

HEAVY TAILS AND STABLE PARETIAN DISTRIBUTIONS IN FINANCE AND MACROECONOMICS

IN CELEBRATION OF THE
80TH BIRTHDAY OF PROFESSOR
BENOIT B MANDELBROT

ELTVILLE, 10-12 NOVEMBER 2005



Heavy tails and stable Paretian distributions in finance and macroeconomics

- In celebration of the 80th birthday of Professor Benoît B Mandelbrot -

Training Centre of the Deutsche Bundesbank, Eltville, 10-12 November 2005

Organisers¹: Jean-Marie Dufour (Université de Montréal)
Jeong-Ryeol Kurz-Kim (Deutsche Bundesbank)

Wednesday, 9 November 2005

Individual arrival of conference participants and check-in at the Bundesbank Training Centre Eltville (address: Erbacher Str. 18, 65343 Eltville, Germany, Tel.: +49 6123 901-0, Fax: +49 6123 901-399); buffet dinner open from 19.00 -21.00.

Thursday, 10 November 2005

8.00 – 9.00	<i>Registration</i>
9.00 – 9.15	Opening speech Hermann Remsperger (Deutsche Bundesbank)
9.15 – 10.15	Keynote speech: Fractal finance (origins and prospects): power laws and concentration Benoît B Mandelbrot (Yale University)
10.15 – 10.30	<i>Coffee break</i>

¹ The conference is also a part of a research project of the two organisers which is financially supported by the Alexander von Humboldt Foundation

10.30 – 12.00

Session I: Exchange rates

Chair: Jean-Marie Dufour (*Université de Montréal*)

A typology of currency crises

Casper G de Vries (*Erasmus University Rotterdam*)

Discussant: Mico Loretan (*Board of Governors of the Federal Reserve System*)

Statistical properties of exchange-rate fluctuations at minute-by-minute frequencies

Mico Loretan (*Board of Governors of the Federal Reserve System*)

Discussant: Rüdiger Frey (*Universität Leipzig*)

12.00 – 13.30

Lunch

13.30. – 15.45

Session II: Financial risk

Chair: Casper G de Vries (*Erasmus University Rotterdam*)

The risk neutral measure and option pricing under log-stable uncertainty

J Huston McCulloch (*Ohio State University*)

Discussant: Ramazan Gencay (*Simon Fraser University*)

On the robustness of economic models to heavy-tailedness assumptions

Rustam Ibragimov (*Harvard University*)

Discussant: Wolfgang Härdle (*Humboldt-Universität zu Berlin*)

Heavy tails and electricity prices

Rafal Weron (*University of Wroclaw*)

Discussant: Rüdiger Kiesel (*Universität Ulm*)

15.45 – 16.00

Coffee break

16.00 – 18.15

Session III: Portfolio management

Chair: J Huston McCulloch (*Ohio State University*)

GHICA – Risk analysis with GH distributions and independent components

Ying Chen (*Humboldt-Universität zu Berlin*)

Wolfgang Härdle (*Humboldt-Universität zu Berlin*)

and Vladimir Spokoiny (*Humboldt-Universität zu Berlin*)

Discussant: Marc S Paoletta (*Universität Zürich*).

Risk management and dynamic portfolio selection with stable Paretian distributions

Sergio Ortobelli Lozza (*University of Bergamo*)
and **Svetlozar T Rachev** (*Universität Karlsruhe*)
Discussant: **Rustam Ibragimov** (*Harvard University*)

Devising zero-investment strategies using reward-risk stock selection criteria

Svetlozar T Rachev (*Universität Karlsruhe*),
Stoyan Stoyanov (*Universität Karlsruhe*),
Teo Jasic (*Universität Karlsruhe*)
and **Frank J Fabozzi** (*Yale University*)

- 18.15 – 18.45 *Break*
- 18.45 *Transfer by bus to dinner venue:
Gutsrestaurant Schloss Vollrads, Oestrich-Winkel*
- 19.00 *Reception and Dinner*
Dinner speech:
Axel Weber (*President of the Deutsche Bundesbank*)

Friday, 11 November 2005

9.00 – 10.30 **Session IV: Heavy-tailed distribution Theory**

Chair: **Claudia Klüppelberg**
(Technische Universität München)

**Multivariate stable densities and distribution functions:
general and elliptical case**

John P Nolan (*American University*)
Discussant: **Alexander J McNeil** (*ETH Zürich*)

The asymptotic codifference and covariation of log-fractional stable noise

Murad S Taqqu (*University of Boston*)
Discussant: **Gennady Samorodnitsky** (*Cornell University*)

- 10.30 – 11.00 *Coffee break*

11.30 – 12.30

Session V: Statistical inference for stable distributions

Chair: John P Nolan (*American University*)

Exact inference and optimal invariant estimation for the tail coefficient of symmetric alpha-stable distributions

Jean-Marie Dufour (*Université de Montréal*)
and Jeong-Ryeol Kurz-Kim (*Deutsche Bundesbank*)
Discussant: Gennady Samorodnitsky (*Cornell University*)

Estimation of stable distributions by indirect inference

René Garcia (*Université de Montréal*), Eric Renault (*University of North Carolina*) and David Veredas (*Université Libre de Bruxelles*)
Discussant: Marco J Lombardi (*European Central bank*)

12.30 – 14.00

Lunch

14.00 – 16.15

Session VI: Statistical analysis in the presence of stable distributions

Chair: Stefan Mittnik (*Ludwig-Maximilians-Universität München*)

EXACT CONFIDENCE SET ESTIMATION AND GOODNESS-OF-FIT TEST METHODS FOR ASYMMETRIC HEAVY TAILED STABLE DISTRIBUTIONS

Jean-Marie Dufour (*Université de Montréal*)
Lynda Khalaf (*Université Laval*)
Jeong-Ryeol Kurz-Kim (*Deutsche Bundesbank*)
and Marie-Claude Beaulieu (*Université Laval*)
Discussant: Sergio Ortobelli Lozza (*University of Bergamo*)

Asymptotic distribution of linear unbiased estimators in the presence of heavy-tailed stochastic regressors and residuals

Jeong-Ryeol Kurz-Kim (*Deutsche Bundesbank*)
Svetlozar T Rachev (*Universität Karlsruhe*)
and Gennady Samorodnitsky (*Cornell University*)
Discussant: Murad S Taqqu (*University of Boston*)

A note on unit root tests with infinite variance noise

D M Mahinda Samarakoon (*University of Toronto*)
and Keith Knight (*University of Toronto*)
Discussant: Jeong-Ryeol Kurz-Kim (*Deutsche Bundesbank*)

16.15 – 16.45

Coffee break

16.45 – 18.30

Round table:

The role of stable distributions for financial market analysis

Benoît B Mandelbrot (*Yale University*)

Casper G de Vries (*Erasmus University Rotterdam*)

Jean-Marie Dufour (*Université de Montréal*)

Paul Embrechts (*ETH Zürich*)

Mico Loretan (*Board of Governors of the Federal Reserve System*)

J Huston McCulloch (*Ohio State University*)

moderated by **Stefan Mittnik** (*Ludwig-Maximilians-Universität München*)

18.30 – 19.00

Break

19.00

Dinner

(*Venue: Bundesbank Training Centre, restaurant, lower ground floor*)

Saturday, 12 November 2005

9.00 – 10.30

Session VII: Volatility modelling

Chair:

Paul Embrechts (*ETH Zürich*)

Stable mixture GARCH models

Markus Haas (*Ludwig-Maximilians-Universität München*), Stefan Mittnik (*Ludwig-Maximilians-Universität München*),

Marc S Paoletta (*Universität Zürich*)

and Sven-Christian Steude (*Universität Zürich*)

Discussant: John P Nolan (*American University*)

Estimating the COGARCH(1,1) model – a first go

Claudia Klüppelberg (*Technische Universität München*)

10.30 – 11.15

Coffee break

11.15 – 12.00

Indirect estimation of α -stable stochastic volatility models

Marco J Lombardi (*European Central Bank*)

and Giorgio Calzolari (*Università degli Studi di Firenze*)

Discussant: Uta Kretschmer (*Rheinische Friedrich-Wilhelms-Universität Bonn*)

12.00 – 13:30

Lunch

13.30 – 15.00

Session VIII: Other models for heavy tails in finance

Chair: **Gennady Samorodnitsky** (*Cornell University*)

Multivariate extremes and market risk scenario

Paul Embrechts (*ETH Zürich*)

Discussant: Dirk Tasche (*Deutsche Bundesbank*)

Extreme spectral risk measures: an application to futures clearinghouse margin requirements

John Cotter (*University College Dublin*)

and Kevin Dowd (*University of Nottingham*)

Discussant: Peter Raupach (*Deutsche Bundesbank*)

15.00

End of conference and return transport to Frankfurt

Professor Axel Weber

President of the Deutsche Bundesbank

Dinner Speech

Bundesbank Conference on

“Heavy tails and stable Paretian distributions in finance and
macroeconomics”

in celebration of the 80th birthday of
Professor Benoît B Mandelbrot

Deutsche Bundesbank's Conference Centre, Eltville, Germany

10 – 12 November 2005

Eltville, 10 November 2005

Dear Professor Mandelbrot, ladies and gentlemen,

It is a very great pleasure for me to welcome you all to this conference dinner, especially after such an exciting and simulating day as today. In particular, I am very happy that Professor Mandelbrot and his spouse are present.

With regard to the topic of our conference, let me just mention the significance of heavy tails in the distribution of economic variables and the importance of this conference to us as central bankers.

It is well known nowadays that many economic variables, mostly high-frequency data in finance and macroeconomics, are heavy-tailed distributed. There is almost no need to mention highly volatile financial data, such as exchange rates and stock prices, as examples. Even interest rates and inflation rates are not uncommonly observed as heavy-tailed variables. The price of oil in recent times would be an appropriate example of heavy tails as a speculative price which has an enormous influence on other macroeconomic variables.

This fact has also been demonstrated in many of today's papers on currency crisis, on financial risks and portfolio operations. Furthermore, it has been shown that the methods for analyses of such data and the interpretation of results from such analyses could be quite different from those under the conventional assumption. Some of the papers warn against a possible systematic underestimation of financial and banking risks on the basis of the normal distribution. Others demonstrate that statistical inferences for estimations and hypothesis tests, and, hence, economic interpretations depend crucially on distributional assumption for underlying data. To sum up: it should be kept in mind that heavy tails and possibly stable Paretian distributions seem to be very relevant when underlying data are high-frequency in economics and finance.

Therefore, it is not surprising that, since Professor Mandelbrot's seminal work in 1963¹, which proposed Levy-stable distributions for the behaviour of speculative prices, a considerable body of theoretical and empirical literature on this topic has

¹ B Mandelbrot (1963): The Variation of Certain Speculative Prices, *Journal of Business* 36, 394 - 419.

emerged.

To mark Professor Mandelbrot's 80th birthday, the Bundesbank Annual Autumn conference 2005 entitled "Heavy tails and stable Paretian distributions in finance and macroeconomics" aims to bring together economists, econometricians, statisticians and empirical researchers in finance and macroeconomics to present and discuss recent developments in this field. Furthermore, this conference also aims to bring Professor Mandelbrot's perspective closer to empirical research. This is particularly important for us as we have to understand its relevance to our own daily analyses.

Monetary policy transmission processes and economic relationships, are, by their very nature, complex. Understanding and interpreting financial markets correctly is of utmost importance for a central banker. On the one hand, useful information for monetary policy from the financial markets can be obtained – risk attitude and expectation of inflation of economic agencies, for example. On the other hand, given a possible causal relationship from monetary policy to financial markets – as has recently been demonstrated empirically by Bernanke and Kuttner² for example – I, as a central banker, would like to interpret the lesson to be learned from Professor Mandelbrot's work as a warning against extreme events. This is not only a useful message for central banks insofar as they are involved in banking supervision. This should be also borne in mind with regard to monetary policy itself. In this respect, I guess a medium-term-oriented monetary policy has a major contribution to make against producing such extreme events.

Understanding Professor Mandelbrot's fractal finance means being aware of the fact that we are confronted with many more bubbles, ruins and extreme outliers than the conventional theory tells us. Therefore, Professor Mandelbrot recommends that we central bankers construct monetary policy, banking supervision and market portfolio operation like Noah's ark – a ship that is capable of withstanding the flood in the risky financial and economic sea.

² B S Bernanke and K N Kuttner (2005): What Explains the Stock Market's Reaction to Federal Reserve Policy?, *The Journal of Finance* 60 (3), 1221-1257. [An unexpected 25-basis-point rate cut would typically lead to an increase in stock prices in the order of 1%. By asking whether monetary policy affects stock values through its effects on real interest rates or expected future dividends/stock returns: the reaction of equity prices to monetary prices is not directly attributable to policy's effects on the real interest rate, because the movements in the real interest rates induced by surprise policy actions is relatively transitory, i.e. the expected future dividends/stock returns matter.]

In this sense, I hope that our conference held in celebration of Professor Benoît Mandelbrot's 80th birthday will contribute to gaining a better understanding of Noah's belief in God – or, putting it another way, Professor Mandelbrot's lecture on fractals finance for practitioners in their empirical work.

Dear Professor Mandelbrot, allow me to summarise briefly your academic principle – at least in the field of finance and macroeconomics. You observe empirical phenomena and translate them into your – I emphasise the word *your* – laws of mathematics by means of visualisation, namely fractals geometry. You analysed cotton prices in the early 1960s, the behaviour of speculative prices, visualised it as the biblical stories of Noah and Joseph, and revealed them through the Levy-stable distribution family. This has changed Bachelier's normal world into Mandelbrot's stable one.

I know, dear Professor Mandelbrot, that – as you remarked in a recent press interview³ – you never talk about your own portfolio. But I hope that our conference will bring us a step closer to being able to imagine what Professor Mandelbrot's private portfolio might look like – assuming that he does what he says!

Lastly, on behalf of the Deutsche Bundesbank, I would like to thank you, and your spouse, again very much for your coming here and for lecturing at the Bundesbank conference this year. Also, I would like to congratulate you on your 80th birthday and wish you a “fractals success” which is as infinite as the length of the United Kingdom's coastline. As mementos of our conference, I would now like to present your spouse with a bouquet and you with a small souvenir.

I have read that Professor Mandelbrot has recently been busy with a mathematical concept – ‘negative dimensions’, which are a way of measuring how empty something is. In *traditional* mathematics, only one set is called empty. It contains nothing whatsoever. But Professor Mandelbrot argues that some sets are “emptier than empty” in a certain useful way. With respect to our conference, I would just like

³ Er hat in einem Interview mit der Frankfurt Allgemeinen Zeitung am 04.06.2005 gesagt: *Ich habe es mir in meinem Leben zur Maxime gemacht, über vier Dinge nicht zu sprechen: Politik, Religion, Sex und mein Portfolio.*

to imitate his concept of negative dimensions by constructing a 'positive dimension' as follows: I hope that our conference will be "fuller than full" in its outcome.