillo, and P. Tobler, *Philosophical Transactions of the Royal Society B: Biological Sciences* 363 (2008), 3801-3811.
13. "Predicting Risk in a Multiple Stimulus - Multiple Reward Environment," with Mathieu d'Acromont and Manfred Gilli, in: *Reward And Decision Making*, ed. J.C. Dreher and L.

- Tremblay, Academic Press (2009).
14. "Encoding of marginal utility across time in the human brain," with A. Pine, B. Seymour, J. Roiser, K. Friston, H.V. Curran and Ray Dolan, *Journal of Neuroscience* 29 (2009), 9575-9581.
 15. "Decision Making in Financial Markets," in: *Encyclopedia of Neuroscience*, Eds. L. Squire, T. Albright, F. Bloom, F. Gage and N. Spitzer, Elsevier (2009).
 16. "Neural Correlates of Value, Risk and Risk Aversion Contributing to Decision Making under Risk," with G. Christopoulos, P. Tobler, R. Dolan and W. Schultz, *Journal of Neuroscience* 29 (2009), 12574-83.
 17. "What Decision Neuroscience Teaches Us About Financial Decision Making," *Annual Review of Financial Economics* 1 (2009), 383-404. Reprinted in: *Biological Economics*, Andrew W. Lo and Ruixun Zhang, eds., Edward Elgar, 2016.
 18. "Exploring the Nature of Trading Intuition," with Antoine Bruguier and Steve Quartz, *Journal of Finance*, 65 (2010), 1703-23.
 19. "Risk and Risk Prediction Error Signals in Anterior Insula," *Brain Structure and Function* 214 (2010) 645-653.
 20. "A Behavioral and Neural Evaluation of Prospective Decision-Making under Risk," with Mkael Symmonds and Ray Dolan, *Journal of Neuroscience* 30 (2010), 14380-9.
 21. "Risk, Unexpected Uncertainty, and Estimation Uncertainty: Bayesian Learning in Unstable Settings," with Elise Payzan, *PLoS Computational Biology* 7 (2011), e1001048.
 22. "MAOA-L carriers are better at making optimal financial decisions under risk," with Cary Frydman, Antonio Rangel and Colin Camerer, *Proceedings of The Royal Society B: Biological Sciences* 278 (2011), 2053-2059.
 23. "The Impact of Disappointment in Decision Making: Inter-Individual Differences and Electrical Neuroimaging," with H el ene Tzieropoulos, Rolando Grave de Peralta and Sara L. Gonzalez, *Frontiers in Human Neuroscience* 4 (2011), 1-19.
 24. "Positive temporal dependence of the biological clock implies hyperbolic discounting," with Debajyoti Ray, *Frontiers in Decision Neuroscience* 5 (2011); Reprinted in: *The Neurobiology of Choice*, Daeyeol Lee, Paul Glimcher, Julia Trommersh user. Frontiers Media SA (Frontiers Research Topic Ebook), 2012.
 25. "The Affective Impact of Financial Skewness on Neural Activity and Choice," with C. Wu and B. Knutson, *PLoS One* 6 (2011), e16838.
 26. "Differentiable Contributions of Human Amygdalar Subregions in the Computations Underlying Reward and Avoidance Learning," with C. Pr evost, J.A. McCabe, R.K. Jessup and J. O'Doherty, *European Journal of Neuroscience* 2011 (34), 1-12 (featured article).
 27. "The human prefrontal cortex mediates integration of potential causes behind observed outcomes," with Klaus Wunderlich, Ulrik Beierholm and John O'Doherty, *Journal of Neurophysiology* 106 (2011), 1558-1569.
 28. "Separate Encoding of Intuition-Based and Reason-Based Subjective Valuations In The Human Brain," with Ulrik Beierholm, Cedric Anen and Steven Quartz, *NeuroImage* 2011 (58), 955-62.
 29. "Hedging your bets by learning about reward correlations in the human brain," with Klaus Wunderlich, Mkael Symmonds and Ray Dolan, *Neuron* 2011 (71), 1141-52.
 30. "Risk, Unexpected Uncertainty, and Estimation Uncertainty: Bayesian Learning in Unstable Settings," with Elise Payzan-LeNestour *PLoS Computational Biology* 7 (2011), e1001048.
 31. "Do not Bet on The Unknown Versus Try To Find Out More: Estimation Uncertainty and 'Unexpected Uncertainty' Both Modulate Exploration." with Elise Payzan-LeNestour, *Frontiers in Decision Neuroscience* 6 (2012), 150.
 32. "Decision Making: How The Brain Weighs The Evidence," with M. d'Acremont, *Current Biology* 2012 (22), 1641-48 (Dispatch).

33. "Activity in inferior parietal and medial prefrontal cortex signals the accumulation of evidence in a probability learning task," with M. d'Acremont and E. Fornari, *PLoS Computational Biology* 2013.
34. "Evidence for model-based computations in the human amygdala during Pavlovian conditioning," with Charlotte Prévost, Dan McNamee, Ryan Jessup and John O'Doherty, *PLoS Computational Biology* 9 (2013), e1002895.
35. "The Neural Representation of Unexpected Uncertainty During Value-Based Decision Making," with Elise Payzan-LeNestour, Simon Dunne and John O'Doherty, *Neuron* 79 (2013), 191-201.
36. "In the Mind of the Market: Theory of Mind Biases Value Computation During Financial Bubbles," with Benedetto de Martino, John O'Doherty, Deb Ray and Colin Camerer, *Neuron* 19 (2013), 1222-1231.
37. "The Human Brain Encodes Event Frequencies While Forming Subjective Beliefs," with Mathieu d'Acremont and Wolfram Schultz, *Journal of Neuroscience* 33 (2013), 10887-10897.
38. "The Chronometry of Risk Processing in the Human Brain," with Mkael Symmonds, Rosalyn Moran, Nicholas Wright, Gareth Barnes, and Ray Dolan, *Frontiers in Decision Neuroscience* 7 (2013), 146.
39. "Using neural data to test a theory of investor behaviour: An application to realization utility," with Cary Frydman, Nick Barberis, Colin Camerer and Antonio Rangel, *Journal of Finance* 69 (2014), 907-46.
40. "Risk and Reward Preferences Under Time Pressure," with A. Nursimulu, *Review of Finance* 18 (2014), 999-1022.
41. "Experienced chimpanzees behave more game-theoretically than humans in simple competitive interactions," with Christopher Flynn Martin, Rahul Bhui, Tetsuro Matsuzawa and Colin Camerer, *Nature Scientific Reports* 4 (5 June 2014): 5182.
42. "Learning About Unstable, Publicly Unobservable Payoffs," with Elise Payzan-LeNestour, *Review of Financial Studies* 28 (2015), 1874-1913.
43. "Value-based choices reveal probability distortion in macaque monkeys," with William Stauffer, Armin Lak, and Wolfram Schultz, *Journal of Neuroscience* 35 (2015), 3146-3154.
44. "Neural mechanisms underlying human consensus decision-making," with Shinsuke Suzuki, Ryo Adachi, Simon Dunne, and John O'Doherty, *Neuron* 86 (2015), 591-602.
45. "From Behavioral Economics To Neuroeconomics To Decision Neuroscience: The Ascent of Biology in Research on Human Decision Making," with Carsten Murawski, *Current Opinion in Behavioral Sciences* 5 (2015), 37-42.
46. "Modeling the evolution of beliefs using an attentional focus mechanism," with Dimitrije Markovic, Jan Glöschner, John O'Doherty and Stefan J. Kiebel, *PLoS Computational Biology* 11.10 (2015): e1004558.
47. "Human reaction to leptokurtic noise and its neurobiological foundations," with Mathieu d'Acremont, *Cerebral Cortex* 26 (2016), 1818-30.
48. "Social contagion during learning about others' risk preferences is associated with modulation of the neural perception of risk but not expected value," with Shinsuke Suzuki, Emily Jensen, and John O'Doherty, *Proceedings of The National Academy of Sciences* 113 (2016), 3755-60.
49. "How Humans Solve Complex Problems: The Case of The Knapsack Problem," with Carsten Murawski, *Scientific Reports* (2016), 6:34851.

**Financial
 Econometrics
 – Articles**

1. "Market Microstructure Effects of Government Intervention in the Foreign Exchange Market," with Pierre Hillion, *Review of Financial Studies* 4 (1991), 513-541.
2. "The Econometrics of Learning in Financial Markets," *Econometric Theory* 11 (1995), 151-189.
3. "Testing the Mean Variance Efficiency of Well-Diversified Portfolios in Very Large Cross-Sections," with Pierre Hillion, *Annales d'Economie et Statistique* 40 (1995), 93-124.
4. "A New Method for Volatility Estimation with Applications in Foreign Exchange Rate Series," with Wolfgang Härdle and Christian Hafner, in *Finanzmarktanalyse und -prognose mit innovativen quantitativen Verfahren*, G. Bol, G. Nakhaeizadeh and K.-H. Vollmer, eds., 71-84, Physica Verlag, 1996.
5. "Exchange Rates Have Surprising Volatility," with Christian Hafner and Wolfgang Härdle, in *Time Series Analysis, in memory of Ted Hannan*, P.M. Robinson and M. Rosenblatt, eds., 2:55-72, Springer Verlag, 1996.
6. "Martingale-Based Hedge Error Control," with Bas Werker, in *Numerical Methods in Financial Mathematics*, C. Rogers and D. Talay, eds., Cambridge University Press, 1996.
7. "Local Parametric Analysis of Hedging in Discrete Time," with Pierre Hillion, *Journal of Econometrics* 81 (1997), 243-272.
8. "Implementing Statistical Criteria to Select Return Forecasting Models: What Do We Learn?" with Pierre Hillion, *Review of Financial Studies* 12 (1999), 405-428.
9. "IPO Post-Issue Markets: Questionable Predilections But Diligent Learners?" with Pierre Hillion, *Review of Economics and Statistics* 83 (2001), 1-15.
10. "Local Parametric Analysis of Derivatives Pricing," with Pierre Hillion, *Journal of Financial Markets* 6 (2003), 573-605

**Financial
 Econometrics
 – Working
 Papers**

1. "A Theorem On (Certain Kinds Of) Out-of-Sample Prediction Tests in Finance," 1996.
2. "On the Power of the Gibbons-Ross-Shanken Test of Optimality of a Portfolio," with Debrah Meloso, 2009.
3. "MDL-Based Variable Lookback Algorithm and Application To Finance," with Lionel Coulot and Martin Vetterli, 2015, *under review*.

**Development
 of Instruments**

1. *jMarkets* 1.0 (2005), 1.5 (2006), 2.0 (2008): Scientific project supervisor; *jMarkets* is a pure-Java, J2EE-compliant open-source software tool to run large-scale internet-based experiments with multiple interconnected markets (source and binary code published at <http://jmarkets.ssel.caltech.edu>); joint with Walter Yuan, Raj Advani and William Zame.
2. U.S. Patents 7,853,514 (Issued: 12/14/2010) and 8,386,370 (Issued: 2/26/2013): *Method and Apparatus For Providing A Market Environment*, with Walter Yuan and Raj Advani.
3. *Flex-E-Markets* (2007-): Scientific project supervisor; "software-on-demand" tool for flexible and easy deployment of internet-based double-sided markets on low-end private computer systems; www.flexemarkets.com
4. *DG* (2014-): Software suite for standalone, online and phone-based games in behavioral finance and neuroeconomics using the Unity platform (uleef.business.utah.edu/games/)

**PhD Advisees
 and Postdocs**

- PhD students (first appointments in parentheses):
 - *Economics & Finance*: Kaoru Kato (McKinsey), Oleg Bondarenko (University of Illinois), Serena Guarnaschelli (McKinsey), Elena Asparouhova (University of Utah), Debrah Meloso (Bocconi University), Ming Hsu (UC Berkeley), Nilanjan Roy (City University of Hong Kong), Cary Frydman (USC), Wenhao Yang (University of Southern Carolina)

- *Decision Neuroscience*: Kerstin Preuschoff (EPFL), Ulrik Beierholm (University of Birmingham), Antoine Bruguier (Google), Alan Hampton (McKinsey), Klaus Wunderlich (Ludwig Maximilians Universitaet Munich), Elise Payzan (University of New South Wales), Anjali Nursimulu (EPFL), Yutaka Kayaba (University of Tokyo)
- Postdocs (some co-mentored; first appointment in parentheses):
 - *Decision Neuroscience*: Kerstin Preuschoff (University of Geneva), Ulrik Beierholm (University of Birmingham), Mathieu d'Acremont (Northwestern University), Charlotte Prévost (Columbia University), Yutaka Kayaba (University of Tokyo)

February 28, 2017