

# An Interview to Carl Chiarella, an Italo-Australian Globe Trotter Who Studies Dynamic Models for Economics and Finance

Gian Italo Bischi

**Gian Italo.** *Carl, what caused the shift of your researches from mathematical modelling in nuclear physics to economics and finance?*

**Carl.** From about my teenage years I had an interest in trying to understand the origins of the economic cycle, I often wondered about their causes. This interest was probably driven by the fact that both my grandfathers had emigrated to Australia from Italy in the mid-1920s, in good economic times that soon turned into the great depression. They experienced quite a deal of hardship during this period, experiences that were shared by both my parents who arrived in Australia as teenagers in the 1930s. So it was probably quite normal that these personal experiences, as well as the impact of the depression on the broader society, formed part of family discussions as I was growing up. Of course such stories could be repeated by many young people growing up during the 1950s. I was also aware of the earlier depression in Australia in the 1890s and of earlier recessions during the nineteenth century in Britain. I was fascinated by the fact that the economic cycle was a constantly recurring event, and often pondered as to its causes, though at that time without doing any formal modelling. As my high-school years unfolded I found that I had an aptitude for mathematics and physics and, after considering engineering studies, decided to major in applied mathematics at university. It would be nice for the purposes of this story to recount that I studied applied mathematics with a view to eventually working in finance and economics, but that was not at all the case. Young people of my generation gifted in mathematics were naturally led to careers in the sciences. For this reason I decided to write my mathematics Ph.D. in the area of nuclear reactor physics, the

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problems and mathematics used interested me and the skills I developed seemed to promise to some sort of “useful” career. After returning to Australia from France in 1971 after a two-year post-doctoral scholarship at l’Université de Nancy, I took a job as a Lecturer in Mathematics at the University of Technology, Sydney. After two years, I felt sufficiently on top of my teaching duties to finally undertake studies in economics, in which I had always retained an interest. After doing the basic first-year economics course, and doing quite well, I was admitted into a course work master’s degree in Economics. It was during the undertaking of this course that I came into contact with a couple of professors who inspired my interest in several of areas of economics and finance and who “took me under their wings” so to speak. The path to a second PhD in Economics followed quite naturally after that. I have written in more detail elsewhere how my particular interests in finance and economics developed.<sup>1</sup>



**Gian Italo.** *There are no doubts about the fact that mathematical models are useful in physics and engineering; however, many economists are quite sceptic about their effectiveness in economics and social sciences, as they consider them more similar to academic exercises than useful tools for solving real problems. What is your opinion?*

**Carl.** The question of the utility of mathematical models in the social sciences has probably been debated for some time, but I would say that as far as their use in economics and finance is concerned the debate is over, and the use of mathematical models is here to stay. This is probably due to a number of factors. First, a maturing of expectations of what one can achieve with mathematical models in economics and finance. The initial early hope was that economics and finance could become predictive sciences in the same way as celestial mechanics can predict perfectly the motion of the planets (actually not perfectly as we know that relativity corrections are necessary to predict perfectly for some planets). We now understand that the science

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<sup>1</sup> C. Chiarella “My chaotic career—from billiard balls to economic dynamics and financial markets”, *Chaos, Solitons and Fractals* 29 (2006) 517–519—special issue on ‘Dynamic Modelling in Economics and Finance’ in honour of Professor Carl Chiarella, edited by Bischi G.I. and I. Sushko..

of economics and finance is more like medical science. My doctor can inform me about all the risk factors I should be wary of if I want to avoid, say heart disease. But she cannot predict when, if at all, heart problems will start to occur if I choose to ignore her good advice. Indeed, she cannot even guarantee that I will not have heart problems even if I do follow her advice. There is nevertheless no call that the study of medical science should be abandoned because it cannot give us perfect predictions of the outcomes of following certain medical advice. So in economics and finance we have come to appreciate that perfect prediction is impossible, in part because the economy is too complex with many feedback loops, and is buffeted by many stochastic factors that it will never be possible to model. Economic science can tell us the general tendency of the economy if for example interest rates are increased or decreased, what are the essential feedback chains in the economy, how they operate and which parameters we need to tie down empirically to know the direction of certain effects, in financial markets we appreciate (at least by and large) that we cannot predict the market movements, but we can quantify and minimise the risk of our exposure to such movements. Indeed, if ever we could predict the movements of financial markets their very nature would any way change as they are institutions that have been established in order to allow society to deal with the inherent uncertainty and risks of the movements of the prices of risky assets.

**Gian Italo.** *Can you give some examples of dynamic models you studied for which you are particularly proud because they gave important suggestions to policy makers, economists or financial operators?*

**Carl.** I would cite two areas of dynamic economic modelling about which I am particularly pleased if not to say proud. The first is my work on macrodynamic modelling which has its roots in my economics Ph.D. thesis (though the ideas were germinating in my head from my initial studies of economics), but took on a new dimension when I started collaborating with Peter Flaschel in the early 1990s. Our recent book “A Disequilibrium Theory of the Business Cycle”, joint with Reiner Franke, brings a lot of this work together and to the point where it could be taken by policy economists and developed into useful policy models. This work will be on-going for some time yet as we refine the basic model, do better estimations and calibrations, carry out policy experiments and so forth, but this book marks an important milestone in this long research agenda. The other area is my work on financial market models of heterogeneous boundedly rational economic agents. This developed out of my dissatisfaction with the standard paradigm of homogeneous rational representative agents, which I believe cannot even serve as a benchmark model for what goes on in real markets. From my original paper “The Dynamics of Speculative Behaviour” published in 1992 (but actually written in 1989) work on this topic has been intense with my UTS colleague (and former Ph.D. student) Tony Xue-Zhong He, Roberto Dieci (Bologna) and Laura Gardini (Urbino) being my principal co-authors. We have recently been joined by Min Zheng whose skills with the theory of random dynamical systems is helping us to elucidate the interaction of the nonlinear and stochastic elements, both of which I think are important in understanding how the interactions among heterogeneous agents bring about the type of price and return behaviour we observe in financial markets, such as fat tails, volatility clustering and so forth. The

work on deterministic effects has reached a mature stage with the publication of “Heterogeneous Expectations and Speculative Behavior in a Dynamic Multi-Asset Framework”, (joint with Tony He and Roberto Dieci), and “Asset Price and Wealth Dynamics in a Financial Market with Heterogeneous Agents” (joint with Roberto Dieci and Laura Gardini). The work on the nonlinear and stochastic elements using the theory of random dynamical systems has just started with the working paper “The Stochastic Price Dynamics of Speculative Behaviour” and this will be a major focus of research effort in the coming few years.

**Gian Italo.** *What do you think about the approach known as “Econophysics”? Economists seem to be a bit reluctant to accept this kind of approach.*

**Carl.** First of all let me say that I dislike the term econophysics as it does not describe the new ideas and concepts that physicists are bringing to economic analysis. The term already creates a separation that I feel makes communication difficult. Recently, in my capacity as one of the editors of the Journal of Economic Dynamics and Control I was asked to oversee a special issue on econophysics (that I think has just recently appeared) with Dooyne Farmer and Thomas Lu as guest editors. I suggested that the title of the special issue be “Applications of Statistical Physics to Economics and Finance” as I felt that the use of techniques and concepts from that discipline were the main ideas that were being used in the economics and finance context. I think there are a number of reasons why the econophysics community has had a minimum impact in economics. First of all there is the communication barrier, the physicists are really writing for other physicists who have developed an interest in economics and finance so they do not try to translate their language into that used by economists. As a result it is very difficult for economists to gain any message from this literature. Second, and this is also related to the communication barrier problem, economists have gained the impression (rightly or wrongly) that physicists have come down from the mount to teach them how to use advanced mathematical tools, whereas economists have been borrowing mathematical tools and concepts as needed from a range of disciplines over the last six decades. To see this one only needs to consider the use in economic analysis of the theory of nonlinear dynamical systems, stochastic differential equations, stochastic optimal control theory, Monte Carlo simulation methods, the numerical solution of partial differential equations; many of these tools had their origins in physics, and economists feel they have not been laggards in adapting them to the needs of economic analysis as required. Third, it seems to me that economists have a higher standard of empirical analysis, so economists remain unconvinced by the type of empirical analysis one encounters in the econophysics literature. It is my fourth point that I believe is at the root of the fact that economists ignore the econophysics literature, and this is to do with the concepts of equilibrium and disequilibrium. Mainstream economists have become firmly wedded to the notion that the economic system is in an equilibrium state, by which they usually mean a stable fixed point of some dynamical system. Physicists see disequilibrium as the more normal state of affairs since this is what they are used to in physics, and so they frequently seek to model the economic process in disequilibrium terms, for instance using concepts from statistical physics. It may further be added that econophysicists seem to not accept the notions of rational expectations and the

representative agent which are regarded almost as an article of religious faith by some mainstream economists. Those who know my work will know that I also share the view of the econophysicists concerning the representative agent and the rational expectations paradigm, and I think the use of concepts from statistical physics to model the interaction of heterogeneous agents similar to an ensemble of particles in physics should (and is indeed already) provide a fruitful avenue for research.

**Gian Italo.** *Carl, you spend a lot of time to travel all around the world to meet research collaborators, and when you are in Sydney you often invite researchers to visit your department. Do you think that these travels are still useful for making research even if Internet connections and email are so diffused, easy and cheap?*

**Carl.** It is certainly the case that I spend many short but intense periods with my various research collaborators either at my home institution UTS or visiting the universities of my colleagues. We also collaborate very much and very effectively by email, skype and telephone. However, I find that the really significant progress on a joint research project comes about when the co-authors are sitting around the same desk staring at and thinking about difficult aspects of some question on a piece of paper or a white board. Also, often the conversations over a coffee or a meal together on such occasions lead to some breakthroughs. Finally, I often think that just the fact that we have gone to so much trouble to be working together for such a short period forces the pace so to speak and leads to a lot of progress in a short period of time.

**Gian Italo.** *Can you make some comparisons among the different ways to organise research in the universities and research institutions in Europe, USA and Asian emerging countries?*

**Carl.** Interestingly I would say that the actual way of doing research on the part of the scholar is universal, and is the same in all the countries I have visited and where I have collaborators. What I have observed differs a lot is the infrastructure support within which the scholar finds himself/herself working, such as the teaching load, support to travel to conferences, general support (computers, libraries etc.), and availability of research grant funding, and more importantly, whether the bureaucratic structures in the universities are aiding or hindering the research enterprise. The views that I have formed are just personal impressions that I hasten to add are not backed up by hard statistics. I would say overall it is best in the USA on pretty well all of the fronts I have mentioned, it is also quite good in Japan though I personally find their bureaucratic structures somewhat Byzantine. In Europe, it may be hard to make a general statement, in some countries (e.g. the Scandinavian countries, the UK and Holland) support seems quite good, but in other countries it could be much better (e.g. France, Italy and Germany), certainly in these latter countries the bureaucratic structures are tending more towards the hinderance side of things. Speaking more broadly for a moment, in my view the difficulties of research support in Europe transcend the bigger question that I think is starting to be debated in several European countries as to whether the university system should remain very open or become more selective. In my own country I would say we are somewhere between the European and North American situation, support is reasonable but could be better. Probably the more market-oriented approach pursued since the late 1980s is pushing us more towards the North American situation. The countries where I have seen the

biggest changes with respect to research support are the emerging countries of Asia, such as Singapore, mainland China, Taiwan and Hong Kong (I mention these last three separately only because their developments have followed quite different paths over the last 60 years). I recall visiting one of the universities in Singapore in the early 1970s, and was very conscious of the fact that they lagged behind universities in the USA, Europe and Australia. I have spent three periods at a university in Singapore since 2000, and I have become very conscious of how far they have progressed. There has been a tremendous investment in teaching and research infrastructure, and there is a real desire on the part of key decision-makers for the Singapore universities to be ranked among the top in the world. Indeed, that is already happening if one takes seriously the rankings one reads about in major international newspapers and, whatever one may think about these rankings (and I have my doubts on several counts), they are nevertheless indicating certain trends that cannot be ignored. There is also a similar trend with universities in China, Hong Kong and Taiwan. I recently read in a major international publication that ranks universities globally a prediction that within the next decade the top universities in Asia will surpass the top European universities. I would have to say that based on my personal observations this is a forecast with which I would tend to agree. This fact will come as a surprise to many Europeans who may still think of these countries as emerging, whereas on many counts they have already emerged.

**Gian Italo.** *How did you start your contacts with Italian researchers? What is your opinion about the level of research here in Italy?*

**Carl.** I have already described in the Chaos, Solitons and Fractals (see footnote 2) article how I became aware of some very interesting and good quality research being done in Italy through the AMASES association, and I published a paper in the AMASES journal<sup>2</sup> in 1985. A contingent of Italians came to the first QMF conference organised annually at UTS, and it was through them that I established contact with Laura Gardini that led to my first visit to Urbino (of which there have been many since) in 1998. The initial contact has led to the blossoming of many research flowers, I will here just highlight the collaborations with Laura herself, Roberto Dieci and Anna Agliari. I also have contacts with the group around Mauro Gallegati in Ancona, the Cagliari-Genoa group around Michele Marchesi and Silvano Cincotti, the group around Matteo Marsili at ICTP in Trieste, and more recently the group in Siena around Alessandro Vercelli and Serena Sordi whom I will visit after the AMASES meeting in Lecce. I think the level of research in Italy is quite high in certain areas, especially in nonlinear dynamics and in particular its applications to economics and finance. I never cease to be amazed at the quality of research in Italy given the many impediments against which the Italian researchers have to struggle. I have already alluded to the general problems in responding to the previous question, but in addition they often have to cope with holding a position in towns far from where their families live (because it takes so long to get a permanent position), quite heavy teaching loads

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<sup>2</sup> The AMASES journal is now known as “Decisions in Economics and Finance”, published by Springer.

and rather patchy infrastructure support. I think the fact that high quality research can be maintained may be due to the long tradition of good research in Italy and the fact that Italian researchers seem to network quite well. Nevertheless, I think it is not a good sign for the future of Italian research that I find many good young Italian researchers working not only in the US, but also in the other European countries that give much better support to research.

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