

Rene Carmona

Mean Field Games: Where do we Stand 7 Years Later

The presentation will discuss the progress made since the introduction of Mean Field Games by Lasry and Lions in 2006, and the simultaneous proposal of Nash Certainty Equivalent by Caines, Huang and Malhame. I will review some of the economic and engineering applications touted as proofs of success of the theory, as well as the remaining mathematical and numerical challenges.

Youngna Choi

Financial Instability Contagion: quantitative definition and mechanism

We use an agent-based dynamical system of wealth for the global economy to investigate and analyze financial crises, which we model as propagation of a negative shock on wealth due to the breakage of a financial equilibrium. Then we formulate and give a quantitative definition of instability contagion in terms the *market instability indicator*, an early warning signal defined as the spectral radius of the Jacobian matrix of the wealth dynamical system. Finally, we analyze the mechanism of instability contagion for both single and multiple economies. Our contribution is to provide a methodology to quantify and monitor the level of instability in chosen sectors and stages of a structured global economic model and how it may propagates between its components.

Michael Dempster

The True Cost of OTC Derivatives

Since the breakdown in the early 70's of the postwar Bretton Woods fixed exchange rates and the achievements of Black, Scholes and Merton in obtaining a satisfactory theory of option pricing almost simultaneously, banking globally has undergone sweeping transformations at an ever increasing rate. After briefly surveying financial market developments from 1980 to the present, the role of structured over-the-counter derivatives in this advance will be examined in some detail. Previous extensive technical consultancy to leading banks on structured derivative products has been followed since the crisis by expert witness work for clients -- individual, commercial and governmental -- who have purchased these OTC products to their cost. This recent and ongoing experience has been an eye opener which I shall detail with numerous real examples. The presentation will go on to discuss our pricing methodology for these examples and close with comments on the evolving global regulation of structured OTC derivatives.

Raphael Douady

A Non-cyclical Capital Adequacy Rule and the Aversion of Systemic Risk

We present in this note a method for computing the regulatory capital of financial institutions, along with the Basel Committee requirements, which avoids the pitfalls of

the Value-at-Risk and, in particular, the fact that - as observed during 2008 crisis - it aggravates systemic risk rather than preventing it. The computation is based on stress testing, with the following principles: (i) market scenarios are defined by the regulator; (ii) sensitivities are estimated by each institution, as well as the impact of scenarios defined by the regulator and reported to it; (iii) the regulator not only counts the number of violations of the risk reporting but also their size; (iv) the regulatory capital is a multiple of the worst stress test, where the multiplier depends on the size and the frequency of the violations. By letting the institutions estimate their sensitivities to extreme market shifts, the regulator not only avoids a costly burden, but also keeps institutions responsible for their reporting. On the other hand, by keeping control on the list of stress tests involved in the computation of the capital, the regulator offers itself a very strong lever to prevent speculative bubbles, by making them costly in terms of capital requirements.

Corrado Di Guilmi

Macroeconomic Instability and Microeconomic Financial Fragility: a Stock-flow Consistent Approach with Heterogeneous Agents

The 2008 financial turmoil itself, and the process of de-leveraging by the private sector observed in the following years, have drawn the attention to the crucial role of credit as a factor leading both to the instability of the system and to a strengthening of real-financial linkages in the economy. This view was central to the work of Hyman Minsky, who stressed the systemic effects of financial fragility at the micro-level.

In this context, the paper introduces heterogeneous microeconomic behavior into a demand-driven stock-flow consistent model. The distinctive feature is in that the aggregation of heterogeneous agents is not performed numerically as in traditional agent-based models but by means of an innovative analytical methodology, originally developed in statistical mechanics and recently imported into macroeconomics. This approach is particularly suitable to microfound stock-flow consistent models, since it is able to endogenously derive the macro-equations and the dynamics of flows from the microeconomic behavioral rules, without imposing ad-hoc constraints.

The proposed framework has two main objectives. First, the closed-form solution will present the analytical links between the financial micro-variables and the macroeconomy, in order to study the joint dynamics of leverage, income distribution and aggregate production.

Second, the theoretical structure can assess the effects of the interaction between leverage dynamics and income inequality, by studying the shift of households between classes of income along the business and leverage cycle.

Hans Follmer

The Coin-Tossing View of Finance: Successes, Pitfalls, and Exercises in Mathematical Humility

For a long time, the "Coin-Tossing View of Finance" (J. Cassidy), characterized by the reliance on probabilistic models driven by Brownian motion or Levy processes, has been widely perceived as a great success story. We mention some of the successes, but our focus will be on the pitfalls. These include strong framing effects, the resulting control illusion, the crucial issue of model ambiguity or "Knighting Uncertainty", and some more fundamental questions concerning the role of Probability in Finance that were already raised by B. de Finetti. From a mathematical point of view, Knightian uncertainty suggests that "we need to have some humility" (A. Greenspan), but it should also be seen as a rich source of new mathematical challenges. We discuss some of them, including probability-free approaches to some classical problems in Mathematical Finance and the analysis of capital requirements and preferences in terms of monetary risk measures.

Jean-Pierre Fouque

Mean Field Games and Systemic Risk

We propose a simple model of inter-bank borrowing and lending where the evolution of the log-monetary reserves of N banks is described by a system of diffusion processes coupled through their drifts in such a way that stability of the system depends on the rate of inter-bank borrowing and lending. Systemic risk is characterized by a large number of banks reaching a default threshold by a given time horizon. Our model incorporates a game feature where each bank controls its rate of borrowing/lending to a central bank. The optimization reflects the desire of each bank to borrow from the central bank when its monetary reserve falls below a critical level or lend if it rises above this critical level which is chosen here as the average monetary reserve. Borrowing from or lending to the central bank is also subject to a quadratic cost at a rate which can be fixed by the regulator. We solve explicitly for Nash equilibria with finitely many players, and we show that in this model the central bank acts as a clearing house, adding liquidity to the system without affecting its systemic risk. We also study the corresponding Mean Field Game in the limit of large number of banks in the presence of a common noise.

Scott Fullwiller

Stimulus vs. Buffer Stocks--What Can Currency Sovereignty Teach Us About Monetary and Fiscal Policies?

Lane Hughston

Social Discounting and the Long Rate of Interest

The well-known theorem of Dybvig, Ingersoll and Ross shows that the long zero-coupon rate can never fall. This result, which although undoubtedly correct has been regarded by

many as counterintuitive and even pathological, stems from the implicit assumption that the long-term discount function has an exponential tail. We revisit the problem in the setting of modern interest rate theory, and show that if the long simple interest rate (or Libor rate) is finite, then this rate (unlike the zero-coupon rate) acts viably as a state variable, the value of which can fluctuate randomly in line with other economic indicators. New interest rate models are constructed, under this hypothesis, that illustrate explicitly the good asymptotic behaviour of the resulting discount bond system. The conditions necessary for the existence of such hyperbolic long rates turn out to be those of so-called social discounting, which allow for long-term cash flows to be treated as broadly as those of the short or medium term. As a consequence, we are able to provide a consistent arbitrage-free valuation framework for the cost-benefit analysis and risk management of long-term social projects, such as those associated with sustainable energy, resource conservation, space exploration, and climate change.

This is based on joint work with Dorje C. Brody (Brunel University).
Paper available at arXiv:1306.5145

Paul Jenkins

Reflections of a Policy-Maker on the Design and Use of Macroeconomic Models

The global financial crisis exposed the multifaceted nature of the way in which financial and economic shocks were felt, especially the very different experiences of advanced economies and emerging market economies in terms of the channels of transmission. For emerging market economies traditional trade channels were the dominant source of transmission. For advanced economies, it was financial linkages that provided a stronger explanation for the scale of the downturn in economic activity.

These financial linkages and interdependencies revealed by the crisis bring to light complexities in analyzing the transmission of shocks as well as the scale of those shocks. This adds a critically new dimension to what we need to understand in the development of our analytic tools, including the economic models used for policy analysis.

These remarks will provide a perspective on macroeconomic models and their usefulness for policy purposes, including the directions of model development post the financial crisis. One theme of these remarks will be the importance of understanding the evolutionary nature of model development.

Stephanie Kelton

Fiscal Space and Financial Instability: A Differential Analysis

Alan Kirman

The Crisis in Economic Theory: Have we Made a Journey Down the Wrong Road

Starting from the widely misrepresented paradigm of Adam Smith's "invisible hand" and following on from the work of Walras and Pareto we have developed a more and more sophisticated set of models based on the vision of isolated optimising individuals who interact only through the market. These models have as equilibria states which are efficient. Although it is claimed that economies self organise in this way this is something we have not shown. Sonnenschein Mantel and Debreu pointed out why we cannot do so in this framework.

But what if we start with the opposite view, that the economy has, as its central feature, the direct interaction between its actors and its components, that it is a complex evolving system that externalities are not just inconvenient frictions and that it will have endogenous crises like the latest one that we are living through? I will argue that we have been hamstrung by the wrong benchmark model and that the mathematical methods that we have used to model this are not appropriate for analysing the economic reality with which we are faced. Help from other disciplines such as statistical physics, computer science, biology, sociology and psychology is welcome.

Marc Lavoie

Convergence Towards the Normal Rate of Capacity Utilization in Kaleckian Models: the Role of Autonomous Non-capacity Creating Autonomous Expenditures.

Kaleckian models of growth and distribution have been highly popular among heterodox economists. Two drawbacks of these models have however been underlined in the literature: first, the models do not usually converge to their normal rate of capacity utilization; second, the models do not include the Harrodian principle of dynamic instability. Some Sraffian economists have long been arguing that the presence of non capacity creating autonomous expenditures provides a mechanism that brings back the model to normal rates of capacity utilization, while safeguarding the main Keynesian message and without going back to classical conclusions. The present paper provides a very simple proof of this, showing that the Harrodian principle of dynamic instability gets tamed by the presence of autonomous consumer expenditures.

Blake LeBaron

Key Components in Agent-based Financial Markets

There are a wide range of styles for building agent-based financial markets. It is often difficult to understand which pieces are essential in building reasonable models of market interactions and agent learning. This talk will present several components that I believe make intuitive sense for agent behavior, and are essential to generating reasonable price and volume dynamics. These include behavior that encompasses multiple memory horizons in the use of past information, along with dynamic adaptation to changes in

market risk. I will argue that any move to more stylized analytic approaches should at least incorporate these pieces.

Oliver Linton

Evaluating the Effects of Market Fragmentation on Market Quality using Panel Data

Andrew Lo

Origin of Behavior

Dilip Madan

Two-price Economies

Two price economies arise when market clearing fails leaving the market exposed to residual risk. Financial market valuation operators in such economies, in the absence of arbitrage, turn out to be nonlinear martin-gales. The new nonlinear valuation methodology leads, in particular, to new approaches for designing portfolios, constructing hedges, investing in options, designing risk sensitive capital, while simultaneously providing new insights into the management of corporate entities and for the financial accounting of economic activity. The talk will briefly introduce the structure of nonlinear martingales and their connection to two price economies and will then move on to highlight the various applications that have already been made.

Pia Malaney

From Neoclassical Mechanics to Economic Field Theory

If there is to be something specific meant by 'New Economic Thinking' we must ask what its mathematics will be. An argument is advanced that it should allow for dynamic, uncertain, behavioral populations of heterogeneous agents, and that these considerations suggest that the toolkit we are seeking is an economics based on field theory. Far from making economics artificially like physics, the approach seeks to allow a view of agents more in line with insights from the theory of selection by using field theoretic geometric formalism in a way that is natural to the economics of prices, quantities, beliefs and desires of both populations and individuals under dynamic uncertainty.

Perry Mehrling

Beyond Monetary Walrasianism: Five Key Features of Modern Monetary Systems

Mario Seccareccia

Banking Sector Viability and the Public Purse: Is There a Link between Public Sector Balances and Banking Sector Economic Performance?

The banking sector's behaviour was critical to what happened during the financial crisis and, which led to the eventual bailout of important financial institutions. Yet, at budget time, banking sector analysts are often the first to applaud austerity measures. The irony of this has been quite obvious to many observers since the financial crisis. However, the question to be addressed is whether these benefits that are derived from the public purse in support of the financial sector were the result of the very exceptional circumstances of the financial crisis or if this relationship between public sector spending and banking sector performance is systemic in nature. The object of this analysis is to try to delineate and sort out empirically the link between banking sector profitability and public sector budgetary net spending by means of some econometric exercises.

Peter Skott

Fiscal Policy in an Unstable Economy

Steady - growth models can be used to derive sets of fiscal parameters that are consistent with continuous full employment; this analysis can show how the resulting trajectory for debt depends on, inter alia, the growth rate of the economy and the structure of taxes (Ryoo and Skott 2013). This paper extends the analysis to examine non - steady growth. We analyze different 'fiscal policy rules' and their implications for the stability properties of the economy. Using a setting with Harrodian instability and a simple government sector, we show how appropriate fiscal policy rules in which government spending and/or tax rates are adjusted in response to utilization and employment gaps can solve the instability problem and bring the warranted growth rate into line with the natural rate. By contrast, the adjustment of fiscal instruments to attain a pre - specified target of the debt ratio aggravates the Harrodian instability.

Didier Sornette

Financial Bubbles with Finite-Singularity Models and their Calibration

We report recent advances on the calibration of financial bubbles, defined as transient super-exponential stochastic price trajectories that reflect positive feedbacks. The results include advanced methods of calibration to address the quasi-degenerate or soft-mode problem in the estimation procedure, the FTS-GARCH model (finite-time singularity GARCH) and the use of self-consistent rational expectation bubble models with stochastic finite-time singularities. We also present results of the Financial Crisis Observatory (www.er.ethz.ch/fco) at ETH Zurich, which aims at testing and quantifying rigorously, in a systematic way and on a large scale the hypothesis that financial bubbles can be diagnosed with a rigorous scientific methodology before they burst.

Leigh Tesfatsion

Situated Mathematics: Agent-Based Test Beds for Mathematics in Practice

In US centrally-managed wholesale power markets operating over AC transmission grids, the market rules of operation include the particular procedures followed by the central manager to solve complicated bid/offer-based "optimal power flow" (OPF) problems for a day-ahead market organized as a double auction subject to system constraints. In purely mathematical terms, the OPF is a highly constrained nonlinear mixed integer programming problem.

The problem is that market participants, acting perfectly in accordance with the market rules, yet motivated by their own particular objectives, might be able to game the rules in their favor by submitting bids/offers that deviate from their true buy/sell reservation values. Such gaming can reduce overall system efficiency and reliability. The key point is that the "best" formulation and approximate solution of the OPF from a purely mathematical point of view might not work so well in practice. We are therefore using the AMES Wholesale Power Market Test Bed to explore the performance of alternative OPF formulations under systematically varied conditions.

The more general idea is that applied mathematics is important for critical social problems, not just for physical/engineering problems. Examples include assurance of reliable energy delivery, a resilient financial system, an effective climate change response, prevention of disease diffusion, and so forth. Clearly the effectiveness of the applied math procedures proposed for social problems should be measured from a system-wide social welfare point of view, which means that the possible behavioral responses of the people comprising the system must be taken into account.

Since (typically) we cannot experiment on actual social systems, this suggests an important role for agent-based computational test beds able to incorporate institutional, physical, and behavioral aspects of social systems. The institutional aspects can include a variety of applied mathematics processes, e.g., sorting routines, search algorithms, risk assessment methods, optimization routines, and voting rules for the aggregation of expressed preferences. The test bed permits the overall social welfare implications of these mathematical processes to be tested in situ.

Eric Tymoigne

Modeling Financial Fragility: A Minskian Approach

The Financial Instability Hypothesis (FIH) focuses on the inner working of capitalist economies to explain the recurrence of a potential debt-deflation. During long periods of economic prosperity that may record small recessions, the risk of debt-deflation (financial fragility) grows as businesses aimed at maintaining their profitability, mostly positive information feeds into credit models, and policy makers aim at fine-tuning the business cycle. In the FIH, the emphasis is not on bubbles, manias, declining net worth and profit, fraud, or rising default to explain the growing financial fragility. There maybe no asset-price bubble, rising profit, rising net worth, and declining profit but a growing financial fragility. The emphasis of the FIH is on the means used to service debts and the changes in underwriting expectations away from income-based lending toward asset-based

lending. Hedge finance involves no expectation that refinancing and asset liquidation will be needed to service debts. Ponzi finance involves expectations of growing refinancing and/or asset liquidation at rising prices to be able to service debts.

Roberto Veneziani

Keynesian DSGD(isequilibrium) Modelling: A Basic Model of Real-Financial Market Interactions with Heterogeneous Opinion Dynamics

We consider an alternative modelling approach to the mainstream DSGE paradigm, namely a Dynamic Stochastic General Disequilibrium (DSGD) baseline model of continuous, more or less gradual adjustment processes on interacting real and financial markets. We introduce heterogeneous capital gain expectations (chartists and fundamentalists) in place of rational expectations and show that the first type of agents tends to destabilise the economy. Global stability can be ensured if opinions favour fundamentalist behaviour far off the steady state. This interaction of expectations and population dynamics is bounding the potentially explosive real-financial market interactions with chartist expectation formation, but can enforce irregular behaviour within these bounds when the dynamics is dominated by fundamentalist behavior far off the steady state (at least in the downturn). The size of output and share price fluctuations can be reduced however by imposing suitably chosen policy measures on the dynamics of the private sector.

Eric Weinstein

Towards a Mathematics of New Economic Thinking for Reflexive Markets: A Natural Economic Connection on Preference Bundles over the Taste-Time Continuum

The mathematics of movement is bound up in differential equations. In order to define a dynamic field theory which is both natural and truly economic, one is naturally lead to seek endogenous differential operators which are intrinsically market based to play a role analogous to the heat and wave operators which give physics its dynamic character. We show that there appears to be a unique such differential 'welfare operator' over spaces of preferences that can be constructed directly from Engels curves alone. All other such operators form a natural vector space suggesting the possibility of endogenous welfare measures. This opens the door to a possible mathematical interpretation of reflexivity where minds move markets and markets curve minds by allowing fields (or sections) to interact with gauge potentials (connections) as is commonly considered in both differential geometry and mathematical physics.

Randall Wray

The Nature of Money: A system of Credits and Debts