SOE 18: Financial Markets and Risk Management I

Time: Thursday 10:15–13:15 Location: GÖR 226

SOE 18.1 Thu 10:15 GÖR 226

The dynamics of the World Income distribution — Faustino Prieto and •Jose Maria Sarabia — University of Cantabria, Santander, Spain.

In this paper, the dynamics of the World Income distribution is studied. The World Income distribution is considered in terms of the Gross Domestic Product (GDP), GDP per capita, GDP at purchasing power parity power (PPP) and GDP-PPP per capita. The country information data is taken from the International Monetary Fund (IMF) for the period 1980 to 2005.

Six different probabilistic distributions are fitted and compared: lognormal, Singh-Maddala, Dagum, Tsallis, classical Pareto and Pareto positive stable (PPS) distributions.

All of these six models are fitted by maximum likelihood. In order to studied several hypotheses, a rolling sample methodology is implemented. This methodology enables to study the sensitivity of the results with respect to the number of the countries included in the sample as well as to analyze the power-law behavior in the upper tail of the distribution.

The different models are compared using the Akaike information criterion (AIC). The PPS and lognormal distributions provide the best fit. The model validation is done by using different types of graphics, including Q-Q and log-log rank-size plots.

Finally, the PPS distribution is used to analyze the dynamics of the World Income distribution, establishing a comparison with the IMF predictions.

SOE 18.2 Thu 10:30 GÖR 226

Record statistics in financial data — •Gregor Wergen, Miro Bogner, and Joachim Krug — Institut für Theoretische Physik, Universität zu Köln

We consider the occurrence of record-breaking events in asymmetric random walks and compare our results to financial data from the Standard and Poors index. Making use of the Sparre Andersen Theorem we analyze the first-passage probabilities of asymmetric random walks and give some new analytical results on the record statistics of such processes. Most importantly we can quantify the effect of a linear drift in the random walk on the occurrence of records. Our model allows us to explain the statistics of upper records in the daily stock data. However, we find that the number of lower records in the stock prices is significantly decreased. We tentatively explain this effect by performing a detailed analysis of the persistence properties of the stock prices.

SOE 18.3 Thu 10:45 GÖR 226

Dominating clasp of the financial sector revealed by partial correlation analysis of the stock market — •Dror Kenett[1], Michele Tumminello[2], Asaf Madi[1], Gitit Gur-Gershgoren[3], Rosario Mantegna[2], and Eshel Ben-Jacob[1] — [1]School of Physics and Astronomy, Tel-Aviv University, Israel — [2]Dipartimento di Fisica e Tecnologie Relative, Universit'a di Palermo, Palermo, Italy — [3]Israel Securities Authority, Jerusalem, Israel

What are the dominant stocks which drive the correlations present among stocks traded in a stock market? Can a correlation analysis provide an answer to this question? We introduce a new concept to tackle the above question - the partial correlation network. Partial correlation is a measure of how the correlation between two variables, e.g. stock returns, is affected by a third variable. By using it we define a proxy of stock influence, which is then used to construct partial correlation networks. The empirical part of this study is performed on a specific financial system, namely the set of 300 highly capitalized stocks traded at the New York Stock Exchange, in the time period 2001-2003. By constructing the partial correlation network, unlike the case of standard correlation based networks, we find that stocks belonging to the financial sector and, in particular, to the investment services sub-sector, are the most influential stocks affecting the correlation profile of the system. Our findings shed a new light on the underlying mechanisms and driving forces controlling the correlation profile observed in a financial market.

SOE 18.4 Thu 11:00 GÖR 226

Heterogeneity in individual price impact — •Alex Bladon[1], Tobias Galla[1], and Esteban Moro[2] — [1]Theoretical Physics Dept. University of Manchester, Oxford Road, Manchester, UK, M13 9PL — [2]Departament de Matemáticas, Universidad Carlos III de Madrid, 28911, Leganés, Spain

The study of financial time series has become a substantial area of research thanks to the large amount of available data. However, the majority of this data contains no information about what traders are associated with any one transaction. Hence there is little empirical information on the behaviour of individuals on financial markets. We here present an analysis of data from the Spanish stock market capturing this individual level information, linking each trade to the IDs of the firms involved.

We use this data to investigate how individual firms manage price impact. Price impact describes the change in the price of a stock due to a trades of different sizes - a phenomenon studied at length at the market level. We show that there is a high degree of heterogeneity in the instantaneous price impact functions of individuals and find evidence suggesting the use of selective liquidity taking. We also consider time-dependent price impact, as measured by response functions. Bouchaud et al propose a market-level bare impact function (Quantitative Finance, Vol. 4, 176-190, 2004) describing how markets digest trades over time. We test the applicability of this global model to individual agents and ask how strongly response functions depend on what individuals were involved in the transaction triggering the response.

SOE 18.5 Thu 11:15 GÖR 226

Tobin Tax in Minority Game Market Models — •Josephine Mielke, Felix Patzelt, and Klaus Pawelzik — Institute for Theoretical Physics, Department Neurophysics, University of Bremen, Bremen, Germany

The introduction of the Tobin Tax is discussed as a financial tool to reduce speculation and short-term trading at foreign exchange (FX) markets, to reduce large fluctuations and thereby to protect national currency stability.

Minority Games serve as minimal models of financial markets. In particular, they reproduce the power-law distributed return fluctuations (stylized facts) by operating close to a phase transition.

In order to include the Tobin Tax we propose to extend a Minority Game market model to include a trading mechanism, fundamentalists and speculators ('chartists'). When chartists are endowed with limited resources and subjected to the tax we observe, that FX rate fluctuations decrease. A reduced number of speculators remain in the market exploiting the increased predictability. Fundamentalists with unlimited resources are not affected by the tax as they function as liquidity suppliers. They correspond to investment banks at real FX markets which do not participate in short-term trades. We find an intermediate tax which maximizes tax revenue and noticeably reduces market fluctuations.

15 min. break

SOE 18.6 Thu 11:45 GÖR 226

Solutions of nonlinear stochastic differential equations with long-range power-law distributions — •Julius Ruseckas, Vygintas Gontis, and Bronislovas Kaulakys — Institute of Theoretical Physics and Astronomy, Vilnius University, A. Gostauto 12, LT-01108 Vilnius, Lithuania

A class of nonlinear stochastic differential equations, providing the long-range processes, the power-law behavior of spectra, including $1/f$ noise, and the power-law distributions of the probability density has been proposed [1] and solved [2]. The models involve the Generalized Constant Elasticity of Variance Process, the Bessel Process and the Squared Bessel Process, which are applied for modeling of the financial markets [3].

[1] B. Kaulakys, J. Ruseckas, V. Gontis and M. Alaburda, Physica A **365**, 217 (2006); B. Kaulakys and M. Alaburda, J. Stat. Mech. P02051 (2009).

[2] J. Ruseckas and B. Kaulakys, Phys. Rev. E **81**, 031105 (2010).

[3] V. Gontis, J. Ruseckas and A. Kononovicius, Physica A **389**, 100 (2010).

SOE 18.7 Thu 12:00 GÖR 226

The origin of Pareto law in house price distribution — •Takaaki Ohnishi[1,2], Takayuki Mizuno[3,1], Chihiro Shimizu[4], and Tsutomu Watanabe[3,1] — [1]The Canon Institute for Global Studies, Tokyo, Japan — [2]Graduate School of Economics, The University of Tokyo, Tokyo, Japan — [3]Institute of Economic Research, Hitotsubashi University, Tokyo, Japan — [4]Faculty of Economics, Reitaku University, Chiba, Japan

We empirically investigate the house price distributions in the Greater Tokyo Area by using a unique dataset containing individual listings of 724,416 condominiums from 1986 to 2009 [1]. The house price follows a Pareto (power-law) distribution. On the other hand, the house size follows an exponential distribution, which is explained by maximizing the entropy (the number of variety of house sizes) subject to the constraint of a fixed total size of all houses.

We find a positive linear relationship between the log price and the size. This is justified by the fact that size-adjusted prices follow a lognormal distribution except for the housing bubble periods. By considering the location of a house as an additional attribute, the distribution of size-adjusted price is close to a lognormal distribution even in bubble periods.

Pareto law in house price distribution can be considered to be generated by the exponential distribution of house size and the linear relationship between the log price and the size.

[1] T. Ohnishi, T. Mizuno, C. Shimizu and T. Watanabe, "On the Evolution of the House Price Distribution", preprint (2010).

SOE 18.8 Thu 12:15 GÖR 226

Statistical Mechanics of a spin stock market model — •Sebastian Krause and Stefan Bornholdt — Institut für Theoretische Physik, Universität Bremen, Otto-Hahn-Allee, 28359 Bremen

The prices of stocks and other financial assets show a typical behavior, known as stylized facts. One example is the power law distribution of the logarithmic absolute returns, wich means that big changes are more common than in a Gaussian random walk, hence there is more risk.

For a better understanding of the emergence of stylized facts from local behavior, the study of agent based models with specific statistical properties is reasonable. We here investigate a magnetic spin model, which is known to reproduce several stylized facts [1]. We identify the mechanism, which leads to power law distributed returns, especially considering finite size effects, and find a crossover in the model dynamics. Our findings also shed some light on the fact that power laws can be found for different time scales with increasing volatility (hence risk) for larger times, reflecting the same property in real markets.

[1] S. Bornholdt, Expectation bubbles in a spin model of markets: Intermittency from frustration across scales, Int. J. Mod. Phys. C, Vol. 12, No. 5 (2001) 667-674; T. Kaizoji, S. Bornholdt, Y. Fujiwara, Dynamics of price and trading volume in a spin model of stock markets with heterogeneous agents, Physica A 316 (2002) 441-452

SOE 18.9 Thu 12:30 GÖR 226

Dependence of defaults and recoveries in credit risk models — •Rudi Schäfer[1] and Alexander Koivusalo[2] — [1]Fakultät für Physik, Universität Duisburg-Essen, Germany — [2]Danske Capital, Copenhagen, Denmark

In view of the recent financial crises the modelling of credit risk is of great importance. There are two fundamentally different modelling approaches: the structural approach which derives both default events and recovery rates from the value of an underlying process at maturity time. And the reduced form approach where defaults and recovery rates are modelled independently. First, we discuss the structural model with correlated diffusion analytically. We find a functional relation between default probabilities and recovery rates with only a single parameter. Although derived for the diffusion case, we demonstrate in Monte-Carlo simulations that the same relation also holds for other processes in very good approximation. We discuss how to incorporate this relation into reduced form models, in order to restore essential structural information which is usually neglected in the reduced form approach.

SOE 18.10 Thu 12:45 GÖR 226

LPM method for portfolio optimization: theory and praxis — •Uli Spreitzer[1] and Vladimir Reznik[2] — [1]Bonus Pensionskassen AG, Traungasse 14-16, 1030 Vienna, Austria — [2]Towers Watson Deutschland GmbH, Abraham-Lincoln-Str. 22, 65189 Wiesbaden, Germany

The well known discussion on what is the most reasonable measure of risk (e.g. not VaR, Artzner [1]) many fund companies (or Pensionskasse in Austria) still use the variance based optimisation strategies. As we suggested, other measures as e.g. lower partial moments LPM may be much more suitable. Most because this measure covers the economic risk much better. Some time ago a fund suitable for pension funds uses this LPM method with excellent results during the financial crisis 2008 - 2010. We will explain, why this method is so successful

[1] P. Artzner, F. Delbaen, J.M. Eber, and D. Heath, Coherent measures of risk. Mathematical Finance, 9: 203ff,1999.

[2] MAARK funds of West LB Mellon

[3] U.W. Spreitzer and V. Reznik, On the optimization of a CAPM portfolio using lower partial moments as measure of risk and using the possibility of safeguarding its loss, Physica A: 378, 2, 423ff, 2007

SOE 18.11 Thu 13:00 GÖR 226

Some considerations on scaling of measures of risk with time — Uli Spreitzer[1] and •Thomas Riepl[2] — [1]Adertshausen 5, 92277 Hohenburg, Germany — [2]Thomas-Mann-Str. 22, 93077 Bad Abbach, Germany

Beside the well known discussion on what is the most reasonable measure of risk (e.g. not VaR, Artzner [1]) investment funds must face the problem that they have cash flow with a certain granularity, and they must optimize using risk measures, which used as input data with a certain granularity. Risk measures are according to Brown movement is used. Using data from several stock indices we show, that this scaling is insufficient and underestimates the increase of these risk measures with time. This in accordance with other results [2]

[1] P. Artzner, F. Delbaen, J.M. Eber, and D. Heath. Coherent measures of risk. Mathematical Finance, 9: 203ff,1999.

[2] Jón Daníelsson, Jean-Pierre Zigrand, On time-scaling of risk and the square-root-of-time rule, Journal of Banking and Finance, 30, 10, 2701ff (2006)