

CONTRIBUTIONS OF SCIENCES AND TECHNOLOGIES TO THE EVOLUTION OF FINANCIAL MARKETS

Public hearing of 14 October 2010

Mr Claude Birraux, deputy, president of OPECST

Presentation of the Office

The Parliamentary Office for Scientific and Technological Assessment (OPECST), still little known by the players of financial circles, is positioned at the crossroads of scientific, technological and political fields. Made up of eighteen deputies and eighteen senators, this analysis and assessment body has been producing, since 1983, studies drawn up in an ever closer manner with the scientific community.

Its close dialogue with the world of research and technology, in the first place with its scientific board made up of twenty-four internationally recognised personalities, provides the Office with a powerful analysis instrument to thoroughly assess complex topics. Its previous studies have played a decisive role in a very wide variety of fields such as the organisation of nuclear safety, the structuring of the rules of bioethics, dam safety, the planning of the national research effort and, more recently, the adaptation of the energy performance standards of buildings, and the monitoring of plans to combat pandemics.

The operational efficacy of the Office results from its determined follow-up of the implementation of its recommendations by all the institutional avenues or channels of influence generally open to parliamentarians or specifically instituted for its own benefit: exchanges with the Government, tabling of amendments, assessment of programmes, supervision of bodies.

Presentation of the public hearing

The 2007 crisis and the lightning crash of 6 May 2007 revealed the **weakness of markets and the sophistication of operations allowed by scientific and technological progress**. This progress has promoted dematerialisation and the acceleration of transactions; brought about the appearance of new forms of processing orders and new risk management techniques; and led to the appearance of a multitude of new players.



From left to right: Mr Jean-Claude Etienne, senator, first vice-president of OPECST, Mr Claude Birraux, deputy, president of OPECST, Mr Ramat Cont, research director at the Probabilities and Random Models Laboratory (CNRS-UPMC Paris VI), associate professor and director of the Center for Financial Engineering, Columbia University.

Organised around two round-tables, 'Scan of the situation' and 'Solutions and Prospects', the public hearing of 14 October helped analyse the rapid change in market technologies, as well as the increasing complexity of strategies underlying the taking of positions. These strategies indeed appear to have caused the gap between, on the one hand, risk monitoring, regulation and management techniques and, on the other hand, the reality of market operation.

Participants and topics addressed

- **Mr Rama Cont**, research director at the Probabilities and Random Models Laboratory (CNRS-UPMC Paris VI), associate professor and director of the Center for Financial Engineering, Columbia University, took part on many occasions, as the [moderator of the hearing](#), to orient the debates towards the most relevant issues. He also made a summary of the presentations at the end of each round-table.
- **Mr Michel Barnier**, European commissioner for Internal Market and Financial Services, presented, through a video recording, the work by the European Commission on high-frequency trading and the revision of the directive on markets in financial instruments (MiFID).



- **Mr Yves Bamberger**, scientific adviser to the chairman and managing director of EDF, presented the analogies between two complex systems: the energy network and financial markets.
- **Mr Charles-Albert Lehalle**, manager of the quantitative research team at Crédit Agricole Cheuvreux, gave a detailed presentation of the role of high-frequency trading in trading-rooms and the impact of the MiFID directive.
- **Mrs Clotilde Bouchet**, financial director, chair of the scientific committee of the DFCG (national association of financial and management control directors) and **Mr Christophe Remy**, financial director, chair of the 'club Sociétés cotées' (listed companies club) at the DFCG, presented the impact of innovatory financial products on listed SMEs.
- **Mr Denis Talay**, research director at INRIA, lecturer at the École polytechnique, former chair of the 'Société de mathématiques

appliquées et industrielles' (applied and industrial mathematics society), presented the importance of mathematics in modern finance: concepts, models, methods and rules.

- **Mr Arnaud Vinciguerra**, co-founder and R&D manager of the company Sophis, gave a presentation on data processing systems in finance.
- **Mr Jean-Paul Betbèze**, chief economist and director of studies at Crédit Agricole, presented the link between financial innovations and the economy.
- **Mr Jean-Pierre Kahane**, mathematician, professor at the Université Paris Sud and member of the Académie des sciences, spoke in favour of a better social use of financial mathematics.
- **Mr Patrick Pailloux**, general director of the National Agency for the Security of Information Systems (ANSSI) presented the various means to make data-processing systems secure in finance.
- **Mr Jean-Philippe Bouchaud**, chairman and managing director of Capital Fund Management, professor at the École polytechnique, gave an empirical analysis of the instabilities of financial markets, based on an analogy with certain physical processes.
- **Mr Henri Sterdyniak**, director of the department of the economics of globalisation at the French Economic Observatory (OFCE), mentioned possible innovations to get financial markets to serve the real economy.
- **Mrs Alexandra Givry**, assistant manager of the market surveillance department at the Financial Markets Authority (AMF), presented the work by the AMF and approaches allowing better control over innovatory trading mechanisms.
- **Mr Marcel-Eric Terret**, policy officer at the Internal Market and Services Directorate-General (DG MARKT) at the European Commission, presented the role of Europe and of the Commission in the new financial regulations.
- **Mr Olivier Oullier**, professor-researcher in neurosciences at the Cognitive Psychology Laboratory of the Université de Provence, presented, at the end of each round-table, the role of psychological factors and the contribution of behavioural sciences in finance.

General conclusions of the Office

The various technical aspects, addressed in a matter-of-fact manner, allowed a certain number of issues to be identified and several paths to solutions to be envisaged.

- First, the need to rethink the definition of a systemic risk, and envisage regulation no longer only from the viewpoint of the behaviour of individual players, but also from that of endogenous risks caused by the intrinsic dynamism of markets. The new institutions tasked with warning about systemic risks could, for instance, commence in-depth work on the causes of the instability, non-linearity and saturation of markets, on the basis of empirical data.

- The introduction of an obligation for market operators to store detailed financial data, which the regulator would then make accessible, in an anonymous manner, for research work. This research would be aimed at compensating the insufficient number of academic studies assessing the impact of high-frequency trading on the evolution of markets, especially as it is impossible for researchers to access financial data, which is often non-public. Moreover, in this respect, more general questions can be raised of the transparency of information

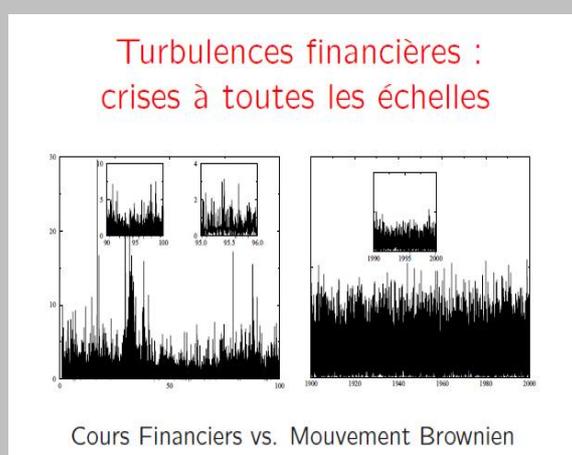
transiting through dark pools or the regulations on the over-the-counter market.

- To detect manipulations of prices more effectively, regulatory agencies could switch from the surveillance of transactions to the surveillance of orders. However, the shortage of the regulator's resources, which prevents it from ensuring better market surveillance, must be taken into account.

- The issue must be raised of a specific pricing of orders placed by automata, as should the introduction of a minimum latency time between the placing of an order and its cancellation, so as to prevent some operators from 'probing' the market, a process which can be likened in all respects with the technological equivalent of insider dealing.

- Last, it appears opportune to address the topic of the social usefulness of innovatory mechanisms. It was emphasised that scientific and technical innovations could also serve to better regulate financial markets, which would grant them greater social usefulness.

High level presentations and debates



Left: Presentation by Mrs Givry showing the evolution of the Euronext order book regarding a CAC 40 stock that has undergone a very rapid price manipulation (in 15 seconds).

Right: Presentation by Mr Bouchaud showing the qualitative mismatch between the real evolution of markets and the variations predicted by a model used in financial mathematics.

**Excerpt from the OPECST meeting of 10 November 2010,
in the presence of the French winners of the Fields medal,
Messrs. Ngô Bảo Châu and Cédric Villani,
as well as the winner of the Gauss prize, Mr Yves Meyer**

The general conclusions of the public hearing of 14 October 2010 were presented at the Office meeting of 17 November 2010. The Office was proud to welcome, on the same day, the French winners of the Fields medal, Messrs. Ngô Bảo Châu and Cédric Villani, as well as the winner of the Gauss prize, Mr Yves Meyer. These people mentioned in particular the place and role of mathematics in finance.



From left to right : MM. Ngô Bảo Châu, Yves Meyer et Cédric Villani

Mr Yves Meyer stated, in this respect, that 'managing these enormous problems – market evolutions, capital movements, etc., of a dimension far greater than that of physics problems, requires the creation of entirely new intellectual instruments. Roland Glowinski, a member of the Académie like myself, told me about a meeting devoted to nonlinear partial differential equations, held in the United States: it was about the issues of the century ahead and three-quarters of these issues concerned the financial sphere. Finance is drawing sciences forward, this phenomenon is quite incredible.'

He also mentioned that 'when you use a credit card to withdraw money, you use a very subtle and very unexpected application of the theory of numbers, which falls within the province of pure mathematics. Furthermore,

all financial mathematics are based on the work by the late Japanese mathematician Kiyoshi Ito, the first to be awarded the Gauss prize, at the Madrid Congress in 2006. The Ito integral, inspired by a martingale, was initially a concept of pure mathematics, but its stochastic calculation has found a tremendous application in finance. It is essential to understand the financial crisis and, in the past fifteen years, banks have massively recruited mathematicians: when Nicole El Karoui taught at the École polytechnique, 70% of its graduates joined banks afterwards.'

Mr Cédric Villani recalled that 'financial problems have inspired and will continue to inspire new mathematical problems. It is however complicated to achieve a faithful modelisation because, in the financial sphere, data is not about particles obeying the laws of physics, but people, who change their mind or apply more or less well known models. It is far more difficult to make predictions in such a field than regarding the customary problems dealt with by physics or mathematics. The system is therefore extremely complicated. I wish to add that the hypotheses on which the projections of the models of financial mathematics are based, such as the Black-Scholes model, are never proven to be true. The relevance of these models is undeniable, but they must be seen as verification instruments; they do not have any predictive value; they do not give any assurance.

In a field of this type, given the considerable human bias and the strong interactions of theory on experience, mathematical modelisation requires very great prudence.'

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The report is available at the following address : <http://www.assemblee-nationale.fr/13/rap-offi/2987.asp>