Centro Franco Argentino de Altos Estudios
Universidad de Buenos Aires

Seminario de Posgrado - 32 horas

Del 18 al 29 de abril de 2016.
De 19 a 22hs. Facultad de Ciencias Económicas. (Aulas detalladas por día)

"Lectures on complexity in Economics"

Profesor invitado
Pr. Alan KIRMAN
(Université Aix Marseille- EHESS)

Profesoranfitrión
Pr. Daniel HEYMANN
(FCE-UBA)

Syllabus

This series of lectures has its origins in the book entitled "Complex Economics: Individual and Collective Rationality" I published in 2010. The main objective is to argue that the current crisis has put into sharp relief the incapacity of our modern theoretical models and, in particular our macroeconomic models to provide an adequate explanation of the sudden and large changes that take place in the economy. The course will provide an account of how we have come to be locked into models which have been declared by former Governor Trichet of the European Central Bank, by Lord Turner, the Director of the Financial Services Authority in the U.K. and Governor Bernanke of the Federal Reserve Board to be useless in times of crisis. They have called for new approaches and this course will provide an opening to such approaches and will draw on the lessons to be learned from other disciplines, such as statistical physics, biology, and the neurosciences. The main theme, using various economic examples, will be to argue that the basic problem has been to treat the economy as if the aggregate behaved like a (representative) individual.

As in other disciplines we have to recognize that aggregate phenomena, although derived from the interaction between individuals, do not have the same characteristics as those of individuals. Such systems, referred to as complex adaptive systems, have a dynamic of their own which may pass through abrupt changes without any exogenous shock. This theme has a long history in economics but its most eloquent advocate in recent times has been Thomas Schelling.

The standard explanations for the crisis given by those responsible for making economic policy invoke three themes, contagion, networks and trust, yet none of these has a place in modern macroeconomics. Yet they are features of complex adaptive systems, of systems of interacting particles, of social insects, of networks of neurons and of epidemic diseases for example. The economy should be considered as a complex adaptive system in which the agents constantly react to, influence and are influenced by, the other individuals in the economy. The message of the course is that coordination rather than efficiency is the central problem in economics. How do the myriads of individual choices and decisions come to be coordinated? How does the economy or a market, "self organise" and how does this sometimes result in major upheavals, or to use the phrase from physics, "phase transitions"? The sort of system described in this course is not in equilibrium in the standard sense, it is constantly changing and moving from state to state and its very structure is always being modified.

In this course we will examine examples including Schelling's model of segregation, contributions to public goods, the evolution of buyer seller relations in fish markets, to financial models based on the foraging behaviour of ants. In particular we shall analyse some simple models which capture the way in which large scale movements emerge from the interaction between individuals who may not themselves be very important players in the economy.

ESTRUCTURA DEL SEMINARIO

PRIMER BLOQUE: PROF. ALAN KIRMAN (Université Aix Marseille-EHESS)

Lunes 18 de abril: Lecture 1 (AULA 31)

This lecture will be devoted to examining the basic foundations of modern theoretical economics. Starting from the observation that the current crisis was not forecast because it was not even possible within our standard models, we will then examine the road that has led us to this point.

- The history of economic theory from Walras to Arrow Debreu

- The switch from the idea of establishing relations between macroeconomic variables to the desire to found economic models on sound scientific principles, i.e on the behaviour of rational optimising but isolated individuals
- The idea of equilibrium and its relevance to the empirical evolution of the economy
- The fundamental theorems of welfare economics
- The problems of stability and uniqueness ; the destructive results of Sonnenschein Mantel and Debreu
- The problem of aggregation; dealing with the heterogeneity of individuals.
- The appearance of the « representative individual » in macroeconomics.
- The problem of the direct interaction between individuals
- Game theory its insights and its limitations.
- The rationality assumptions, are they based on the observation of behaviour or on the introspection of economists?
- The influence of behavioural economics.
- Agent basedmodels
- Lessonsfrom social insects
- Rational expectations and itsproblems
- Self organisation: Do markets self organise and if so do they achieve an optimal state?
- The importance of coordination as opposed to efficiency.

Readings lecture 1

- Foellmer, H. (1974) 'Random economies with many interacting agents', Journal of Mathematical Economics, 1: 51–62.
- Kirman, A. (1992) 'Whom or what does the representative individual represent?' Journal of Economic Perspectives, 6 (2): 117–36.
- Kirman, A. (2006) 'Demand theory and general equilibrium: From explanation to introspection, a journey down the wrong road', History of Political Economy, 1 (38, suppl. 1): 246–80
  Kirman A, (2011)"Walras' Unfortunate Legacy"(Chapter 11 in Pascal Bridel (ed) *General Equilibrium Analysis: A Century after Walras*Abingdon, Routledge.

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<u>Martes 19 de abril</u>: Lecture 2 (AULA 113)

This lecture will be devoted to examining how the way in which individuals interact influences economic outcomes. In most theoretical models little is said about who trades with whom, who communicates with whom and who sets prices for example.
We will examine the consequences of direct interaction. Then we will examine the role of the networks which govern that interaction and how these networks evolve. Wewill look atbothdeterministic and stochasticnetworks.

- The role of networks in the crisis. Haldane's analysis
- The interaction of simple individuals can produce sophisticated results: some examples.
- The interaction of apparently rational individuals may not generate results which are "collectively rational". Someexamples.
- Economics and sociology: two very different approaches to the relationships between individuals.
- The role of networks in economic analysis. The notion of local interaction and of "neighbours"
- Given graph structures and their consequences.
- The importance of certain characteristics: connectivity and diameter for example
- Stochastic interaction with a given graph of relations.
- The dynamics of interaction on a fixed graph. Contagion and diffusion
- Stochastic graphs: in this case the graph itself is a random variable. Connectivity in random graphs.
- The emergence of networks; the choice of links to create or to destroy
- Strategicchoice of links
- Emerging random graphs: the probabilities of links evolve over time
- An example: buyer seller networks.
- The identification problem
- The highly concentrated network of ownership of Transnational Corporations
- Clustering in networks. The example of citations.

Readings lecture 2

- Goyal, S. (2007) Connections: An introduction to the economics of networks, Princeton, NJ: Princeton University Press.
- Haldane, A. (2009) 'Rethinking the financial network', Bank of England, Speech delivered at the Financial Student Association, Amsterdam.
- Haldane, A and May, R 2011, 'Systemic risk in banking ecosystems', Nature, Vol. 469, pages 351–55.
- Jackson, M. (2008) Social and economic networks, Princeton, NJ: Princeton University Press.
- Kirman, A., C. Oddou and S. Weber (1986) 'Stochastic communication and coalition formation', Econometrica, 54 (January): 129–38.
- Manski, C. (1995), Identification Problems in the Social Sciences, Cambridge Mass., Harvard University Press,
- VitaliStefania, James B. Glattfelder, and Stefano Battiston 2011 "The Network of Global Corporate Control". PLoS ONE 6(10): e25995. doi:10.1371/journal.pone.0025995

<u>Miércoles 20 de abril:</u> Lecture 3 (AULA 306)

In this lecture we will deal with markets as institutions and how their structure and organisation impinges on the allocations that they achieve. The main point here being that we cannot talk reasonably about market outcomes if we do not really specify how markets organise the interactions between the market participants. But this is largely absent from the theoretical literature. Following on from Douglas North's remark, –"It is a peculiar fact that the literature on economics…contains so little discussion of the central institution that underlies neoclassical economics—the market." (North, 1977, p.710) and the same thing is echoed by Coase, –"Although economists claim to study the market, in modern economic theory the market
itself has even a more shadowy role than the firm" (Coase, 1988, p.7).

We will take a rapid look at some well known historical and anthropological studies of markets, Claire de Ruyt's study of the agora in ancient Rome, its functioning, its structure and its rules.

John Padgett's study of some markets in Florence, his comparison of the differences between the markets for wool and silk Clifford Geertz's study of North African souks Theodore Bester's study of Tsukiji, the Tokyo fish market.

Mitchel Abolafia's study of Bond traders on Wall Street, Making Markets.

In particular we will concentrate on markets for perishable goods and a special example of these, fish markets which have a long history in the economic literature and for which we have a lot of empirical data.

- Fish markets: historical background
- The Marseille fish market: the data (every transaction over three years) pairwise negotiation and no posted prices
- Marketproperties and individualbehavior
- Market organisation and its impact on price dispersion
- Price-quantity relations and their relation to "demand"
- A full-blown game theoretic approach??
- An approach in which agents follow simple behavioural rules
- The emergence of loyalty and trading relationships: a little formal analysis and some empirical evidence
- The Ancona fish market: 3 simultaneous Dutch auctions.
- Comparison with the results from Marseille.
- Otherperishablegoodsmarkets.

Readings lecture 3

- Gallegati Mauro, Gianfranco Giulioni, Alan Kirman, Antonio Palestrini (2011) "What's that got to do with the price of fish? Buyers behavior on the Ancona fish market" Journal of Economic Behavior and Organisation,Volume 80, Issue 1, Pages 20-33
- Gianfranco Giulioni, Edgardo Bucciarelli (2011) "Agents' ability to manage information in centralized markets: Comparing two wholesale fish markets" Journal of Economic Behavior and Organisation,Volume 80, Issue1, Pages 34-49

- Graddy, K. and G. Hall (2011) 'A dynamic model of price discrimination and inventory management at the Fulton fish market', Journal of Economic Behaviour and Organization, Volume 80, Issue 1, Pages 6-19
- Haerdle,W. andA.Kirman(1995)'Non-classical-demand:A model-free examination of price quantity relations in the Marseille fish market', Journal of Econometrics, 67: 227–57.
- Kirman, A. and N. Vriend (2001) 'Evolving market structure: A model of price dispersion and loyalty', Journal of Economic Dynamics and Control, 25: 459–502.
- Rauch, J. and A. Casella (eds) (2001), Networks and markets, New York: Russell Sage Foundation.
- SapioSandro, Alan Kirman, Giovanni Dosi (2011), "The emergence and impact of market institutions: The wholesale market for fish and other perishable commodities" Journal of Economic Behavior and Organisation,Volume 80, Issue 1, Pages 1-5
- VignesAnnick, Jean-Michel Etienne (2011), "Price formation on the Marseille fish market: Evidence from a network analysis", Journal of Economic Behavior and Organisation,Volume 80, Issue 1 Pages 50-67
- Weisbuch, G., A. Kirman and D. Herreiner (2000) 'Market organisation and trading relationships', Economic Journal, 110: 411–36
- Working E. J. (1927) 'What do statistical "demand curves" show?' Quarterly Journal of Economics, 212–35.

<u>Jueves 21 y viernes 22 de abril</u>: Lectures 4 and 5 (AULA 31 y 113 respectivamente)
These will be devoted to financial markets. We will take a look at the foundations of modern financial economics and in particular the extent to which those foundations are solid. We will also examine the role of financial networks and the problem of the fragility of interbank and international financial networks. Once we move away from the idea of a large anonymous market which processes all information efficiently we can see how phenomena of contagion and of bubbles and crashes can occur. We will examine examples of models in which agents switch between the rules that they use depending on the success of those rules and will show how this can lead to the sudden collapse of markets.

Readings lectures 4 and 5

- Anand, K., A. Kirman and M. Marsili (2010), ''Epidemics of Rules, Information Aggregation Failure and Market Crashes' European Journal of Finance (forthcoming).
- Banerjee, A. (1992) 'A simple model of herd behaviour', Quarterly Journal of Economics, 108: 797–817
- Bikhchandani, S., D. Hirschleifer and I. Welch (1998) 'Learning from the behavior of others: Conformity, fads, and informational cascades', Journal of Economic Perspectives, 12: 151–70.
- Chamley, C. (2004) Rational herds, Cambridge: Cambridge University Press.

- Foellmer, H., U. Horst and A. Kirman (2005) 'Equilibria in financial markets with heterogeneous agents: A probabilistic perspective', Journal of Mathematical Economics, Elsevier, 41: 123–55.
- Keynes J.M. (1912), « Review of Louis BacheliersCalcul des Probabilités », Review of the Royal Statistical Society, Décembre, réédité en Collected Articles of John Maynard Keynes, Macmillan and Cambridge University Press, 1983
- Kirman, A. (1993) 'Ants, rationality and recruitment', Quarterly Journal of Economics, 10108: 137–56.
- Mandelbrot, B. and R. L. Hudson (2004), The (Mis)behavior of Markets: A Fractal View of Risk, Ruin, and Reward, Basic Books, New York.
- Woodford, M. (1990) 'Learning to believe in sunspots', Econometrica, 58 (2): 277–307.

<u>Lunes 25 y martes 26 de abril</u>: Lectures 6 and 7 (AULA 31 y 113 respectivamente)
These will be devoted to two topics. The first is the public goods problem.

Public Goods
Many experiments have shown that individuals contribute more to public goods than game theory would suggest. The basic problem of externalities will be examined and the "tragedy of the commons" analysed. The game theoretic solution, the Nash equilibrium will be compared with the social optimum. What has then to be explained is that individuals when playing a public goods contribution game initially give much more than in the Nash equilibrium. However, their contributions decline over time. This has led to the argument that they "learn to play Nash". We will see that this conclusion fits the data at the aggregate level but not at the individual level.

- The basic public goodsgame
- A modified version with an interior solution
- The role of information
- Learning in games
- Results in differenttreatments
- The reinforcement learning model of Erev and Roth and the EWA model of Camerer and Ho.
- Aggregate v. Group behaviour.
- Group v. Individual behaviour.
- The difficulty that these results pose for the Fehr and Schmidt model.
- Individuals are noisy and do not base their behavior on a simple model of fairness

Schelling's Segregation Model
Schelling's analysis of racial segregation in urban areas is one of the pioneering articles in which there is a stark contrast between what he calls "micromotives" and "macrobehaviour".

When individuals have relatively moderate preferences in favour of neighbourhoods with their own colour and move in consequence the result can be total segregation. Worse, if people actually prefer mixed neighbourhoods segregation can still occur. We will examine the basis for these results and will analyse a physical analogy and some generalisations of the original model.

- The basic model
- Individuals on a grid acting on the basis of local information
- The original utility function and alternatives.
- A physicalanalogy
- The income dimension
- Introducing a housingmarket
- Someempiricalevidence

Readings lectures 6 and 7

- Hardin, G. (1968) 'The tragedy of the commons', Science, 162: 1243–8
- Hichri, W. and A. Kirman (2007) 'The emergence of coordination in public good games', The European Physical Journal B – Condensed Matter and Complex Systems, 55: 149–59
- Ho, T., C. Camerer and X. Wang (2008) 'Individual differences in EWA learning with partial payoff information', Economic Journal, 118: 37–59.
- Pancs R and Vriend N.J, (2006) 'Schelling's spatial proximity model of segregation revisited', Journal of Public Economics, 91: 1–24
- Roth, A. E. and I. Erev (1995) 'Learning from extensive-form games: experimental data and simple dynamic models in the intermediate term', Games and Economic Behavior, 8: 164–212.
- Vinkovic, D. and A. Kirman (2006) 'A physical analogue of the Schelling model', Proceedings of the National Academy of Sciences, 103: 19261–5.

<u>Miércoles 27 de abril</u>: Lecture 8 (AULA 306)

In the last lecturs I will pass in review some recent models which illustrate both the Complexity view and the agent based model approach and then draw some conclusions.

- Learning in complicated situations, do such learning processes converge when agents are learning simultaneously? How do individuals learn to bid in auctions?
- How did man learn to rotate crops? A simple model.
- An application of the "El Farol" problem to that of market entry
- Identity and its importance in economics. Reconciling the philosophical and economic points of view. Can individualslearn to change theiridentity?

<u>Conclusions :</u>

The purpose of this course has been to examine the difficulties with current theoretical models of the economy, particularly macroeconomic models and to suggest an alternative approach. This would emphasise the importance of the direct interactionbetween individuals in the economy, and suggest that this is a central question not a peripheral

imperfection. Coordination is a more important criterion than efficiency. Such an approach limits the degree of rationality attributed to individuals and emphasises the difference between individual and aggregate behaviour. This approach allows us to analyse large endogenous changes in the aggregate without resort to exogenous shocks and explicitly recognises the possibility of the endogenous formation of bubbles and crashes. Such models undermine the idea that markets self organise in a stable and efficient way, and that they automatically attain equilibria, but they do have the merit of providing a basis for some of the most important economic phenomena of our time.

Readings lecture 8

- Hanaki, Nobuyuki &Kirman, Alan &Marsili, Matteo, 2011. "Born under a lucky star," Journal of Economic Behavior & Organization, vol. 77(3), pages 382-392, March
- Guerci Eric, A Kirman and S Moulet (2014), "Learning to bid in sequential Dutch Auctions", (forthcoming) Journal of Economic Dynamics and Control)
- Bouchaud, J. P. (2008) 'Economicsneeds a scientificrevolution', Nature, 455:1181–7
- Colander, D., P. Howitt, Kirman A., A. Leijonhufvud and P. Mehrling (2008) 'Beyond DSGE models: Towards an empirically-based macroeconomics', American Economic Review, 98: 236–40
- Kirman A, (2010), "The Economic Crisis is a Crisis for EconomicTheory", CESifo Economic Studies (2010) 56 (4): 498-53

General Readings (PRIMER BLOQUE)

- Kirman Alan, (2011) Complex Economics: Individual and Collective Rationality, London Routledge (paperback edition)

  Books which adopt similar approaches are the classic,

- Schelling, T. S. (1978) Micromotives and macrobehavior, New York: W.W. Norton and co.
- Epstein, J. M. (2007) Generative social science: Studies in agent-based computational modeling, Princeton, NJ: Princeton University Press.
- Miller John and Scott Page (2007) Complex Adaptive Systems : An Introduction to Computational Models of Social Life, Princeton and Oxford Princeton University Press

And a collection of earlier articles in

- W. B. Arthur, S. N. Durlauf and D. Lane (eds) (1997), The Economy as an Evolving Complex System II, Redwood City, CA: Addison Wesley.

Just in case you might think that the crisis is new:

- Reinhart, Carmen M., and Kenneth S. Rogoff. (2010). This Time Is Different: A Panoramic View of Eight Centuries of Financial Crises..Princeton, NJ: Princeton University Press.

A sociologicalapproach

- Granovetter, J. (1997) Society and economy: The social construction of economic institutions, Cambridge, MA: Harvard University Press.

Lessonsfrom social insects

- Seeley T (2012), Honeybee democracy Princeton Princeton University Press
- Gordon D (2010) Ant Encounters: Interaction Networks and Colony Behavior Princeton, Princeton University Press.

The reactions of policymakers

- Greenspan Alan, (2008), Testimony to House of Representatives Committee on Government Oversight and Reform, October 23rd 2008
- Trichet Jean-Claude (2010), « Reflections on the nature of monetary policy nonstandard measures and finance theory » Speech by President of the ECB, Opening address at the ECB Central Banking Conference Frankfurt, 18 November 2010.
- Turner Adair (2010) « The crisis, conventional economic wisdom, and public policy » Industrial and Corporate Change, Volume 19, Number 5, pp. 1317–1329
- Turner Adair (2013) Economics After the Crisis: Objectives and Means, Cambridge Mass. M.I.T Press.

<u>SEGUNDO BLOQUE</u>: PROF. DANIEL HEYMANN (FCE-UBA)

<u>Jueves 28 de abril</u>: "Expectativas, esquemas de aprendizaje y crisis macroeconómicas" (AULA 31)

Bibliografía

Evans, G. y S. Honkapohja (2001): *Learning and Expectations in Macroeconomics*, Princeton University Press
Heymann, D. y P. Sanguinetti (1998): "Business Cycles from Misperceived Trends", *Economic Notes*, Vol. 27, 2, pp. 205- 232
Heymann, D. (2007): "Macroeconomía de las Promesas Rotas", *REPBA*, Noviembre

<u>Viernes 29 de abril</u>: "Modelos de agentes múltiples en contextos de mercado" (AULA 113)

Bibliografía

Heymann, D., R. Perazzo y M. Zimmermann (2013): *Economía de Fronteras Abiertas: Exploraciones en Sistemas Sociales Complejos*, Editorial Teseo.

Heymann, D., E. Kawamura, R. Perazzo y M. Zimmermann (2014): "Behavioral Heuristics and Market Patterns in a Bertrand- Edgeworth Game", *Journal of Economic Behavior and Organization*, 105 pp. 124- 139

¡INFORMACIONES IMPORTANTES!

Acreditación del seminario

Para poder acreditar el seminario, es necesario cumplir con el 80% de la asistencia y presentar una monografía.

El trabajo final debe ser entregado de la siguiente manera, a menos que los Profesores que dictan el seminario particularicen otra metodología:

-Dentro de 3 meses siguientes a la finalización del seminario.

-Las monografías deberán ser enviadas al siguiente correo electrónico: cfaae@rec.uba.ar

-Una vez corregida por el profesor, el CFAAE confeccionará y entregará los certificados correspondientes.

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