**Finance & Philosophy: The Complexity Science Approach to the Financial System**

**Type:** Blockseminar
**Number**:
**Contact eMail:** mm822@cam.ac.uk
**Participants:** P&E Bachelor, P&E Master, BA IWB, BA Economics, MA IWB, MA Economics
**Lecturers:** Marco Meyer, Carsten Jung
**Dates:** 22 - 24 January 2016

Complexity science provides new ways of modelling the financial system as a complex system. It challenges dominant views of linearity, predictability, and responsibility in finance. On the philosophical side, this could have implications for how we think about morality in financial markets. On the policy side, the complexity approach could require a rethinking of how we regulate the financial system.

In this seminar, we first provide an introduction to some key concepts and the mathematical foundations of complexity science. Drawing on resources from the philosophy of science, we then ask what we can possibly expect to learn from models of complexity. We also ask if the financial system is really 'complex'. We'll spend a lot of time investigating some specific complexity models. Finally, we discuss the implications of these approaches for the ethics of finance and for financial regulation.

**Lecturers**

*Carsten Jung*
Carsten is an economist at the Bank of England's International Directorate. He currently works on policy issues concerning the global financial safety net. He holds a BA in Philosophy & Economics from Bayreuth, an MSc in Economics from Warwick University and an MSc in Economic Sociology from LSE. He was also a Carlo-Schmid intern at the International Monetary Fund.

*Marco Meyer*
Marco Meyer is currently reading for a PhD in a research project on financial ethics at Cambridge University and Groningen University. He received a Master's degree in philosophy from Oxford University, a BA degree in Philosophy & Economics from Bayreuth university, and a BA in European History from Bayreuth University. His research interests include financial ethics, complicity and moral responsibility. He has taught students at the universities of Oxford and Cambridge, and has given seminars on philosophy and economics.

**Goals**

- Understand what complexity is, and how the notion applies to financial systems
- Understand the reasons for the complexity of the financial system, and what would have to change for the financial system to become less complex
- Reflect on how economists usually explain, and how complexity models challenge this explanatory paradigm
- Be able to explain and apply central mathematical concepts pertaining to complexity, such as power laws and non-linearity
- Experiment with different models of complexity in finance
- Reflect on implications of understanding the financial system as a complex system for financial regulation
- Explore the normative implications of understanding the financial market as a complex system, especially in terms of responsibility

**Preliminary Seminar Plan**

*Friday*

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| 12.00-13.00 | **Introduction**, Welcome, Expectations |
| 13.15-14.45 | **Introduction to complexity science**<br>> What is Equilibrium Analysis?<br>> What is Complexity?<br>> In what sense is the financial system complex? |
| 15.15-16.45 | **Mathematical BootCamp**<br>> Analysis vs. Simulation<br>> Distributions: Gauss distribution vs. Power Laws<br>> Linearity vs. Non-Linearity |
| 17.15-18.00 | **Some initial examples of Complexity Models in Finance** |

*Saturday*

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| 09.00-10.45 | **(How) Do Complexity-Models Explain?**<br>> Do complexity explanations need micro-foundations?<br>> Why do complexity models work in physics as well as economics?<br>> What are the sources of complexity in the financial system? |
| 11.15-12.45 | **Complexity and Responsibility**<br>> What do complexity models tell us about how to assign responsibility for financial crises?<br>> Case Study: Northern Rock |
| 14.00-17.30 | **Parallel Workshops**<br>1. Agent-Based Modelling<br>2. Network-Models |
| 17.30-18.00 | Feedback, Wrap-Up |

*Sunday*

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| 09.00-10.30 | **Presentations from Workshops** |
| 11.00-12.00 | **Does the Financial System need to be Complex?**<br>> How could complexity be reduced in the financial system?<br>> How will current reform proposals impact complexity in finance? |
| 13.00-14.45 | **Regulating the Financial System as a Complex System**<br>> How can we make the financial system more robust?<br>> What is Adaptive Regulation, and how does it work? |
| 15.15-16.00 | Feedback |

**Workshops**
On Saturday afternoon, we'll split up in two workshop groups. In both workshops, we will look in depth at a complexity model of the financial system. The workshops differ in what kinds of models they focus on.

*Workshop 1: Network Models* Network Network models have become an important tool for modelling contagion in the financial system. In this group we will discuss some basics of network modelling. And, using simulations, we will discuss how agents' properties and network structure affect contagion dynamics.

*Workshop 2: Agent-Based Models* Agent-based models focus on the interactions between often heterogenous agents, and can thereby illuminate boom-and-bust dynamics driven by endogenous factors such as herding. In this group, we will discuss the the merits of agent-based modeling as compared to "representative agent models", and, using simulations discuss how behavioural assumptions about multiple groups of agents can explain volatility in the financial system.

You can sign up for a workshop, on a first-come-first-serve basis, here: https://docs.google.com/spreadsheets/d/1C8NLRZl-0itPLI5ZaVftdPyt0cuts-VceSzuukQbC-4/edit?usp=sharing

The deadline for sign-up is 15 November 2015.

You will receive a separate communication from your workshop leader on how to prepare.

**Assessment**
P&E Bachelor: V, P4, P6, P7, P9; PE Master: Elective

*Attendance-only "Schein" (PE: 2 ECTS):* You need to (1) do the readings, (2) do the problem set, (3) participate actively in the seminar

*Essay "Schein" (PE: 6/8 ECTS):* You need to (1) do the readings, (2) do the problem set, (3) write an essay (4.000-5.000 words). If you give a presentation, this will feed into your grade as well.

**Readings**

There will be very few presentations in the seminar, and there won't be presentations to recap readings, so it is crucial that you do the readings. There are two kinds of required readings.

- Most readings are general readings.
- There will be a few additional readings specific to the workshop that you do on Saturday. We will announce these readings once you have been allocated to workshops.

*Overview of General Readings*

*Introduction*

- Mitchell, Melanie. 2011. *Complexity: A Guided Tour*. Oxford University Press. Chapter 1
- Arthur, W. Brian. 2013. "Complexity Economics: A Different Framework for Economic Thought." *Complexity Economics, Oxford University Press*

*Math Boot-Camp*

- Strogatz, Stephen. 2001. *Nonlinear Dynamics And Chaos: With Applications To Physics, Biology, Chemistry, And Engineering*. Cambridge, MA: Westview Press. p. 4-9; p. 123-129 and 145-150 (ignore 'numerical computation of phase portraits')
- Newman, Mark EJ. 2005. "Power Laws, Pareto Distributions and Zipf's Law." *Contemporary Physics* 46 (5): 323–51.

*Economics*

- Haldane, Andrew G. 2009. "Rethinking the financial network." In *Fragile Stabilität – stabile Fragilität*, edited by Stephan A. Jansen, Eckhard Schröter, and Nico Stehr, 243–78. pp. 1-19.
- Gai, Prasanna, Andrew Haldane, and Sujit Kapadia. 2011. "Complexity, Concentration and Contagion." *Journal of Monetary Economics*, Carnegie-Rochester Conference on public policy: Normalizing Central Bank Practice in Light of the credit Turmoi, 58 (5): 453–70.
- Lux, Thomas, and Michele Marchesi. 2000. "Volatility Clustering in Financial Markets: A Microsimulation of Interacting Agents." *International Journal of Theoretical and Applied Finance* 03 (04): 675–702. focus on the pages until 684.

*Philosophy*

- Keynes, John Maynard. 1936. *General Theory of Employment, Interest and Money*. Ch. 12
- Haslanger, Sally. 2015. "What Is a (social) Structural Explanation?" *Philosophical Studies*, January, 1–18. doi:10.1007/s11098-014-0434-5.
- Björnsson, Gunnar. 2011. "Joint Responsibility Without Individual Control: Applying the Explanation Hypothesis." In *Moral Responsibility*, edited by Nicole A. Vincent, Ibo van de Poel, and Jeroen van den Hoven, 181–99. Library of Ethics and Applied Philosophy 27. Springer Netherlands.

*Regulation*

- Aikman, David, Mirta Galesic, Gerd Gigerenzer, Sujit Kapadia, Konstantinos V. Katsikopoulos, Amit Kothiyal, Emma Murphy, and Tobias Neumann. 2014. "Taking Uncertainty Seriously: Simplicity versus Complexity in Financial Regulation."
- Haldane, Andrew G. 2009. "Rethinking the financial network." In *Fragile Stabilität – stabile Fragilität*, edited by Stephan A. Jansen, Eckhard Schröter, and Nico Stehr, 243–78. pp. 20-31.

**Problem Set**

The problem set is a mix of maths tasks and reading questions.

Deadline for Submission: 18 January 2016

Please submit it online here: http://financeandphilosophy.pandaform.com/pub/al08u3/new

*Math Section*

First do the Strogatz reading. Do not be discouraged if you find the math challenging. If you cannot make progress, simply describe where you struggle.

*Task 1:* Strogatz p. 141, exercise 5.1.7

*Task 2:* Strogatz p. 181, exercise 6.1.1

*Reading Questions*

Please answer each of the questions in no more than 100 words.

*Q1:* According to Arthur, what differentiates complexity economics from mainstream economics?

*Q2:* What are the common properties of complex systems according to Mitchell? Does her characterization of complexity fit with Arthur's?

*Q3:* Methodological Individualism says that good explanations of social phenomena should appeal to the actions of individuals. Sally Haslanger casts doubt on methodological individualism by suggesting that social structural explanations can be good explanations, too. Explain what she means by social structural explanations. Could network models of financial crises be seen as providing social structural explanations?

*Q4:* Read chapter 12 of Keynes' general theory as an attempt to answer the question what about the behaviour of individuals causes exuberance on financial markets. What are the reasons that Keynes gives that lead investors to herding behaviour?

*Q5:* Explain the main features of the Agent-based Model of financial markets developed by Lux and Marchesi in your own words.

*Q6:* Referring to the article by Haldane, provide two examples of how the financial system has changed and why this has made the financial network more fragile.

**Presentations**

General guidelines for presentations

• Stick to the presentation topic
• Stick to the time limit: 15 min
• A projector will be available

Presentations should be in English, but don't be intimidated — we'll have an atmosphere which is quite tolerant of less than perfect English; what matters is that you can get your point across.

All texts for the presentations are in the dropbox folder with the general seminar readings.

*Presentation 1: Flash crashes*

- Text: Sornette & von der Becke (2011): Crashes and High frequency trading
- The aim is to explain whether and how high-frequency trading is related to financial instability, and how this relationship can be illuminated with complexity models.
- Concentrate in particular on the material on pp. 13 -18

*Presentation 2: Why Did Northern Rock Experience a Bank Run?*

- Text: Shin 2013 Reflections on Northern Rock
- The aim is to explain the "bank run" that happened at Northern Rock, and to recapitulate Shin's reasoning why the bank run happened.
- The key point for our purposes is his allusion to the role of Northern Rock as a node in a financial network, esp. on p. 117: "When the financial system as a whole finances long-term, illiquid assets by short-term liabilities, not every institution can be perfectly hedged in terms of its maturity profile. Northern Rock could be seen as such a "pinch point" in the financial system, where tensions would finally be manifested."

*Presentation 3: Adaptive Regulation*

- Text: Arthur 2014: All Systems can be gamed
- The aim of the presentation is to present Arthur's reasons why there cannot be static regulation that rules out financial instability, and to explain his alternative proposal of "adaptive regulation".

If you would like to do one of the presentations, send an eMail to Carsten: mail@carstenjung.net
Deadline: 30 October 2015

**Essays**
*Topics:* We'll run a short session on possible seminar topics during the Blockseminar, and point out possible seminar topics during the seminar. You are encouraged to come up with your own topics. There will be opportunities to do a NetLogo project in connection with your essay.

*General Guidelines*
- Between 4,000 and 5,000 words
- English or German
- Before you start writing, look at this essay writing guide: http://www.phil.cam.ac.uk/curr-students/IA/curr-students/writing-skils/
- Re-read and revise before submitting. Ask a friend to read your paper.
- We set a deadline for the essay with students individually to fit their needs.

*General Structure*
- Define and answer a precise research question (check with us!), give a clear answer to the question which you state in the introduction (your thesis), and use your essay to defend that answer.
- Structure essay according to thesis: No paragraph and indeed no sentence that does not help investigating the thesis belongs in the essay.
- When developing an argument, state premises and conclusion clearly.
    - Make sure the argument is valid
    - Anticipate objections to your premises and discuss in the essay
- When using empirical data, explain and scrutinize it
    - Make sure the data is relevant to your argument and explain how that is
    - Indicate the source
    - Do not only report results, but also show awareness of the methodology used
- Summarize your argument in a brief conclusion

We encourage you to look for additional literature. You are not expected to read everything there is on your topic, however. In depth analysis and development of your own sustained argument matter much more. So, read a few things, but then start writing quickly.