Dynamic Portfolio Choice, Asset Pricing and Mathematical Finance

An ESF Exploratory Workshop

Scientific Report

1. Executive summary

This workshop brought together researchers from the worlds of Financial Economics and Mathematics to examine problems relating to portfolio selection and asset valuation. These problems lie at the core of financial theory as market participants make trading decisions on the composition of their portfolio. The element of stochastic risk which distinguishes Financial Economics leads to a high degree of Quantitative complexity so there is a natural overlap with Mathematicians interested in applying the techniques of their own field to applied problems such as these. Hence there is a sufficiently common language between disciplines to make collaboration a fruitful exercise whilst the different perspectives of the two groups has the potential to provide novel ideas and approaches. This was reinforced by ensuring a good mix of people from each area; and ensuring that papers were presented and discussed by researchers from the other group.

The workshop also fits in the larger context of real world financial markets where there has been an increasing sophistication of financial products such as exotic derivatives, greater computing power and the employment of a more quantitatively literate generation of market agents. This has led to a much larger appreciation and use of mathematical models and techniques in making trading decisions such as valuing and hedging portfolio components.

Typically theoretical financial models which consider the issues of portfolio selection and asset valuation are developed from simplified and fairly unrealistic assumptions. Typically investors are assumed to know the distributional parameters of future asset returns, have only publically available information, with new information arriving smoothly; and it is assumed complete markets exist. This event aimed to extend these models in a number of ways by relaxing each of these assumptions and examining the implications.

Some of the relevant applications of the papers presented included:

- Insider trading – by knowing the possible trading strategy of insider traders vs other traders this form of market abuse could be more easily detected
- Hedging of portfolios – particularly relevant in a world where managed portfolios contain larger numbers of heterogeneous assets
- Portfolio selection in a dynamic environment – static analysis of portfolio selection is of little value since portfolios are rarely frozen once the initial selection is made
- Parameter estimation –applicable to all real world portfolios as parameters are usually both unknown and variable, though some proxies, e.g. Implied volatility, are available.

A unique feature of the conference was a round-table discussion which involved all of the participants (rather than a select few, as is typical). This allowed those present to indulge in some strategic thinking about the future of research in this area. The round-table should help to further the frontiers of current financial models and suggest interesting areas where work needs to be done.

Overall we felt the conference was a success with high quality papers presented and excellent discussions. The conference was invaluable in providing a networking opportunity between disciplines, and intra-discipline (both geographically and between senior and more junior members of the research community).

2. Scientific content of the event

The objective of this workshop was to focus on research that applies results from modern mathematics to models of portfolio selection and asset valuation, so that these models can incorporate features of the real world. To achieve this objective, the conference invited people from both the Mathematics and the Finance academic community. There was a focus on inviting young scholars and graduate students.

The scientific presentations were organized in such a way that papers presented by people from Mathematics were typically discussed by Finance academics, and vice versa.

Papers presented at the workshop explored the following issues:

(i) **Optimal Partial Information Portfolio in an Insider Influenced Market** Typically, it is assumed that the only information an investor has is about current and past events and prices. This paper extends the mathematical machinery to consider the case where an investor has information about future events, such as a news announcement that a firm is about to make. It then asks what is the optimal trading strategy in such a setting.

(ii) **Portfolio Selection with Periodic News Arrival** Standard models of portfolio selection assume that information arrives smoothly and at the same frequency as the one with which decisions are made. But, in the real world, information about macroeconomic conditions arrives only infrequently (often once every 3 months) even though investors can trade daily. This paper shows how the infrequent arrival of information affects optimal portfolio selection.

(iii) **The Risk of Optimal, Continuously Rebalanced Hedging Strategies and Its Efficient Evaluation via Fourier Transform** This paper considered the problem of determining the optimal trading strategy in order to hedge a risky position and showed how tools from mathematics, in particular Fourier Transforms, could be used to solve this problem.

(iv) **Power Utility Maximization Under Incomplete Markets and Portfolio Constraints** Another important problem that was addressed was how to solve for the optimal portfolio when markets were incomplete; that is, when the number of risks was greater than the number of hedging instruments.

(v) **Persistance, Predictability, and Portfolio Planning** An important theme of the conference was how to choose *dynamically* optimal portfolios; that is, how to design portfolios to take advantage of changes in future stock returns.

(vi) **Parameter Uncertainty and International Investment in a Multi-period Setting** This paper considered the problem of multi-period portfolio selection but under the assumption that one does not know precisely the parameters driving stock returns. Thus, one needs to worry not just about *optimization* of the portfolio but also about *estimation* of the inputs to the optimization model, since these are not known with certainty in the real world.

(vii) **Robust Portfolio Optimization with Multiple Priors** The last paper in the conference examined how an investor who was aware about the estimation problem would incorporate the concern for robustness in decision-making into the process of selecting an optimal portfolio.

3. Assessment of the results, contribution to the future direction of the field, outcome

3.1 Assessment

In the view of the organizers and also the participants, the conference was a major success. The papers presented were of very high quality, the discussants did an excellent job of putting each paper in perspective, and there was also very active participation from the audience. The conference was also successful in bringing together the very top people in Europe working in the areas of Finance and Applied Mathematics, and in making possible a very healthy dialogue between these two groups, who usually work on similar problems but rarely communicate with each other. Finally, the conference allowed young researchers and doctoral students to network with very senior members of the academic community.

3.2 Contribution to the future direction of the field

The concluding session of the conference consisted of a Panel Discussion. Unlike most panel discussions where only a few people participated, we decided that the panel would consist of all the people attending the conference. The idea was to give each person a chance to list what she or he thought were the important issues for the field. The senior-most persons from Mathematics and from Finance were asked to start off this discussion. There was very active participation, and at the end of the discussion we had a four-page long list of suggestions for future directions for the field. This was an important outcome because it highlighted the areas of importance about which there was broad agreement. It also identified for young scholars and doctoral students the areas in which they should focus their research efforts.

3.3 Outcome

The main outcome of the conference was the bringing together of researchers from the areas of Applied Mathematics and Finance, an exchange of ideas between these two communities of researchers, and the building of a relationship between these two groups. Hopefully, this was just the first of many such meetings. A second outcome of the conference was the identification of the main areas where these two communities should focus their energies. Last, but not least, was the chance for young academics and doctoral students to meet the more senior members of the profession and to build a relationship with them.

4. Final programme

<u>Friday 24 September</u>

11.00 - 11.30	Introduction by Raman Uppal (London Business School and CEPR) and Robert Carver (CEPR)
	Presentation of the European Science Foundation **Dalina Dumitrescu** (ESF Standing Committee for the Social Sciences)

Session 1:

Chair:	Suleyman Basak (London Business School and CEPR)
11.30 – 12.30	**Optimal Partial Information Portfolio in an Insider Influenced Market** *Bernt Øksendal (University of Oslo) Agnes Sulem (INRIA)
Discussant:	Fabio Trojani (University of Lugano)
12.30 – 13.30	**Portfolio Selection with Periodic News Arrival** Lixin Huang *Hong Liu (Washington University, St Louis)
Discussant:	Giulia Di Nunno (University of Oslo)
13.30 – 14.45	Lunch

Session 2:

Chair:	Bernard J Dumas (INSEAD and CEPR)
14.45 – 15.45	**The Risk of Optimal, Continuously Rebalanced Hedging Strategies and Its Efficient Evaluation via Fourier Transform** Ales Cerny (Imperial College Management School)
Discussant:	Lucie Teplá (INSEAD)
15.45 – 16.15	Coffee
16.15 – 17.15	**Power Utility Maximization Under Incomplete Markets and Portfolio Constraints** Julien Hugonnier (HEC- Université de Lausanne)
Discussant:	Martin Schweizer (ETH Zürich)

Saturday 25 September

Session 3:

Chair:	Raman Uppal (London Business School and CEPR)
09.30 – 10.30	**Persistance, Predictability, and Portfolio Planning** Michael Brennan (Anderson School, UCLA) *Yihong Xia (University of Pennsylvania)
Discussant:	Francisco J Gomes (London Business School and CEPR)
10.30 – 11.00	Coffee
11.00 – 12.00	**Parameter Uncertainty and International Investment in a Multi-period Setting** *Pierluigi Balduzzi (New York University) Ludan Liu (Deutsche Bank)
Discussant:	Astrid Schornick (London Business School)
12.00 – 13.00	**Robust Portfolio Optimization with Multiple Priors** Frank Lutgens (LIFE, Maastricht University) *Peter C Schotman (LIFE, Maastricht University and CEPR)
Discussant:	Mark Salmon (Warwick Business School and CEPR)
13.00 – 15.00	Lunch and panel discussion on directions for future research

Each speaker should present for 30 minutes then there will be 15 minutes for the discussant and 15 minutes for general discussion.

*denotes speaker

Organizers:	Suleyman Basak (London Business School and CEPR) Bernard J Dumas (INSEAD and CEPR) Raman Uppal (London Business School and CEPR)

5. Final list of participants

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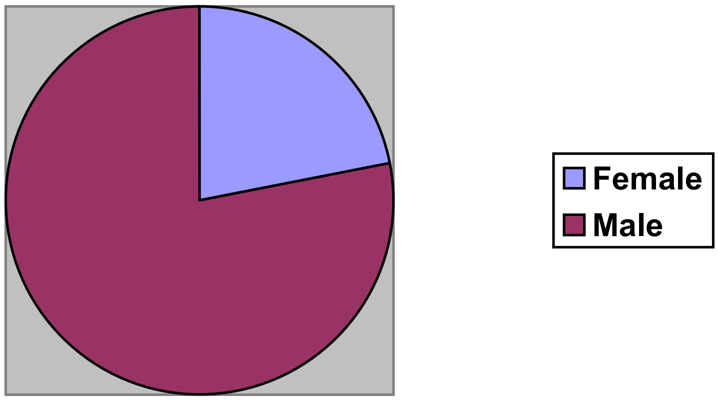
6. Statistical information on participants

Gender of participants



Geographical base of participants