

AKSOE 10 Poster Session (posters are expected to be displayed the full day 8:30-18:00)

Time: Wednesday 16:00–18:00

Room: P2

AKSOE 10.1 Wed 16:00 P2

Increasing market efficiency: Evolution of cross-correlations of stock returns — ●BENCE TÓTH^{1,2} and JÁNOS KERTÉSZ^{1,3} —

¹Department of Theoretical Physics, Budapest University of Technology and Economics, Budafoki út 8, H-1111 Budapest, Hungary — ²Lagrange Interdisciplinary Laboratory for Excellence in Complexity ISI Foundation, Turin, Italy — ³Laboratory of Computational Engineering, Helsinki University of Technology, P.O.Box 9400, FIN-02015 HUT, Finland

We analyse the temporal changes in the cross correlations of returns on the New York Stock Exchange. We show that lead-lag relationships between daily returns of stocks vanished in less than twenty years. We have found that even for high frequency data the asymmetry of time dependent cross-correlation functions has a decreasing tendency, the position of their peaks are shifted towards the origin while these peaks become sharper and higher, resulting in a diminution of the Epps effect. All these findings indicate that the market becomes increasingly efficient.

AKSOE 10.2 Wed 16:00 P2

Pattern detection in Continuous Double Auction Markets —

●BETTINA HOSER and ANDREAS GEYER-SCHULZ — Chair of Information Services and Electronic Markets; Universität Karlsruhe (TH); 76128 Karlsruhe

In this paper the method of eigensystem analysis of complex Hermitian adjacency matrices is used to analyze accounting patterns in markets such as a political stock market. We model an accounting system of a market as an asymmetric weighted digraph. Depending on the accounting system structure the result of the eigensystem analysis yields different degrees of detail.

If a market is organized such that each trade has to be made via a central market counter party, we see the eigensystem of a bipartite graph with the shares on one side and the traders on the other. It represents the trading behavior within the submarkets but gives almost no information on the trading behavior between the traders. If on the other hand the underlying graph is defined such that a link between two traders is formed if the offer of one trader is matched with the demand of the other (this can be done by an equivalent transformation in the records of the accounting system), the eigensystem yields information on the trading behavior between traders. These two perspective could lead to new insights and invariants on market efficiency and fraud within a market.

[1] M. Franke, A. Geyer-Schulz, B. Hoser: Analyzing Trading Behavior in Transaction Data of Electronic Election Markets; Data Analysis and Decision Support; D. Baier, R. Decker, L. Schmidt-Thieme (eds.); Springer (2005); p.222–230.

AKSOE 10.3 Wed 16:00 P2

Variations of the Bak Asset Market Model — ●BORIS BRODDA, JOHANNES J. SCHNEIDER, SEBASTIAN GOLKE, TOBIAS PREIS, and WOLFGANG PAUL — Institute of Physics, Johannes Gutenberg University of Mainz, Staudinger Weg 7, 55099 Mainz, Germany

In the Bak stock market model, several agents buy and sell shares at a virtual stock market. In this model, which can be generalized also to other kinds of assets, the agents update their individual conceptions of the price for buying and selling an asset, respectively, according to the current market price, a drift probability, and an imitative behavior [1].

We introduce several variations of this Bak model by adding new approaches for volatility feedbacks. One approach already mentioned in [1] consists of adapting the individual conceptions according to the price change during some time interval. Another approach focuses on the agents' strategies, which contain profit taking, stop loss orders, and momentum analysis.

In our investigations, we concentrate on some stylized facts of the asset returns, which can e.g. be determined from the autocorrelation function of returns and absolute returns.

[1] P. Bak, M. Paczuski, and M. Shubik, *Physica A* **246**, 430, 1997.

AKSOE 10.4 Wed 16:00 P2

Introduction and Investigation of a Multi-Agent Based Order Book Model of Financial Markets — ●TOBIAS PREIS, SEBASTIAN GOLKE, WOLFGANG PAUL, BORIS BRODDA, and JOHANNES J. SCHNEIDER —

Institute of Physics, Johannes Gutenberg University of Mainz, Staudinger Weg 7, 55099 Mainz, Germany

We introduce a new model for simulating financial markets, based on an order book, in which several agents trade assets at a virtual exchange. The agents can place and cancel orders at different rates according to their individual strategies.

The foundation of our model is an order book structure that is close to reality. We provide two types of traders, liquidity providers and liquidity takers with different strategies.

AKSOE 10.5 Wed 16:00 P2

To a local approximation method of time-series short-range predictability of developing assets — ●MICHAEL ROMANOVSKY — Vavilov str., 38 119991 Moscow Russia

Two facts permit us to consider assets of developing stock markets as complex dynamical systems (or, at least, "more dynamical" than the respect developed assets): a comparably small quantity of stocks and players and an influence of developed stock markets [1]. The method of short-range forecast is proposed for developing stock markets based on the generalized linear approximation of a day return. The method deals with the daily-recorded time series return of the investigated asset. The first step is the searching of predecessor time series parts, which have similar past values in comparison with the present part of the investigated time series. The short-range forecast (for one day and several days) is produced as some mean of these time series parts continued up to the forecast horizon. Thus we increase a redundant information of this time series [2]. The method gives satisfactory good several-days forecast: prediction of investigated time-series return changes (up or down) is larger than 60%, and the ratio of prediction error variation to the time-series variation is normally less than one. 1.T.B.Ersov, M.Yu.Romanovsky. Modern problems of statistical physics, 2, 168-179 (2003). 2.R.N.Mantegna, H.E.Stanley. An introduction to econophysics. Correlation and complexity in finance. Cambridge University Press (Cambridge 2000).

AKSOE 10.6 Wed 16:00 P2

Multiple time scales and the exponential Ornstein-Uhlenbeck stochastic volatility model — ●JOSEF PERELLÓ and JAUME MASO-LIVER — Universitat de Barcelona

We study the exponential Ornstein-Uhlenbeck stochastic volatility model and observe that the model shows a multiscale behavior in the volatility autocorrelation. It also exhibits a leverage correlation and a probability profile for the stationary volatility which are consistent with market observations. All these features make the model quite appealing since it appears to be more complete than other stochastic volatility models also based on a two-dimensional diffusion. We present an approximate solution for the return probability density designed to capture the kurtosis and skewness effects. This approximate is also very useful to option pricing. We finally study the smile effect in this model with parameters estimated with the underlying data.

AKSOE 10.7 Wed 16:00 P2

Statistical Analysis of Stock-Market Fluctuations: A Single Parametric Formulation — ●PRAGYA SHUKLA — Department of Physics, IIT Kharagpur-721302, West Bengal, India

An understanding of the stock-market dynamics requires a characterisation and quantification of the correlations in the prices of various stocks at a series of time-steps. To obtain the mutual correlations between N such stocks, therefore, one needs to analyze the correlation matrix " C ", with its elements as the correlation function between two stock-prices, represented by the time series. However the complexity of the stock market leads to complicated fluctuation of prices and an exact determination of the associated time-series is not always possible. The correlations can be obtained, therefore, only within a certain distribution, resulting in " C " as a random matrix. The mutual dependence of various stocks and their effect on stock market fluctuations can thus be characterized by the nature of the associated correlation matrix, that is, by its eigenvalue and eigenvector statistics. Our analysis of the correlation matrices of various stock markets reveals the existence of a deep level of universality underlying their statistical behavior.

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AKSOE 10.8 Wed 16:00 P2

Interacting Gap Model — ●ANDREJ SVORENČÍK¹ and FRANTIŠEK SLANINA² — ¹Dept. of Theoretical Physics and Didactics of Physics, Faculty of Mathematics, Physics and Informatics Comenius University, Mlynska Dolina, 842 48 Bratislava, Slovak Republic — ²Institute of Physics, Czech Academy of Sciences, Na Slovance 2, CZ-182 21 Prague, Czech Republic

The interacting gap model is one of the theoretical attempts to reconcile various numerical and theoretical results about the limit-order market models of financial markets. We firstly formulate a kinetic equation which describes the dynamics of this model. Secondly, numerical and partial analytical solution is provided. Lastly, we relate these new results to the power law tail of the return-distribution of stock-market fluctuations.

AKSOE 10.9 Wed 16:00 P2

The socioeconomic equation of state, structural interest rates, employment, and growth — ●H G DANIELMEYER — Inst. f. Neuro- and Bioinformatics, Luebeck, Ratzeburger Allee 160

In the 1980ies the G7 reached the state where intelligent use became as important for growth as intelligent production. The input variables labor and physical capital (K) are complemented by introducing spare time and user potential (UP) as output variables. An exact socioeconomic equation of state (SES) is obtained that yields the working and spare time, gross domestic product (GDP), K, and UP in analytically closed form without any adjustable parameter. The continuous agreement with the real per capita data from 1850 to date is perfect for coherent phases of G7 growth, including recovery and convergence dynamics of post war Germany and Japan. The values obtained for the UP per capita agree with the value of human capital per capita as computed from the cost of national education systems. For the first time an interest rate can be obtained from extensive economic variables: The long-term dynamic structural rate $Z=(dK/dt)/UP$. It agrees well with Germany's post WWII bond rates: K/UP is a valid measure of investment risk. For the G7, the limits to growth are spare time and education for UP, no longer working time and K.

AKSOE 10.10 Wed 16:00 P2

The pace of networking technical and social innovation may be genetically stabilized — ●H G DANIELMEYER — Inst f. Neuro- und Bioinformatik, Lübeck, Ratzeburger Allee 160

The evolution of the leading nation's real gross domestic products per capita from the UK of 1750 to the G7 of 2000 fits a simple S-curve with half time in 2040 and exponential decay rate of $1/60$ p. a. Only a very basic process can stabilize the pace of innovation over 10 generations. The first explanation assumed that networking technical and social innovations requires generally the sum of the average lifetime of our physical capital of $F=25$ years and a postulated social reaction time against change of $M=35$ years. The second uses the result that the corresponding life expectancies yield the same S-function (preceding the evolution by 30 years). The heritability of longevity (A. M. Herskind et al., Hum Genet (1996) 97: 319-323) shows that some experiences made in life can be passed on to the next generation. For this process the reproduction biology yields indeed the sum $F+M$, but now with a genetic instead of a sociotechnical meaning: The pace of the industrial evolution may be genetically stabilized and therefore predictable.

AKSOE 10.11 Wed 16:00 P2

Dynamics of correlations from a FTSE100 portfolio — ●RICARDO COELHO, STEFAN HUTZLER, PRZEMYSŁAW REPETOWICZ, and PETER RICHMOND — School of Physics, Trinity College, University of Dublin

In the last years many studies were made about Financial Markets and their topology. We study time series of daily data of stocks belonging to FTSE100 and compute the correlations between them. Using the concept of distance introduced by Mantegna [1], we then compute Minimal Spanning Trees for this data. We find these trees much less clustered than the Minimal Spanning Trees that we obtained from treating the logarithmic returns as random numbers from a Gaussian distribution. We also study the mean correlation and variance of the correlations as a function of time and with varying window sizes. As in [2] we find that these two moments appear to be strongly correlated with each other. This may be understood with the help of a simple analytic model based on the concept of moving averages.

[1] R. N. Mantegna, Eur. Phys. J. B **11**, 193 (1999)

[2] J.-P. Onnela, A. Chakraborti, K. Kaski, J. Kertesz and A. Kanto, Phys. Rev. E **68**, 056110 (2003)

AKSOE 10.12 Wed 16:00 P2

Feedback between market return and excess demand of heterogeneous interacting traders — ●FERNANDO PIGEARD DE ALMEIDA PRADO — f,p

We introduce an agent-based model for the price dynamics of financial assets.

In this model each trader evaluates the fundamental value of the asset differently from each other. Each trader is also influenced by the opinion of some local trusted peers.

For uniformly distributed evaluations of the fundamental value of the asset we find a dynamical critical point of the price evolution which is determined by the competition of social susceptibility and the trader's heterogeneity. Below the critical point we compute exactly the approach to equilibrium of the market return in terms of an average over realizations of the stochastic dynamics.

Non-rigorous treatment of the critical point suggests the occurrence of price oscillations with a frequency determined the ratio of return rate and social heterogeneity.

For a more sharply peaked heterogeneity distribution we prove that the invariant measure of the decision process is an Ising measure on the network. Here equilibrium criticality is determined by the network structure and the strength of social susceptibility.

AKSOE 10.13 Wed 16:00 P2

Portfolio optimization with respect to different risk types. — ●URSZULA SKORNIK-POKAROWSKA¹ and ARKADIUSZ ORLOWSKI^{1,2} — ¹Katedra Ekonometrii i Informatyki SGGW, Nowoursynowska 159, 02-787 Warszawa — ²Instytut Fizyki PAN, al. Lotników 32/46, 02-668 Warszawa

There are many risk types, such as inflation risk, credit rates risk, ect. Some of them can be estimated based on macroeconomic indicators. We show an example of portfolio optimization done for Warsaw Stock Exchange with respect to different risk types.

AKSOE 10.14 Wed 16:00 P2

Examples of risk measures and their application to portfolio optimization — ●URSZULA SKORNIK-POKAROWSKA¹ and ARKADIUSZ ORLOWSKI^{1,2} — ¹Katedra Ekonometrii i Informatyki SGGW, Nowoursynowska 159, 02-787 Warszawa — ²Instytut Fizyki PAN, Al. Lotników 32, 02-668 Warszawa

In the paper we present and compare some examples of risk measures such as VaR, CVaR, Hurst exponent and some traditional measures based of coefficient of variation or standard deviation. Experimental analysis made for Warsaw Stock Exchange shows how useful the measures can be for investment portfolio optimization.

AKSOE 10.15 Wed 16:00 P2

A subjective approach to the risk measurement — ●PIOTR JAWORSKI — Institute of Mathematics, Warsaw University, ul. Banacha 2, 02-097 Warszawa, Poland

Decision making in finance is decision making under uncertainty. A natural question is how to measure risk. In my talk I would like to present a subjective point of view on risk measurement.

If a financial institution has a risky position then it has to prepare some reserves to secure its position. It is natural to consider the optimal level of reserves as a risk measure of the position. Furthermore we assume that the "risk-bearers" are "rational". Their decisions depend on their subjective preferences. In our model these preferences are described by two non-decreasing, weakly convex functions L_1 and L_2 . The first one measures the cost of keeping reserves, and the second the loss when the reserves are not sufficient. Let the random variable \mathcal{X} describe the liabilities, and the function

$$L(\mathcal{X}, r) = L_1(r) + L_2((\mathcal{X} - r)^+)$$

costs. The risk-bearer, whom we assume to be rational, chooses the optimal level of reserves r^* , i.e. such that no other level r gives better outcome

$$\forall r \quad V(r, r^*) = E(L(\mathcal{X}, r) - L(\mathcal{X}, r^*)) \geq 0.$$

The optimal r^* becomes a measure of the risk associated with \mathcal{X} . Note, that for any fixed r such r^* is a minimizer of the expected relative costs $V(\cdot, r)$.

AKSOE 10.16 Wed 16:00 P2

Investigation on optimization of portfolios by different methods — •ULI WILLIBALD SPREITZER and VLADIMIR REZNIK — Dr. Dr. Heissmann GmbH, Abraham-Lincoln-Str. 22, 65191 Wiesbaden

Using portfolios consisting of shares and bonds we investigate different optimization methods and the effects on the portfolios. The optimization methods we used were the standard optimization (maximization of rate of return minus (λ times volatility or variance)) and rate of return minus (κ times the expected loss (or premium to safeguard this loss)). The later one, the lower partial moments method, is based on works of Fishburn [1] and our works [2]. The standard method results in portfolios which have a lower rate of return of the portfolio (for large λ) or have more risk (for small λ) compared to portfolios which are optimized by the lower partial moments method. This can be shown for different kind and shares and bonds.

[1] Fishburn, P., Mean-risk analysis with risk associated with below-target returns; American Economic Review; 1977; 67, 116-26

[2] Reznik, V., Spreitzer U. W.; An investigation of a portfolio-loss under CAPM; Proceedings of the 15th AFIR colloquium Zuerich CH; 6-9, 2005, Session B6: pensions

AKSOE 10.17 Wed 16:00 P2

Investigation on CAPM-portfolios built by agents with insufficient knowledge of the market — •VLADIMIR REZNIK and ULI WILLIBALD SPREITZER — Dr. Dr. Heissmann GmbH, Abraham-Lincoln-Str. 22, 65191 Wiesbaden

In the CAPM model [1] and the 'standard' optimization the portfolio is optimized with respect to the rate of return minus κ times the volatility or variance. The quality of the optimization depends from the knowledge of the characteristics of the assets (shares, bonds etc.) within the portfolio. Assuming a market of two agents, who assume wrong values of the assets - nevertheless both agents together are in accordance with the market - we investigate the portfolios, they built caused by these wrong assumptions. Assuming, that the two agents represent a market, we investigate this 'wrong' portfolio of the market compared to a portfolio, which is built according to CAPM and correct assumptions on the assets. Considering this at different times and for different wrong assumptions, we calculate the differences of the composition and the rate of return of the portfolio and the effect on the assets.

[1] Sharpe, W.F.: Capital Asset Prices: A Theory of Market Equilibrium under conditions of risk. The Journal of finance Vol. 19. S. 425-42

AKSOE 10.18 Wed 16:00 P2

Random matrix theory, elliptical distributions and correlations in incomplete financial data — •UWE JAEKEL¹ and GABRIEL FRAHM^{1,2} — ¹C&C Research Laboratories, NEC Europe Ltd, Sankt Augustin — ²Lehrstuhl für Statistik und Ökonometrie, Universität zu Köln

Recently (e.g. [1,2]) random matrix theory (RMT) has been applied to financial data with interesting implications for the identification of driving factors in financial markets. We discuss complications resulting from the observed non-normality and tail-dependence of financial data. Both facts together limit the applicability of random matrix theory for sample correlation matrices obtained for market data time series since classical theorems assume either normality or componentwise independence of the time series. We show that for the large class of generalized elliptical distributions - consistent with the so-called stylized facts of empirical finance - a covariance matrix estimator (which turns out to be Tyler's M-estimator [3]) can be derived that allows the application of standard RMT. Another practical problem in the analysis of financial time series is that parts of the data can be missing due to errors, different trading times, index re-compositions, and for various other reasons. We show how RMT can be applied also to incomplete time series by an observed data maximum likelihood approach.

[1] Laloux, L. et al., RISK Magazine, 12, 69 (March 1999)

[2] Plerou, V. et al., PRL 83, 1471 (1999)

[3] Tyler, D.E., Annals of Statistics 15, 234 (1987)

AKSOE 10.19 Wed 16:00 P2

Analyzing Memory Effects of Complex Systems from Time Series — •DANIEL T. SCHMITT and MICHAEL SCHULZ — Department of Theoretical Physics, University of Ulm, Germany

Observables of complex systems show more or less pronounced memory effects. This can be rigorously derived within the Mori-Zwanzig Theory in Statistical Physics. In a recent paper [1] we have developed an al-

gorithm to quantitatively characterize memory effects by analyzing one time series of such an observable. Using this algorithm we analyze the short- and long-term structure memory kernel calculated from observables. Observables include absolute price changes and signum of price changes in major stock markets, wind strength and wind direction, and temperature data. The memory kernel allows to characterize the dynamics of complex systems and also to study changes in the dynamics over time.

[1] Daniel T. Schmitt, Michael Schulz, Analyzing Memory Effects of Complex Systems from Time Series, Physical Review E, submitted

AKSOE 10.20 Wed 16:00 P2

Methods of claim reserving and Monte Carlo Simulation — •MAGDA SCHIEGL — Haydnstr. 6, D-84088 Neufahrn

Claims reserving is an important topic for P&C insurance companies both for product pricing and reporting, especially as new reporting and solvency standards will be introduced within the next years. Claim reserves are necessary to cover the liabilities arising from insurance contracts written in the presence and past. They are calculated for homogeneous portfolios of insurance contracts via mathematical methods which are well known from actuarial literature. The Chain Ladder method is one famous example.

In reality the claim process consists of claims occurrence, reporting and run off. All classical methods reduce this process to a two dimensional run-off-matrix and estimate on that basis the reserves* expectation value.

We model the realistic claim process by the help of Monte Carlo simulation. The variables of the model are: Number of claims and claim payments. The expectation value and the variance of the reserve are given analytically. The reserve distribution can be calculated numerically. This makes risk measures as VaR or expected shortfall accessible. The performance of the classical reserving methods can be reconsidered in the framework of our model. This concept enables investigations if the projection into a two dimensional space, as used for application of classical methods, is appropriate.

AKSOE 10.21 Wed 16:00 P2

Point processes models for the trading activity — •BRONISLOVAS KAULAKYS, MIGLIUS ALABURDA, and VYGINTAS GONTIS — Institute of Theoretical Physics and Astronomy of Vilnius University, A. Gostauto 12, LT-01108 Vilnius, Lithuania

Point processes models generating the multifractal time series with the power-law distributions of the signal intensity and of the power spectrum will be presented. The developed [1] multiplicative point processes models of 1/f noise may be used for analysis and modeling of stochastic processes in different systems with the power-law distributions of the interpulse, interevent, interarrival, recurrence or waiting times, with the power-law distribution of the signal intensity or of the counting statistics. Further, we analyze the financial markets where the stock volatility, trading activity and trading volume usually fluctuate as 1/f noise, as well [2]. The model reproduces spectral properties of the real markets and explains the mechanism of the power-law distribution of the trading activity [3]. The study indicates that the statistical properties of the financial markets are related with the statistics of the time intervals between the trades.

We acknowledge support by the Lithuanian State Science and Studies Foundation.

[1] B. Kaulakys, V. Gontis and M. Alaburda, Phys. Rev. E **71**, 051105 (2005).

[2] X. Gabaix et al., Nature **423**, 267 (2003).

[3] V. Gontis and B. Kaulakys, Physica A **343**, 505 (2004); **344**, 128 (2004).

AKSOE 10.22 Wed 16:00 P2

Phase diagrams for an evolutionary Prisoner's Dilemma game on different random regular graphs — •JEROMOS VUKOV¹ and GYÖRGY SZABÓ² — ¹Department of Biological Physics, Eötvös University, H-1117 Budapest, Pázmány P. stny. 1/A., Hungary — ²Research Institute for Technical Physics and Materials Science P.O. Box 49, H-1525 Budapest, Hungary

We studied an evolutionary Prisoner's Dilemma (PD) game with players located on random regular graphs. Systematical Monte Carlo simulations and dynamical cluster techniques were performed to analyse the effects of changing the payoffs and the noise (temperature) upon the maintenance of cooperation. The system exhibits second order phase transition from mixed state of cooperators and defectors to absorbing

state where only defectors remain alive. Plotting the critical points on the temperature- b (temptation to defect) plane, we have determined the phase boundaries. In comparison to the phase diagrams of two-dimensional lattices, in the high temperature limit, cooperation consists on random regular graphs in a much wider parameter range than on two-dimensional lattices. Thus (in this limit) the maintenance of cooperation needs rather fixed neighborhood than spatial structure.

AKSOE 10.23 Wed 16:00 P2

The Problem of Relativity in Economic Models — ●BODO HERZOG — Wittelsbacherstr. 33, 65 189 Wiesbaden

The paper studies the evolution of relativity in economic systems and models. We use new and innovative ideas by combining economic and physical systems of agents. Our main objective is to find new insights in economic models and systems with interdisciplinary approaches. The paper shows several new insights in many respects: First, we show some limitations in economic models, which focusing only on pure economic systems without any connection to other systems. Second, we try to model a new system and incorporating the problem of relativity in economic models. Thereafter we derive some conclusions for the design of institutions mainly for the macroeconomic and European level.

<More details later in our paper.>

AKSOE 10.24 Wed 16:00 P2

Nongaussian Fluctuations arising from finite populations: Exact results for the evolutionary Moran process — ●JENS CHRISTIAN CLAUSSEN¹ and ARNE TRAUlsen² — ¹Institut für Theoretische Physik und Astrophysik, Christian-Albrecht-Universität Kiel, Germany — ²Center for Evolutionary Dynamics, Harvard

The appropriate description of fluctuations within the framework of evolutionary game theory is a fundamental unsolved problem in the case of finite populations. The Moran process recently introduced into this context defines a promising standard model of evolutionary game theory in finite populations for which analytical results are accessible. We derive the stationary distribution of the Moran process population dynamics for arbitrary 2×2 games for the finite size case. In contrast to the common approach to mimic finite-size fluctuations by Gaussian distributed noise, the finite size fluctuations can deviate significantly from a Gaussian distribution.

[1] J.C. Clausen & A. Traulsen, Phys. Rev. E 71, 025101(R)

AKSOE 10.25 Wed 16:00 P2

The Missing Exchange Rate of Banking — ●DIETER BRAUN — Noether Group on Dissipative Microsystems, Applied Physics, Ludwig Maximilians Universität München, Amalienstr. 54, 80799 München, Germany

A bank accepts deposits and grants credits. Using a Feynman-graph representation of bookkeeping, we show that the bookkeeping of a bank actually creates two competing currencies, one for deposits and one for credits. Both are fully separated by bank bookkeeping. The market can demand that prices are split into deposit price levels and credit price levels. A free floating exchange rate between deposit units of account and credit units of account is the result.

Such a generalized bookkeeping allow markets to judge the value of bank assets versus bank liabilities in real time, even at zero interest rates. We give scenarios by applying quantity theory to the proposed bicurrency banking. Market interplay is simulated in a physically motivated random exchange economy model. Both indicate that two-currency banking reduces the impact of interest rates and transforms the profit mechanism of a bank.

AKSOE 10.26 Wed 16:00 P2

Strong wealth condensation in stochastic transfer potential economy models — ●DIETER BRAUN — Noether Group on Dissipative Microsystems, Applied Physics, Ludwig Maximilians Universität München, Amalienstr. 54, 80799 München, Germany

We analyze wealth condensation for a wide class of stochastic economy models on the basis of the economic analog of thermodynamic potentials, termed transfer potentials. The economy model is based on three common transfer modes of wealth: random transfer, profit proportional to wealth and motivation of poor agents to work harder.

The economies never reach a steady state. Wealth condensation is the result of stochastic tunneling through a metastable transfer potential. In accordance with reality, both wealth and income distribution transiently show Pareto tails for high income subjects.

All studied metastable transfer economies show exponential wealth condensation as a robust feature. The simplest model with 10 % annual profit leads to a situation where 1% of the population owns 50 % of the wealth after 50 years. The time to reach such a strong wealth condensation is a hyperbolic function of the annual profit rate.

AKSOE 10.27 Wed 16:00 P2

Random fragmentation with inequality constraint: A model of income distribution — ●APARNA BASU — Institute of Genomics and Integrative Biology, (at TCGA) 254 Okhla Industrial Estate-Phase 3, New Delhi 110020, INDIA

The unequal distribution of wealth in society is a universal feature that has been noted and quantified fairly early. In 1897 Wilfredo Pareto observed a power law distribution of income relating the fraction $f(x)$ of the population earning income x , to x . Another curve frequently used to represent income inequality is the Lorenz curve connecting the proportion p of total income earned by individuals earning less than or equal to x to the proportion q of persons in this income group. The qualitative features of economic inequality typified by these relationships appear to be universal, holding across a wide variety of social, economic and political structures. Moreover, similar distributions are seen in other areas such as language, species diversity, etc. This suggests that the observed regularity may be statistical in character. In this paper, we have used the fragmentation of the unit line as a statistical model of the distribution of wealth in society, with an added constraint that forces the fragments to be unequal, thereby incorporating the observed inequality of incomes as a property of the model. The most probable distribution obtained is a variant of the Lorenz curve, and is represented by the equation $P=(Q-Q\ln Q)^b$ (where Q and P are $1-q$ and $1-p$ respectively, and b is a free parameter.) We compare model results with observed data on income distribution.

AKSOE 10.28 Wed 16:00 P2

Equilibrium Econophysics — ●TÂNIA SOUSA and TIAGO DOMINGOS — Instituto Superior Tecnico (DEM-SAE). Av. Rovisco Pais, n 1, 1049-001 Lisboa PORTUGAL

We provide a unified conceptual structure for Equilibrium Econophysics, i.e., the use of concepts and tools of equilibrium thermodynamics in neoclassical microeconomics and vice-versa. Within this conceptual structure the results obtained in microeconomic theory are: (1) the definition of irreversibility in economic behavior, (2) the clarification that the Engel Curve and the offer curve are not descriptions of real processes dictated by the maximization of utility at constant endowment, (3) the establishment of a relation between elasticities, (4) the proof that *Giffen Goods* do not exist in a market stable equilibrium, (4) the establishment that 'economic integrability' is equivalent to the Generalized Le Chatelier Principle and (5) the definition of a phase transition of first order. In thermodynamics a relationship is established between the sign of the adimensional thermodynamic coefficients and the increase or decrease in the potentials defined by the Legendre transforms.

AKSOE 10.29 Wed 16:00 P2

Statistical Properties of U.S. Output Growth-Rate Distributions — ●ANDREA ROVENTINI^{1,2}, GIORGIO FAGIOLO³, and MAURO NAPOLETANO¹ — ¹Sant'Anna School of Advanced Studies, Laboratory of Economics and Management - Piazza Martiri della Libertà, 33 - 56127 PISA (Italy) — ²Department of Social, Cognitive and Quantitative Sciences, University of Modena and Reggio Emilia — ³Department of Economics, University of Verona

The paper investigates the statistical properties of U.S. output growth-rate distributions by employing both parametric and non-parametric techniques. Many empirical contributions have recently pointed out that growth rates follow a Laplace distribution at different levels of aggregation (e.g., at firm-, industry- and country-level). Following this line of research, we test whether U.S. output growth rates can be approximated by a Laplace distribution. Furthermore, we ask whether our results are robust to alternative ways of detrending output series. Indeed, it is well-known that different detrending techniques (e.g., first difference, Hodrick-Prescott and bandpass filters) affect both qualitative and quantitative stylized facts of the business cycle. Finally, we compare the results for the U.S. to different countries (e.g. U.K.). Preliminary results show that output growth-rate distributions are not Gaussian and are well proxied by fat-tailed, tent-shaped densities. Moreover, we find that different detrending techniques do affect output growth-rate distributions.

AKSOE 10.30 Wed 16:00 P2

Econo-Thermodynamics: The Nature of Economic Interactions — ●JÜRGEN MIMKES — Physics Department, Paderborn University, Germany

Physicists often model economic interactions like collisions of atoms in gases: by interaction one agent gains, the other loses. This leads to a Boltzmann distribution of capital, which has been observed in wealth distributions of different countries. However, economists object: no economic agent will attend a market in which he gets robbed! This conflict may be resolved by writing basic laws of economics into terms of calculus. In these terms the daily struggle for survival of all economic systems turns out to be a Carnot cycle that is driven by energy: heat pumps and economic production depend on oil, GNP and oil consumption run parallel for all countries. Motors and markets are based on the same laws of calculus (macro-economics) and statistics (micro-economics). Economic interactions mean exploiting a third party (nature) and are indeed close to robbing! A baker sells bread to his customers, but the flour comes from nature. Banks sells loans to investors, but the money comes from savers. Economic interactions are Carnot cycles.

AKSOE 10.31 Wed 16:00 P2

Stabilization of chaotic dynamic in micro-economical model of competing firms — ●MARIA DAVIDICH¹ and ALEKSANDR LOSKUTOV² — ¹davidich@itp.uni-bremen.de — ²loskutov@polly.phys.msu.ru

We propose a method, which allows to realize the stabilization of chaotic dynamic in a simple micro-economical model of competing firms. Our model consists of two firms competing on the same market of goods. The firms perform active and asymmetric investment strategies, i.e. their temporary investments depend on their relative positions on the market. Under certain parameter values the given model exhibits the properties of dynamical chaos that consists of continuous power spectrum and positiveness of Lyapunov exponents.

We show that by means of weak external direct parametric excitations it is possible to suppress chaos and stabilize the prescribed periodical orbits. As control parameters we choose such values that describe the investment values of both firms. With economical point of view this means, that we may realize a quite simple control and present a way of increasing profit.

AKSOE 10.32 Wed 16:00 P2

A Stochastic Theory of Geographic Concentration and the Empirical Evidence in Germany — ●THOMAS BRENNER — Max-Planck-Institute of Economics, Kahlaische Str. 10, 07745 Jena

A stochastic model of the evolution of the firm population in a region and industry is developed. This model is used to make predictions about the expected probability distribution of the firm number in regions and their dynamics. Data on the spatial distribution of firms in Germany is used to check the predictions and estimate the parameters of the model. This is done for each industry separately.

AKSOE 10.33 Wed 16:00 P2

Modeling framework for railway stations in regional systems — ●DOMINIK E. REUSSER¹ and PETER LOUKOPOULOS^{1,2} — ¹Swiss Federal Institute of Technology, Zürich — ²Göteborg University, Sweden

Railway stations are an important part of a regional system and we need a better understanding of the relationship between a railway station and its surroundings. This need is potentially greater given historical trends of diminishing patronage and railway station closures. The poster presents a conceptual framework for a model which allows to assess medium and long term dynamics of railway station development together with the connected regional system. The framework includes the description of the behavior of the main actors. This allows a deeper understanding of the dynamic of railway stations, which is also vital if the trends with respect to patronage and closures are to be halted and reversed.

An existing integrated model for railway stations is enhanced to include information for decisions concerning railway development. An appropriate methodology is agent-based modeling linked to a system dynamic model comprised of a system boundary and system elements together with the relationships between system elements.

At a later stage, the presented framework will be discussed at round tables with stakeholders to select relevant agents to be included in the model; together with existing behavioral theories and expert interviews, these will be used to obtain knowledge about the perceptions, internal states and anticipated actions of agents in the railway-station-related

actor network.

AKSOE 10.34 Wed 16:00 P2

Phase Transition in Density between Urban and Rural Areas, Commuting and Perurbanization — ●YURI YEGOROV — Institute for Advanced Studies, Stumpergasse 56, A-1060, Vienna, Austria, yegorov@ihs.ac.at

Mathematical model is proposed to explain the emergence of spatial pattern with heterogeneous density and phase transition between urban and rural areas. There are three types of agents: workers who live in a city, farmers who live in a rural area and workers-commuters from rural area to city. In equilibrium they are indifferent between occupation and residence. Indifference across locations for a priori identical agents implies the shape of land rent. The model is in continuous two-dimensional space. There is phase transition between urban and rural population densities due to the difference in land-use intensity for industrial and agricultural technologies. The whole spatial pattern changes as the reaction to change in different model parameters (transport cost, prices of output, population, etc.). Split of rural residents into commuters and farmers depends on road infrastructure development. Under certain conditions per urbanization occurs: farmers convert themselves into new ring of commuters beyond city border. Different bid rent shapes for farmers and commuters make their spatial coexistence problematic in equilibrium, while it can exist in the transition period.

AKSOE 10.35 Wed 16:00 P2

Analysis of dynamic processes on air traffic networks — ●MARCUS RAUHUT¹ and MICHAEL SCHULZ² — ¹marcus.rauhut@uni-ulm.de — ²michael.schulz@physik.uni-ulm.de

Many real networks present a bounded scale-free degree-distribution with connectivity cut-off due to physical constraints. Models of epidemics (susceptible-infected-susceptible and susceptible-infected-removed) exhibit an epidemic threshold one order of magnitude smaller for bounded scale-free networks than for their homogeneous counterparts. Networks in air traffic have exactly, this bounded scale-free structure and are additionally well documented. The extensive records of north-american air traffic make it therefore, besides the internet, an ideal subject to examine dynamic processes on networks. Furthermore, inefficiencies and delays in air-traffic can cause enormous costs, i.e. 1999 delays in the european air traffic caused damages to the EU-members of about 150 to 200 billion euros. Therefore exists also an economic interest in the better understanding of the interaction of topology and dynamics. In our work we investigate if delays can spread similar to an epidemics behaviour on networks and try to forecast the development of delays with methods of non-equilibrium statistics, regarding the predicted growth of flight traffic in the future.

AKSOE 10.36 Wed 16:00 P2

Time Series Analysis of the NGSIM-Vehicular-Dataset — ●CHRISTOF LIEBE¹, REINHARD MAHNKE¹, and PETER WAGNER² — ¹Institute of Physics, Rostock University, D-18051 Rostock — ²German Aerospace Center, Institute of Transport Research, D-12489 Berlin-Adlershof

Within the american Next Generation Simulation Program (NGSIM) several datasets were made, where the trajectory of every single car on a highway segment of 1000 m were measured. These datasets build a good basis of time-series-analysis. The method how to analyze the trajectories in a probabilistic way and investigate quantities which describe the situation on the observed road will be presented.

AKSOE 10.37 Wed 16:00 P2

Propagation of Traffic-Related Information on Freeways via Inter-Vehicle Communication — ●MARTIN SCHÖNHOF¹, MARTIN TREIBER¹, ARNE KESTING¹, and DIRK HELBING^{1,2} — ¹Institute for Transport & Economics, Technische Universität Dresden, Andreas-Schubert-Str. 23, D-01062 Dresden, Germany — ²Collegium Budapest — Institute for Advanced Study, Szentháromság u. 2, H-1014 Budapest, Hungary

A freeway with vehicles transmitting traffic-related messages via short-range radio is a technological representation for a complex network: A dynamical process runs on a network with dynamical topology. Here the network dynamics can strongly influence the message propagation because it is of the same timescale. In addition, if the cars generate the messages concerning irregularities in the traffic flow and also react to such information generated by other cars, the system has a feedback loop

from the network topology to the *generation* of messages and from the message propagation to the network topology. The complexity of this system is restricted by its one dimensionality, i.e., the network nodes are distributed in one dimension, but moving in different directions. By microscopic simulation of congested freeway traffic, where a certain fraction of cars are equipped with inter-vehicle-communication facilities, we investigate how the equipment level influences the efficiency of transmitting traffic related information such as the position of jam fronts.

AKSOE 10.38 Wed 16:00 P2

Impact of automated driving strategies on future traffic dynamics — ●ARNE KESTING, MARTIN TREIBER, MARTIN SCHÖNHOF, and DIRK HELBING — Technische Universität Dresden, Institute for Transport & Economics

Adaptive cruise control (ACC) automatically accelerates or decelerates a vehicle to maintain a selected time gap, to reach a desired velocity, or to prevent a rear-end collision. Furthermore, an increasing market penetration of ACC systems will make an impact on the traffic dynamics, and, therefore, leads to interesting questions about the future traffic flows consisting of human drivers and automated longitudinal control.

Microscopic traffic modelling is an appropriate approach to investigate the traffic dynamics. Furthermore, sufficiently high equipment levels of ACC systems provide an interesting option to enhance the traffic performance by automated driving strategies that are designed to increase the capacity and stability of traffic flows. We propose a driving strategy for ACC that adapts the driving style dynamically to the overall traffic situation. We analyse this driving strategy by means of simulation and show how the system's performance depends on the equipment level. Remarkably, we find that already a small amount of ACC-equipped cars and, hence, a marginally increased free and dynamic capacity, can lead to a drastic reduction of traffic congestion.

AKSOE 10.39 Wed 16:00 P2

Can Urban Clusters Trace Political Changes? — ●EFRAT BLUMENFELD-LIEBERTHAL¹, IRIS ARAVOT¹, LUCIEN BENGUIGUI², and DANIEL CZAMANSKI¹ — ¹Faculty of Architecture and Town Planning, Technion - IIT — ²Department of Physics and Solid State Institute, Technion - IIT

This paper presents a relatively new approach to understanding the spatial behavior and structure of cities. According to this approach, based on the work of Schweitzer and Steinbrink (1997), cities are viewed as physical objects characterized by morphologies. Instead of data organized according to political units, such as municipalities, cities are comprised of urban clusters. Clusters are defined as contiguous built-up urban areas.

By means of historic maps from 1935 to 2000 of the Tel-Aviv metropolis we present cluster statistics and analyses of their dynamics. We present characteristics of clusters, including their number, area, rank-size distribution, and morphology, along with area-perimeter relations. We examined the characteristics of the entire metropolis in general and of the biggest cluster specifically. The findings of our analysis present significant anomalies in the 1960s and in the 1980s.

For the anomalous years we examined historical events. We suggest that the development of the Tel Aviv metropolis in terms of morphology can be divided into 3 stages that are associated with socio-economic trends and processes: (1) 1930s - 1960s (2) 1960s - 1980s (3) 1980s - 2000s.

AKSOE 10.40 Wed 16:00 P2

An agent-based modelling approach of Plague transmission: the SIMPEST prototype — ●DOMINIQUE BADARIOTTI¹, ARNAUD BANOS², VINCENT LAPERRIÈRE³, and JEAN-PIERRE MÜLLER⁴ — ¹dominique.badariotti@univ-pau.fr — ²arnaud.banos@univ-pau.fr — ³vincent.laperriere@yahoo.fr — ⁴jean-pierre.muller@cirad.fr

Since European settlers and traders brought plague to Madagascar, research on this re-emergent disease has been focusing on the main processes of transmission between the main host (rats) and humans via a vector, fleas. Although modalities of disease' transmission at the individual level are now well known, the question of their control and reduction is far from being solved, due to the complexity of spatio-temporal patterns emerging at the population's level. Therefore, it becomes crucial to improve our understanding of the functional relationships that link fleas, rats and humans. In such a perspective, we propose an agent-based prototype, SIMPEST, allowing running "what-if scenarios". Basically, rats, fleas and human agents are located on a spatial grid that represents a

village and its surrounding land. Demographic dynamics of the three populations are introduced. Every population is characterized by a life expectancy and a reproductive rate that govern individuals' birth and death. Then, agents move according to their own goals, in a dynamic environment (seasonal flooding of rice fields and crops are integrated). We will then present this prototype, developed using Netlogo, before highlighting the first results obtained on specific scenarios. Finally, we will focus on a strategy we retained to analyze the behaviour of the model, based on a systematic combination of its main parameters.

AKSOE 10.41 Wed 16:00 P2

Crowd Dynamics; Modeling, Calibraton, and Empirical Findings — ●ANDERS JOHANSSON and DIRK HELBING — Institute for Transport and Economics, TU Dresden

In the field of pedestrian modeling, a variety of models are used. These models are differently accurate and based on different assumptions and approximations. In this contribution we present a quantitative study of properties of crowds, extracted from empirical trajectory data. From these properties, we discuss which have a large impact on the overall crowd dynamics, and which might be neglected in a simulation model.

Parallel to this, we present a new generic method, based on an Evolutionary Algorithm, for calibrating pedestrian models to empirical trajectory data. As a special case, we present a calibration of an updated Social-Force Model.

AKSOE 10.42 Wed 16:00 P2

Traffic Flow by Cellular Automata: Effect of Maximal Car Velocity — ●DANUTA MAKOWIEC and WIESLAW MIKLASZEWSKI — Institute of Theoretical Physics and Astrophysics, Gdansk University, 80-952 Gdansk, ul.Wita Stwosza 57, Poland

The effect of maximal car velocity on the fundamental diagram in the Nagel-Schreckenberg model of traffic is studied. The car density giving the maximal flow and so-called jamming transition parameters are investigated by computer simulations. The basic model is modified by the assumption that for each car an individual velocity limit is assigned. One can give many reasons supporting this assumption: high diversity of vehicles, namely, from sport-cars to scrap-cars, and rather common driver's habit of breaking the speed limit. However, if each driver is assigned his/her own maximal driving speed at random, then the stationary state is determined by the slowest vehicles. Therefore, following hints from Polish roads, the slowest driver is forced to change his/her behavior. In simulation, the self-organization of the traffic is observed when the maximal velocity of the slowest moving vehicle is changed in different ways.

AKSOE 10.43 Wed 16:00 P2

Interaction Spaces: a general method to derive differential equations from multi-agent and cellular automata models — ●PAOLO GIORDANO, SERGIO ALBEVERIO, DENISE ANDREY, and ALBERTO VANCHERI — USI, via Canavée, Mendrisio, Switzerland

A new kind of model for complex systems (CS) including cellular automata (CA) and multi-agent models (MM), named Interaction Spaces (IS), is proposed. The state of interacting entities are described by continuum variables. The time evolution is defined through a counting process with a given intensity for each type of interaction, and a continuum probability giving the variation of state variables. The intensities depend on the configuration of a suitable set of interacting entities called 'neighbourhood of the interaction'. The use of a continuum state space permits to prove that the time dynamics of extensive state variables fulfil a system of random DE (RDE) using the concept of forward mean derivative (Nelson, Quantum Fluctuations, 1985). We prove that this RDE reduces, for small stochastic fluctuations, to an ODE for the expected values obtainable using a master equation's approach. The general definition of IS is illustrated using an urban growth model. In this case the counting processes are Poisson distributed and their intensities are defined using fuzzy logic. The extensive use of a CA and MM-like language permits to easily construct a detailed and realistic model of the CS, but IS can also be studied like continuum dynamical systems, including memory effects and random fluctuations. These results permit to guess the possibility to extend Synergetic's methods to the wide class of CS described by CA or MM. See www.mate.arch.unisi.ch/ACME for references.

AKSOE 10.44 Wed 16:00 P2

A dynamic model for city size distribution — ●LUCIEN BENGUIGUI¹ and EFRAT BLUMENTFELD-LIEBERTHAL² — ¹Solid State Institute, IIT-Technion 32000 Haifa Israel — ²Faculty of Architecture and Town Planning IIT-Technion 32000 Haifa Israel

We present a model of urban evolution, which yields all kinds of City Size Distributions (CSD). In order to describe the Zipf's law as well as cases that are represented by downward curves on a logarithmic plot, a new positive exponent α is introduced. This exponent corresponds to Zipf's law only when it is equal to 1. The model is based on a random growth of the city population and on the variation of the number of cities in the system. The results of the model are surprising as they indicate a chaotic behavior of the model which is only statistically deterministic. We found that both the rate of the growth of new cities and the number of steps affect the final result of the model. The values of exponent α include all possible cases in reality, i.e. it may be larger, smaller or equal to 1.

AKSOE 10.45 Wed 16:00 P2

Stability of steady state solutions in balanced vehicular traffic — ●FLORIAN SIEBEL and WOLFRAM MAUSER — Department of Earth and Environmental Sciences, University of Munich, Luisenstraße 37, D-80333 Munich

We investigate a continuum model for vehicular traffic flow, which can be motivated by including a finite reaction time of drivers in the traffic model of Aw, Rascle and Greenberg. The model can be written as a hyperbolic system of balance laws. We analyze the steady state solutions and their stability properties. In addition to the equilibrium flow curve the trivial steady state solutions form two additional branches in the flow-density diagram. We show that the characteristic structure excludes parts of these branches resulting in the reverse λ shape of the flow-density relation. The upper branch is metastable against the formation of synchronized flow for intermediate densities and unstable for high densities, whereas the lower branch is unstable for intermediate densities and metastable for high densities. Moreover, the model reproduces the characteristic properties of wide moving jam formation and propagation.

AKSOE 10.46 Wed 16:00 P2

Filtering tools for correlation networks — ●JAN NAGLER^{1,2}, PHILIPP WEBER², SHLOMO HAVLIN^{2,3}, and H. EUGENE STANLEY² — ¹Institute for Theoretical Physics, Bremen University, Bremen, Germany — ²Center for Polymer Studies, Boston University, Boston, USA — ³Minerva Center and Dept of Physics, Bar-Ilan University, Ramat-Gan, Israel

We present a novel method for filtering information from cross-correlation data. The key point of our method is a reconstruction process of the original cross-correlation matrix from a filtered correlation network. In order to recover the original correlation matrix we theoretically derive a procedure capable to estimate unknown correlation coefficients from known ones. We apply the method to correlation networks of stock market returns. First, we compare clustering with standard stock sector classification schemes. Second, we check whether our proposed procedure is tailored to evaluate other filtering methods (e.g. Minimal Spanning Tree based methods or approaches applying percolation schemes).

AKSOE 10.47 Wed 16:00 P2

Correlations of centrality metrics on complex networks — ●MAGNUS JUNGSBLUTH and ALEXANDER K. HARTMANN — Institut für theoretische Physik, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

The study of complex networks plays a crucial role in understanding systems like metabolic pathways, collaborations and computer networks. A popular task is to identify the most important nodes of a network. There are several definitions, often called centrality measures, which lead to different results. The most prominent centrality measure is the *degree* of a node which is easy to obtain. For many real-world networks, the degree distribution follows a power law and hence these networks are often called *scale-free*. Another frequently used measure is the *betweenness centrality* which is based on calculating shortest-paths. Recently other centrality measures have been proposed, based on *random walks* or on participation in *subgraphs*. Yet it is not clear under what circumstances which measure is most appropriate and what the relations between these measures are.

Here we study correlations between the above mentioned four mea-

asures on different random-graph models like Erdős-Renyi, Small-World and Barabasi-Albert and on several real graphs to get a thorough comparison and to be able to identify which measure is the best suited one for each individual situation. Since at least the last two measures are expensive to calculate (running time slightly above $O(n^3)$ for n nodes) we look at how accurate approximations are if only a small subset of the whole network is considered.

AKSOE 10.48 Wed 16:00 P2

Scaling Laws for the Lifetimes of Governments — ●CHRISTIAN HIRTREITER¹ and JOHANNES J. SCHNEIDER² — ¹Institute of Organic Chemistry, University of Regensburg, Universitätsstr. 31, 93053 Regensburg, Germany — ²Institute of Physics, Johannes Gutenberg University of Mainz, Staudinger Weg 7, 55099 Mainz, Germany

We investigate the lifetimes of governments in the original and a randomized one-dimensional Sznajd model [1]. We find various scaling laws for the lifetime of a democracy and for the reigning time of governments in this model, depending on the system size N [2]. We compare our results with the lifetimes of governments in the Western democracies.

[1] K. Sznajd-Weron and J. Sznajd, Int. J. Mod. Phys. C **11**, 1157 (2000).

[2] J. J. Schneider and Ch. Hirtreiter, Int. J. Mod. Phys. C **16**, 157 (2005).

AKSOE 10.49 Wed 16:00 P2

Proactive robustness control of heterogeneously loaded networks — ●MIRKO SCHÄFER — Institut für Theoretische Physik, Justus Liebig Universität Gießen, Heinrich-Buff-Ring 16, D-35392 Gießen

The introduction of a load-dependent metric increases the robustness of networks against cascades of overload failures. It also reduces respective investment costs. These findings are of relevance for critical infrastructures like communication networks and power grids.

AKSOE 10.50 Wed 16:00 P2

IPD network creation games — ●JAN SCHOLZ — Institut für Theoretische Physik, Justus Liebig Universität, Heinrich-Buff-Ring 16, 35392 Gießen, Germany — Frankfurt Institute for Advanced Studies and Frankfurt International Graduate School for Science, Johann Wolfgang Goethe Universität, Max-von-Laue-Straße 1, 60438 Frankfurt am Main, Germany

Motivated by the possible application to technical communication networks, we study a game-theoretical approach to network structure formation. A short introduction to game theory with focus on the iterated prisoners dilemma and the concept of (network) Nash equilibria is given. Results on various generic couplings of the IPD game dynamics with network structure evolution are presented and shown to lead to various different selforganizing network topologies.

AKSOE 10.51 Wed 16:00 P2

Impact of observational incompleteness on the structural properties of protein interaction networks — ●MATHIAS KUHN^{1,2}, INGMAR GLAUCHE³, and MARTIN GREINER² — ¹Institut für Theoretische Physik, Technische Universität Dresden, D-01062 Dresden, Germany — ²Corporate Technology, Information & Communications, Siemens AG, D-81730 München, Germany — ³Institut für Medizinische Informatik, Statistik und Epidemiologie, Universität Leipzig, Härtelstr. 16/18, D-04107 Leipzig, Germany

The observed structure of protein interaction networks is corrupted by many false positive/negative links. This observational incompleteness is abstracted as random link removal and a specific, experimentally motivated (spoke) link rearrangement. Their impact on the structural properties of gene-duplication-and-mutation network models is studied. For the degree distribution a curve collapse is found, showing no sensitive dependence on the link removal/rearrangement strengths and disallowing a quantitative extraction of model parameters. The spoke link rearrangement process moves other structural observables, like degree correlations, cluster coefficient and motif frequencies, closer to their counterparts extracted from the yeast data. This underlines the importance to take a precise modeling of the observational incompleteness into account when network structure models are to be quantitatively compared to data.

AKSOE 10.52 Wed 16:00 P2

Statistical significance of community structures in complex networks — ●JÖRG REICHARDT and STEFAN BORNHOLDT — Institute for Theoretical Physics, University of Bremen, Otto-Hahn-Allee, 28359 Bremen, Germany

The community structure of complex networks, i.e. the assignment of

nodes into groups, (communities, modules) that have high inner and low outer link density, has been a major research focus in the last years. It is of interest for exploratory data analysis in many disciplines. Many algorithms to detect community structure have been developed using a variety of different approaches. We will show, that the problem of finding communities in a network can be mapped onto finding the ground state of a spin glass [1,2]. We can calculate expected community structures for random networks, which can be used for comparisons with real world data. We show the influence of degree correlations on the modularity of networks and investigate the theoretical limits of community detection.

[1] J.R. S.B, Phys. Rev. Lett., **93**, 21, 218701

[2] J.R. S.B. preprint, arxiv:physics/0503138

AKSOE 10.53 Wed 16:00 P2

Dynamics of language competition: bilingualism and local effects. — ●XAVIER CASTELLÓ, VICTOR M. EGUÍLUZ, and MAXI SAN MIGUEL — IMEDEA (CSIC-UIB), Universitat Illes Balears, E-07122 Palma de Mallorca, Spain

Several models have been proposed to study the dynamics of competition between languages [1]. Starting from the model of Abrams and Strogatz for the dynamics of endangered languages [2], the models proposed by Mira and Paredes, and Minett and Wang [3] address the issue of bilingualism. Along these lines we consider the dynamics of language use, allowing for bilingualism, within a social network, in the case where the languages are equivalent. Understanding this case seems a necessary first step to describe the more general case of an endangered language competing against another one with a higher status. Local effects are analyzed, studying the interface dynamics and growth laws of the system. We observe that the interface density and bilingual population density decay following a power law. The system reaches an absorbing state where one of the languages dominates, and the other language together with the bilingual community disappears. We also study the stability of the bilingual communities, which suggests possible explanations for the difficulty of coexistence of languages in the long term.

[1] Schulze, C., Stauffer, D. (2005) Simulation of language competition by physicists, Preprint cond-mat/0511049.

[2] Abrams, D.M., Strogatz, S. H. (2003). Nature 424, 900.

[3] Mira, J., Paredes, A. (2005). Europhysics Letters 69, 1031; Minett, J. W., Wang, W. S-Y. (unpublished).

AKSOE 10.54 Wed 16:00 P2

The Network of Inter-Regional Direct Investment Stocks across Europe — ●JOAO M. RODRIGUES¹, STEFANO BATTISTON¹, and HAMZA ZEYINOGLU² — ¹Chair of Systems Design, ETH Zurich, CH-8092 Zurich — ²Clarifax Ltd., Suite 302, 95 Wilton Road, London SW1V 1BZ, UK

We study the dynamics of inter-regional investment flow in Europe from a complex networks perspective. The network of investment stocks in Europe is investigated at two different levels: the level of firms, based on ownership shares and number of employees; and the level of regions in Europe, by aggregating the ownership network of firms, based on their headquarter location. We focus on statistical distributions and scaling laws of activity, investment stock and connectivity degree both at the two levels. We find that investment stock of firms is power law distributed with an exponent very close to the one found for firm activity. On the other hand investment stock and activity of regions turn out to be log-normal distributed. At both levels we find scaling laws relating investment to activity and connectivity. In particular, we find that investment stock scales with connectivity in a similar way as has been previously found for stock market data.

AKSOE 10.55 Wed 16:00 P2

Evolutionary Design of Robust Signal Transduction Networks — ●PABLO KALUZA and ALEXANDER S. MIKHAILOV — Fritz-Haber-Institut der Max-Planck-Gesellschaft

Signal transduction networks of a living cell can retain their functions despite noise and mutations. This suggests that their architecture is optimized in the process of biological evolution not only with respect to a particular function, but also to increase their robustness. In our theoretical study, a toy pipeline model of transduction networks is considered. By running an artificial evolution process, we design robust functional networks with predefined, randomly generated response patterns. The robustness of a network, optimized during its evolution, is estimated as the fraction of all test mutations leaving the response within a certain tolerance window. The signal transduction networks which are robust

with respect to deletion of either a single node or of a single link are thus constructed. In an extension of this study, we design transduction networks that are robust with respect to static noise, modelled as random variations of connection weights. The statistical analysis of a large ensemble of designed functional networks allows us to detect characteristic features of the network architecture, implied by the robustness with respect to noise and various mutations.

AKSOE 10.56 Wed 16:00 P2

Directory trees created by computer users: Individuality vs. universality — ●KONSTANTIN KLEMM¹, VICTOR M. EGUÍLUZ², and MAXI SAN MIGUEL² — ¹Dept. of Bioinformatics, Leipzig University, Germany — ²IMEDEA (CSIC-UIB), Palma de Mallorca, Spain

We describe the topological structure and the underlying organization principles of the directories created by users of a computer cluster when storing their own files. For each of the 63 observed users, the branching ratio (number of directories with the same parent) exhibits a broad, typically scale-free distribution with a non-universal exponent. Thus users can be distinguished by the degree exponent of the scale-free trees they create. The size distribution of the branches (subtrees below the root) decays algebraically with a universal exponent -2. These scaling properties and further observations are captured by a model of incremental tree growth [1]. The single parameter of the model interpolates between agglomeration into star-like structures and fully random attachment that leads to deep hierarchies. The alignment between model and empirical trees reveals the universal features of trees created independently and unrestrictedly by different users. Individual differences of tree construction boil down to a single real-valued parameter that is extracted by the alignment.

[1] Konstantin Klemm, Victor M. Eguiluz, Maxi San Miguel, Phys. Rev. Lett. 95, 128701 (2005).

AKSOE 10.57 Wed 16:00 P2

Material and Information Flows in Production Networks — ●KARSTEN PETERS¹ and DIRK HELBING^{1,2} — ¹Institute for Transport & Economics, Dresden University of Technology, Andreas-Schubert-Str. 23, 01062 Dresden, Germany — ²Collegium Budapest – Institute for Advanced Study, Szentháromság u. 2, 1014 Budapest, Hungary

Production and supply networks are complex networks of nonlinear dynamical elements designed to fulfill certain functional requirements. By using recently developed models we study the interaction and dynamics of production units exchanging material and information in such network structures. Whereas the directed flow of materials introduces a coupling between nearest neighbours in a supply network, the accompanying information network can involve even long range interactions. The stability and robustness under demand variations with respect to the topology of the underlying network structures is investigated. Surprisingly, even small changes in network topology can lead to different dynamics. Furthermore, for a fixed material flow network, the stability and dynamical behaviour of the system can be influenced significantly by changing the structure of the sub-network for information exchange. These results can be used to optimize the structure of the material flow network and the information network in order to obtain more reliable, stable and robust supply networks.

AKSOE 10.58 Wed 16:00 P2

Initiating a Mexican wave: An instantaneous collective decision combining short and long range interactions — ●ILLES FARKAS and TAMAS VICSEK — Biol. Phys. Res. Group of HAS and Dept. of Biol. Phys., Eotvos Univ., Pazmany P. stny. 1A, H-1117 Budapest, Hungary

The Mexican wave (La Ola) emerges through the coordinated behavior of spectators in a stadium as they stand up and then sit down again following those to their left (or right) with a short delay. Since its spontaneously selected direction of motion is the result of a rapid collective decision, it can serve as a paradigm for processes with limited complexity of the interaction. The global patterns of collective opinion formation in more complex situations are of considerable interest and have recently been studied with success using the methods of statistical physics. Guided by the extensive observations of volunteers filling out our online questionnaire, we use a simple, but still realistic model of the Mexican wave to explain how the combined effect of the local and global interaction terms produces a spontaneous symmetry breaking. The symmetric solution containing two waves (one moving left and one right) is replaced by a single wave (one of the two possible directions of propagation is

selected and the other is suppressed). We find that this transition has features reminiscent of discontinuous transitions. After the spontaneous symmetry breaking the two directions of propagation are still statistically equivalent. We investigate also how this remaining symmetry is broken in real stadia by a small asymmetrical term in the perception of spectators.

AKSOE 10.59 Wed 16:00 P2

Dynamics of Social Systems: Cooperation and Free-Riding — ●YIPING MA^{1,2}, MIRTA B. GORDON¹, and JEAN-PIERRE NADAL³ — ¹Laboratoire Leibniz-IMAG, Grenoble, France — ²Department of Physics, Hong Kong University of Science and Technology, Hong Kong — ³Laboratoire de Physique Statistique, Ecole Normale Supérieure, Paris.

We study the mean field dynamics of a model introduced in [1] of a social community. The N agents may choose between three strategies: either to join the community or not, and in the case of joining it, either to cooperate or to behave as a free-rider. Individuals' preferences have an idiosyncratic willingness to join, and a social component that depends on the fractions of cooperators and free-riders. Cooperators bear a fixed cost whereas free-riders support an idiosyncratically weighted cost proportional to the number of cooperators. We study the dynamics of this model analytically in the large N limit for both parallel and sequential updating. The resulting 2-d map in parallel updating, and 2-d flow in sequential updating, are analyzed within the framework of dynamical systems. As one varies one of the parameters, the phase diagram experiences a rich class of bifurcations. Noticeably, a stable limit cycle is shown to exist in both parallel and sequential updating, under certain parameter settings. We illustrate these results by computer simulations exhibiting examples of fixed points and of limit cycles, reached both through parallel and sequential updating. Comparison with the analytical predictions reveals however strong finite size effects.

[1] D. Phan, R. Waldeck, M. B. Gordon and J.-P. Nadal, WEHIA 2005 [<http://perso.univ-rennes1.fr/denis.phan/papers/pgnw2005.pdf>]

AKSOE 10.60 Wed 16:00 P2

Fairness state with plastic preferences — ●ELENA RAMIREZ BARRIOS¹ and JUAN GUILLERMO DIAZ OCHOA² — ¹eramirez@economics.uni-kiel.de — ²diazchoa@itp.uni-bremen.de

The definition of preferences is a concept that concerns decision making in social systems (for instance in vote systems) and economics. We are interested in the phenomena of efficient choice and economic fairness. In Arrow's theorem this situation is expressed as an impossibility of aggregate preferences among agents without running into unfairness. This situation was also analyzed in a previous model in a network of agents with a random allocation. Both researches are based on static preferences.

In a real society the individuals are confronted to exchanges of information that can modify the way they think. In particular, the preferences of each person are influenced by this exchange. This consideration is not enough realistic and is not able to make an accurate analysis of the fairness state when the preferences are changing. The aim of this research is to consider the coupling of two systems: the first one consider the formation of preferences and a second stage, where an allocation of goods is done.

AKSOE 10.61 Wed 16:00 P2

Skiba thresholds in a model of controlled migration — ●FEICHTINGER GUSTAV — Vienna University of Technology

This paper presents a dynamic optimization model of a central challenge of US housing policy: deconcentrating poverty via housing mobility programs without inducing middle-class flight. We explore two versions both with and without the possibility that poor families assimilate into the middle class. Both demonstrate multiple equilibria with a Skiba point separating initial conditions for which the optimal strategy leads to substantial flight from those leading to a stronger middle-class population. We also find an interesting mathematical phenomenon of a "lens" focusing the trajectories in a sense that allows for the coexistence of three saddles and an unstable equilibrium

AKSOE 10.62 Wed 16:00 P2

Persistence problem in a socio-economic dynamics of the diluted Ising ferromagnet in high dimensions — ●TAKUYA YAMANO¹ and SUDHIR JAIN² — ¹Institut für Theoretische Physik, Otto-Hahn-Allee, Universität Bremen, Germany — ²School of Engineering & Applied Science, Aston University, Birmingham, United Kingdom

The spins in a system which does not flip up to some time t is called the

persistence problem. The Glauber dynamics at zero-temperature in the cases of Ising model, disordered, higher dimensions, q -state Potts model and so forth have been studied in the literature. In this presentation, we report the results obtained in a socio-dynamics model with finite temperature on hypercubic lattice (up to 5 dimension) and determine the exponent of the decay of the persistence probability $P(t)$. The model we treat is based on a social local field which contains a magnetization at time t and we impose a $\pm J$ model, that is, a quenched random interaction for pairs, which is drawn from the binary distribution as a function of bonds concentration p . We argue whether or not the *blocking* phenomena in $P(t)$ exists and implications for the social and economic context.

AKSOE 10.63 Wed 16:00 P2

Metrics for a physics of organizational decision-making — ●BILL LAWLESS — Paine College, Augusta, GA 30901

Agent dynamics (behavior) are guided by self-observations (static information) that converge into a stable worldview, whether in human-social or computational-agent or organizational reality. Examples of convergent worldviews among human and organizational agents abound as single-sided stories, religious beliefs, and political perspectives. The successful ones of these simple, linear rational descriptions of phenomena stabilize into cultural heuristics. But the computational question arises in how effective this knowledge of the common interaction for human agents translates to the bi-sided perspectives of actual interactions, which until now have remained mathematically intractable. We believe that only bi-sided computational agents will be capable of replicating social phenomena such as the dynamics of human agents, including the more difficult problem of organizational decision-making.

AKSOE 10.64 Wed 16:00 P2

Collaborative Tagging and Semiotic Dynamics — ●CIRO CATTUTO^{1,2}, VITTORIO LORETO², and LUCIANO PIETRONERO² — ¹Museo Storico della Fisica e Centro Studi e Ricerche "Enrico Fermi", Compendio Viminale, 00184 Roma, Italy — ²Dipartimento di Fisica, Università di Roma "La Sapienza", P.le A. Moro, 2, 00185 Roma, Italy

A new paradigm has been quickly gaining ground on the WWW: Collaborative Tagging. In web applications like Del.icio.us, Flickr, Connotea, users manage their personal collection of online resources by enriching them with semantically meaningful information in the form of freely chosen tags. Despite the anarchic nature of users' behavior, the global dynamics of these systems leads to a self-organized categorization ("folksonomy") of a large and evolving body of online resources. Here we collect data from a popular online system and select a semantic context by extracting all the resources associated with a given tag. On studying the distribution of tags co-occurring with the selected one, we find a heavy-tailed behavior and observe properties that point to an emergent hierarchy of tags. We introduce a stochastic model embodying two main aspects of collaborative tagging: (i) a multiplicative character related to the exposure of users to each other's activity; (ii) a notion of long-term memory. Remarkably, our model is able to account quantitatively for the measured properties of tag association. This is a clear indication that collaborative tagging is able to recruit the uncoordinated actions of web users to create a coherent and predictable semiotic dynamics at the emergent level.

AKSOE 10.65 Wed 16:00 P2

Needs and decisions in ghetto — ●KRZYSZTOF KULAKOWSKI — Faculty of Physics and Applied Computer Science, AGH UST, Cracow, Poland

We consider ghetto as a social group of people ruled by an external power; members of the group feel that their laws are broken; however, attempts to leave ghetto make their situation worse. We discuss the relation of ghetto inhabitants to the ruling power, in the context of their needs organized according to the Maslow hierarchy. Decisions how to satisfy successive needs are undertaken in cooperation with or defection the ruling power. This issue allows to construct a tree of decisions and an adaptation of the tree pruning technique from the game theory. Dynamics of the decisions can be described within the formalism of fundamental equations. The result is that the strategy of defection is stabilized by the estimated payoff.

AKSOE 10.66 Wed 16:00 P2

Modelling a public investment game: a dynamical approach — ●SILVIO R. DAHMEN¹, ROBERTO DA SILVA², ANA L.C. BAZZAN², and ALEXANDRE BARAVIERA³ — ¹Instituto de Física, UFRGS, Brazil — ²Instituto de Informática, UFRGS, Brazil — ³Instituto de Matemática, UFRGS, Brazil

In this paper we deal with a public investment game, where each agent may contribute with a quantity in the interest of the wealth of the group of investors. Interactions among agents happen in a neighborhood and depend on the motivation level (insider information, economy prospects). Several scenarios are investigated. In the deterministic case, we focus on the existence of periodic behavior for the profit of the group, whereas in the stochastic case we analyze the behavior of the global persistence. Our simulations show that this quantity has a robust power law updating behavior, indicating that this can be used to model emerging collective behavior. We have also performed simulations with heterogeneous agents, including deceiver and conservative agents. Finally we have performed simulations for the local persistence exploring two different versions of this concept: the probability of a particular agent not going bankrupt and the probability of a particular agent not losing money. Different power-law behaviors are also observed in these two situations.

AKSOE 10.67 Wed 16:00 P2

An analytical solution of a wealth exchange model — ●PRZEMYSŁAW REPETOWICZ and PETER RICHMOND — Department of Physics, Trinity College Dublin 2

We solve analytically a toy version of a Boltzmann model with applications in economics. This model was first proposed by [1,2] and analysed numerically in [3,4,5]. The authors studied variants of the model and claimed that in one case the steady state corresponds to a Gamma function [3,4] and in another case that it corresponds to a distribution with a power law with index unity [5] in the high end. It was suggested that the existence of equilibria and the power law exponent of unity are universal features of the model. More recent [6,7] analytical calculations revealed that the Gamma function is only an approximation to a steady state solution. In this work we analyze the existence of equilibrium and the rate of convergence to it. Our approach rests on a body of other work published many years ago [8] and more recently studies using probabilistic tools [9,10].

[1] Chatterjee A et al, Physica Scripta T **106**, p 36-38 (2003) and cond-mat/0311227

[2] Chatterjee A et al, Physica A 335 155-163 (2004)

[3] Patriarca M et al, preprint cond-mat/0312167

[4] Patriarca M et al, preprint cond-mat/0402200

[5] Patriarca M et al, preprint cond-mat/0504153

[6] Repetowicz P et al, Physica A, 356 (2005) 641-654

[7] Chatterjee A et al, preprint cond-mat/0407770

[8] Wild E, Proc. Camb Phil Soc 47 (1951) 602-609

[9] Ferland R et al, Stochastics Rep. 35 (1991) 23-33

[10] Carlen E A et al, Jour. Func. Analysis

AKSOE 10.68 Wed 16:00 P2

A model for social dynamics with controlled mass media. — ●JUAN CARLOS GONZÁLEZ-AVELLA — juancarlos@imedeia.uib.es

We study the effect of mass media, modeled as an applied external field, on a social system based on Axelrod's model for the dissemination of culture. The numerical simulations show that the system undergoes a nonequilibrium phase transition between an ordered phase (homogeneous culture) specified by the mass media and a disordered (culturally fragmented) one. The critical boundary separating these phases is calculated on the parameter space of the system, given by the intensity of the mass media influence and the number of options per cultural attribute. Counterintuitively, mass media can induce cultural diversity when its intensity is above some threshold value. The nature of the phase transition changes from continuous to discontinuous at some critical value of the number of options

AKSOE 10.69 Wed 16:00 P2

Reactions to extreme events: moving threshold model — ●EDUARDO G. ALTMANN, SARAH HALLERBERG, and HOLGER KANTZ — Max Planck Institute for the Physics of Complex System, Dresden - Germany

The occurrence of unexpected large events is a common feature of complex dynamical systems considered in physical (earthquakes, extreme

weather conditions), biological (heart attacks, epileptic seizures), and sociological (stock market crashes) contexts. The harmful effects of such extreme events are due to the overcome of the preventive barriers, what results not only from its extreme character, i.e., large fluctuation of some scientifically relevant observable, but also from its unpredictable nature. An event is thus defined to be *extreme* if it exceeds a given threshold that corresponds to the preventive barriers, which account for the expected events and typically change in time. These barriers usually increase drastically right after the occurrence of extreme events, but steadily decay in their absence. We consider in this presentation a simple model that mimics the evolution of the protection barriers to study the efficiency of the system's reaction to extreme events and how it changes our perception of the sequence of extreme events itself. We obtain that the usual method of fighting extreme events introduces a periodicity in their occurrence and is generally less efficient than the use of a constant barrier. On the other hand, it shows a good adaptation to the presence of slow non-stationarities.

[1] E. G. Altmann, S. Hallerberg, H. Kantz, arXiv: physics/0508170, Physica A.

AKSOE 10.70 Wed 16:00 P2

From small world to hierarchic business information networks by reorganizations - a real world study of a failure — ●MARKUS CHRISTEN¹, GEORGES BONGARD², ATTILA PAUSITS³, and RUEDI STOOP¹ — ¹Institute of Neuroinformatics, University / ETH Zürich, Winterthurerstrasse 190, 8057 Zürich, Switzerland — ²Swisscom IT Services AG, 3050 Bern, Switzerland — ³Center for Telematics, Donau Universität Krems, Dr.-Karl Dorrek-Strasse 30, 3500 Krems, Austria

Business units in large enterprises are frequently objects of reorganizations. These change the social network of the unit, expressed by the flow of information between the employees that is necessary for performing business processes. Reorganizations usually intend to increase the efficiency of the unit, measured in terms of the speed of business processes performed by the unit. We take a real-world example and investigate the change of the information-flow induced by a reorganization that transformed a small-world type into a hierarchical type network. We show that the robustness, determined in terms of how the business processes are affected by an outage of nodes in the information-flow, is a critical parameter that tends to counteract the intended gain in efficiency. The example demonstrates that reorganizations should not only focus efficiency in terms of classical business studies, but should include an analysis of the robustness of the information-flow network within a business unit as well. Otherwise, theoretically expected gain in efficiency may not be achievable in practice.

AKSOE 10.71 Wed 16:00 P2

Taxing Principles and their influence on Economy — ●ALEXEI VASILEV¹ and ALEXANDER CHALYI^{1,2} — ¹Taras Shevchenko Kiev University, Department of Theoretical Physics, 2 Glushkov Prosp., Building 1, 03680 Kiev, Ukraine — ²National Medical University, Department of Physics, 13 Shevchenko Blvd., 01601 Kiev, Ukraine

The efficiency of different schemes of taxing is investigated. For this purpose the mathematical model is proposed. The dependence of the government income on average taxing rate is received analytically. It is shown that this dependence coincides with the law of Laffer curve. It is found also that this dependence takes place when economic system is in the stable stationary state only while the instability of stationary state causes the deviation from the law of the Laffer curve. Moreover special investigation is carried out and it is shown that the model used is structurally stable.