

ECONOFIS'14

3rd EDITION

Scientific Programme

CBPF - Rio de Janeiro - Brazil

From 1st to 3rd October – 2014

The digital version of this booklet can be downloaded at URL:

<http://econofis14.fis.puc-rio.br/>

Also directly accessible on smartphones and tablets by reading the cyber code on the back cover.

Foreword

Dear Colleagues,

It is our great pleasure to welcome you to CBPF, in Rio de Janeiro, for the *ECONOFIS'14*. The conference follows after previous meetings held in Rio de Janeiro (2007) and São Paulo (2010). As the name easily denotes it, the ECONOFIS' was at first intended to work as the forum for the Brazilian community of physicists interested in quantitative and complex aspects of Finance and Economics, but it swiftly captivated the interest of other academics and practitioners becoming a truly multidisciplinary conference. The span between events has allowed grasping how the limelights of the research field have evolved, which has permitted to settled ideas and concepts on some problems and reorient the research focus onto new ones. Besides established matters like *Statistical physics of fluctuating economic observables*, *Market complex dynamics*, *Agent-based models of socio-economic systems* and *Socio-economic complex networks* the present edition gives special attention to issues related to *Market behaviour and forecasting*, *Microstructure of financial markets* and *Risk assessment and management* representing current hot topics.

We wish you all a great and inspiring conference.

Sílvia M. Duarte Queirós (CBPF & INCT-SC)
Celia Anteneodo (PUC-Rio & INCT-SC)
Daniel Cajueiro (UnB & INCT-SC)
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Rogério Rosenfeld (UNESP, Brazil)

Benjamin Tabak (Federal Senate & UCB, Brazil)

Constantino Tsallis (CBPF & INCT-SC, Brazil)

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11:00-11:50	Lillo	Moldes	Smerlak
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Abstracts: Invited Talks

Point processes and order book dynamics

Alan De Genaro

Securities, Commodities and Futures Exchange - BM&FBOVESPA, Brazil
Faculdade de Economia e Administração, Universidade de São Paulo, Brazil

This talk discusses properties of a Doubly Stochastic Poisson Process (DSPP) where the intensity process belongs to a class of affine diffusions. For any intensity process from this class we derive an analytical expression for probability distribution functions of the corresponding DSPP. A specification of our results is provided in a particular case where the intensity is given by one-dimensional Feller process and its parameters are estimated by Kalman filtering for high frequency transaction data.

A look into dependency structure and scaling properties of financial time series

Tiziana di Matteo

King's College London, UK

There are two main elements that define the complexity of financial time series: the first is multifractality [1], which is associated to the behavior of each single variable and the way it scales in time; the second is the structure of dependency between time series, associated with the collective behavior of the whole set of variables [2,3]. So far, these two manifestations of complexity have been investigated separately. In this talk I will point out that -in fact- they are related [4]. I will first introduce a graph-theoretic approach to extract clusters and hierarchies in an unsupervised and deterministic manner, without the use of any prior information [2] showing that applications to financial data-sets can meaningfully identify industrial activities and structural market changes [5]. I will then show new empirical observations of an interplay between cross-correlations hierarchical properties and multifractality [4]. In particular the degree of multifractality displayed by different stocks is found to be positively correlated to their depth in the hierarchy of cross-correlations.

References [1] T. Di Matteo, *Quantitative Finance* **7**(1) (2007) 21;
[2] Won-Min Song, T. Di Matteo, T. Aste, *PLoS One* **7**(3) (2012) e31929;
[3] F. Pozzi, T. Di Matteo and T. Aste, *Scientific Reports* **3** (2013) 1665;
[4] R. Morales, T. Di Matteo, T. Aste, *Scientific Reports* **4** (2014) 4589;
[5] N. Musmeci, T. Aste, T. Di Matteo, *Clustering and hierarchy in financial markets: advantages of the DBHT*, (2014) [arXiv:1406.0496](https://arxiv.org/abs/1406.0496) [q-fin.ST]

Implied volatility smirk under asymmetric dynamics

José Fajardo

EBAPE, Fundação Getúlio Vargas, Brazil

In this paper focusing on Lévy process, with exponential dampening controlling the skewness, we obtain a result that allow us to relate the implied volatility skew and the asymmetric dynamics of the underlying. Moreover, with this result in mind we propose alternatives specifications for the implied volatility and test them using S&P 500 options data, obtaining a very good fit. Although, there is in the literature more general data-generating process, including stochastic volatility models, by focusing on a particular class we can learn a bit more insights about how this particular process generates the skew. More exactly, the market symmetry parameter is deeply connected with the risk neutral excess of kurtosis, which will allow us to relate the risk neutral skewness and kurtosis with the implied volatility skew.

Systemic risk in the interbank network

Roberto Iglesias

Instituto de Física, Universidade Federal do Rio Grande do Sul, Brazil
National Institute of Science and Technology for Complex Systems, Brazil

One of the most striking characteristics of modern financial systems is its complex interdependence, standing out the network of bilateral exposures in interbank market, through which institutions with surplus liquidity can lend to those with liquidity shortage. While the interbank market is responsible for the client liquidity allocation, it also introduces the possibility for systemic risk via financial contagion. Insolvency of one bank can propagate through the network leading to insolvency of other banks. Moreover, empirical studies reveal that some interbank networks have features of scale-free networks, which means that the distribution of connections among banks follows a power law. This work explores the characteristics of financial contagion in networks whose links distributions approaches a power law, using a model that denes banks balance sheets from information of network connectivity. By varying the parameters for the creation of the network, several interbank networks are built, in which the concentrations of debts and credits are obtained from links distributions during the creation networks process. Three main types of interbank network are analyzed for their resilience to contagion: i) concentration of debts is greater than concentration of credits, ii) concentration of credits is greater than concentration of debts and iii) concentrations of debts and credits are similar. We also tested the effect of a variation in connectivity in conjunction with variation in concentration of links. The results suggest that more connected networks with high concentration of credits (featuring nodes that are large creditors of the system) present greater resilience to contagion when compared with the others networks analyzed.

The adaptive nature of liquidity in financial markets

Fabrizio Lillo

Scuola Normale Superiore di Pisa, Italy
Santa Fe institute, USA

In financial markets, the order flow, defined as the process assuming value one for buy market orders and minus one for sell market orders, displays a very slowly decaying autocorrelation function. Since orders impact prices, reconciling the persistence of the order flow with market efficiency is a subtle issue. A possible solution is provided by asymmetric liquidity, which states that the impact of a buy or sell order is inversely related to the probability of its occurrence. We empirically find that when the order flow predictability increases in one direction, the liquidity in the opposite side decreases, but the probability that a trade moves the price decreases significantly. While the last mechanism is able to counterbalance the persistence of order flow and restore efficiency and diffusivity, the first acts in the opposite direction. We introduce a statistical order book model where the persistence of the order flow is mitigated by adjusting the market order volume to the predictability of the order flow. The model reproduces the diffusive behaviour of prices at all time scales without fine-tuning the values of parameters, as well as the behaviour of most order book quantities as a function of the local predictability of the order flow.

Reference Taranto, Bormetti and Lillo, Journal of Statistical Mechanics (2014)

The Dynamics of the Interbank Market: Statistical Stylized Facts and Agent-Based Models

Thomas Lux

Universität zu Kiel, Germany

Universitat Jaume I, Spain

We review a number of basic stylized facts of the interbank market that have emerged from the empirical literature over the last years. Our objective is to explain these findings as emergent properties of dynamic agent-based model of the interaction within the banking sector. To this end, we develop a simple dynamic model of interbank credit relationships. Starting from a given balance sheet structure of a banking system with a realistic distribution of firm size, the necessity of establishing interbank credit connections emerges from idiosyncratic liquidity shocks. Banks initially choose potential trading partners randomly, but form preferential relationships via an elementary reinforcement learning algorithm. As it turns out, the dynamic evolution of this system displays a formation of a core-periphery structure with mostly the largest banks assuming the roles of money center banks mediating between the liquidity needs of many smaller banks. Preferential interest rates for borrowers with strong attachment to a lender prevent the system from becoming extortionary and guarantee the survival of the small periphery banks.

Leverage and Feedback Effects on Multifactor Wishart Stochastic Volatility for Option Pricing

Michael McAleer

National Tsinghua University, Taiwan
Erasmus University Rotterdam, The Netherlands
Complutense University of Madrid, Spain

A general asymmetric multifactor Wishart stochastic volatility (AMWSV) diffusion process which accommodates leverage, feedback effects and multifactor for the covariance process is proposed. It gives the closed-form solution for the conditional and unconditional Laplace transform of the AMWSV models. It also suggests estimating the AMWSV model by the generalized method of moments using information not only of stock prices but also of realized volatilities and co-volatilities. The empirical results for the bivariate data of the NASDAQ 100 and S&P 500 indices show that the general AMWSV model is preferred among several nested models.

Reference M. Asai and M. McAleer, *Journal of Econometrics* (2014)

Contagion Risk within Firm-Bank Bivariate Networks

Benjamin Tabak

Federal Senate of Brazil

Catholic University of Brasilia, Brazil

In this talk is proposed a novel way to model a network of firm-bank and bank-bank interrelationships using a unique dataset for the Brazilian economy. We show that distress originating from firms can be propagated through the interbank network. Furthermore, we present evidence that the distribution of distress can have contagious effects due to correlated exposures. Our modeling approach and empirical results provide useful tools and information for policy makers and contribute to the discussion on assessing systemic risk in an interconnected world.

Elimination of systemic risk by a systemic risk tax

Stefan Thurner

Medizinische Universität Wien, Austria
Santa Fe Institute, USA

Nodes in a financial network, e.g. banks, cannot assess the true risks associated with lending to other nodes in the network, unless they have full information on the riskiness of all other nodes. These risks can be estimated by using network metrics of the interbank liability network. We show that transactions in a financial network change the systemic risk levels of the involved institutions. By imposing a tax on transactions that increase the total systemic risk in the system we show with an agent based model that systemic risk in financial networks can be eliminated. As a result of the tax the asset liability network is dynamically restructured and does not allow for contagion of failing institutions anymore, and systemic risk becomes marginal. This scheme does not reduce the efficiency of the financial network, but fosters a more homogeneous risk-distribution within the system in a self-organized critical way. A regulation-policy implementation of the proposed scheme is discussed.

[1] R. Hanel, S. Thurner, *Europhys Lett.* **93**, 20006 (2011);

[2] R. Hanel, S. Thurner, *Europhys Lett.* **96**, 50003 (2011);

[3] S. Thurner, R. Hanel, What do generalized entropies look like? An axiomatic approach for complex, non-ergodic systems, in *Recent advances in Generalized Information Measures and Statistics*, Bentham Science eBook, (in production 2013).

Abstracts: Oral Communications

Is there any connection between the network morphology and the fluctuations of the stock market index?

Fischer M. Stefan and Allbens P.F. Atman

CEFET-MG, Brazil

National Institute of Science and Technology for Complex Systems, Brazil

Models which consider behavioral aspects of the investors have attracted increasing interest in the Finance and Econophysics literature in the last years. Different behavioral profiles (imitation, anti-imitation, indifference) were proposed for the investors, which take their decision based on their trust network (neighborhood). Results from agent based models have shown that most of the features observed in actual stock market indices can be replicated in simulations. Here, we present a deeper investigation of an agent based model considering different network morphologies (regular, random, small-world) for the investors trust network, in an attempt to answer the question raised in the title. We study the model considering four scenarios for the investors and different initial conditions to analyze their influence in the stock market fluctuations. We have characterized the stationary limit for each scenario tested, focusing on the changes introduced when complex networks were used, and calculated the Hurst exponent in some cases. Simulations showed interesting results suggesting that the fluctuations of the stock market index are strongly affected by the network morphology, a remarkable result which we believe was never reported or predicted before.

Nonstationarities in financial data

Sabrina Camargo

Fundação Getúlio Vargas, Brazil

The treatment of non-stationary data is often tackled assuming sets of coupled stochastic differential equations representing different scales of evolution of the system, which frequently pave the way to demanding solutions. However, allowing for the large relaxation times of some of these equations must have, the modeling of non-stationary quantities can be simplified by considering that the system is in a generic steady state and the data are well described by a juxtaposition of intervals of length ℓ characterized by few N parameters $\{\Pi\}$ constant within the scale ℓ . In this work the impact of the non-stationary nature of financial time series. Specifically, from a characterization of the features of the trading volume at short time scales (1 minute), we pitch at describing not only its statistical properties but also at depicting price fluctuations from the trading volume as first endeavoured using daily data and more recently essayed in using coupled equations. The analysis focus on the 30 blue chip companies defining the Dow Jones Industrial Average. From the segmentation procedure we are able to introduce a quantitative description of statistical features of these two quantities, which are often named stylized facts, namely the tails of the distribution of trading volume and price fluctuations and a dynamics compatible with the U-shaped profile of the volume in a trading section and the slow decay of the autocorrelation function. The segmentation of the trading volume series provides evidence of slow evolution of the fluctuating parameters of each patch, pointing to the mixing scenario. Assuming that long-term features are the outcome of a statistical mixture of simple local forms, we test and compare different probability density functions to provide the long-term distribution of the trading volume, concluding that the log-normal gives the best agreement with the empirical distribution.

Analysis of Tax Evasion Dynamics via an Agent-Based Model

Nuno Crokidakis

Instituto de Física, Universidade Federal Fluminense, Brazil

In this work we study the problem of tax evasion on a fully-connected population. For this purpose, we consider that the agents may be in three different states, namely honest tax payers, tax evaders and undecided, that are individuals in a intermediate class between honest and evaders. Every individual can change his state by means of an opinion dynamics governed by stochastic pairwise interactions, being positive or negative, representing agreement/disagreement between pairs of agents. In addition, we consider the punishment rules of the Zaklan econophysics model, for which there is a probability p_a of an audit each agent is subject to in every period and a length of time k detected tax evaders remain honest. Our results suggest that below the critical point of the opinion dynamics the compliance is high, and the punishment rules have a small effect in the population. On the other hand, above the mentioned critical point the tax evasion can be considerably reduced by the enforcement mechanism.

An Agent-Based Approach and Confidence in the Financial Market

Mario Bertella

Faculdade de Ciências e Letras, Universidade Estadual Paulista “Júlio de Mesquita Filho”, Brazil

Using a behavioral finance approach we study the impact of behavioral bias. We construct an artificial market consisting of fundamentalists and chartists to model the decision-making process of various agents. The agents differ in their strategies for evaluating stock prices, and exhibit differing memory lengths and confidence levels. When we increase the heterogeneity of the strategies used by the agents, in particular the

memory lengths, we observe excess volatility and kurtosis, in agreement with real market fluctuations indicating that agents in real-world financial markets exhibit widely differing memory lengths. We incorporate the behavioral traits of adaptive confidence and observe a positive correlation between average confidence and return rate, indicating that market sentiment is an important driver in price fluctuations. The introduction of market confidence increases price volatility, reflecting the negative effect of irrationality in market behavior.

Analysis of stochastic time series produced by a model of the dynamics of a financial asset based on differential equations

Arthur Magalhães

CEFET-MG, Brazil

We model the dynamics of the price of a financial asset through a system of differential linear equations. The set of equations represents the position of buying or selling of each agent in the market and the deviation of the price of the asset in relation to a price considered fair (fundamentalist). Each variable evolves according to the impact that the quantity demanded or supplied by the agents, as well the deviation of the price, provoke in the decision of the agents to demand or offer the asset in question. The model considers the behavior of imitation, antiimitation or neutrality of agents, analyzing different cases of this behavior. By prior knowledge, we believe that imitation is the feature that is closest to real situations. For systems consisting of imitators agents, it was found that a term that models the finiteness of money is necessary in order to the dynamics not to diverge. We note that to find distributions of characteristic exponents of series of efficient financial markets, it is essential the predominant participation of random components, exogenous to the model. However, we conclude that the presence of internal dynamics must be considered in order to find characteristic exponents of emerging markets.

Strategies generalization and payoff fluctuation optimization in the iterated ultimatum game

Alexandre S. Martinez

Universidade de São Paulo – Campus Ribeirão Preto, Brazil

National Institute of Science and Technology for Complex Systems, Brazil

In this work we studied a iterated version of ultimatum game based on generalized probabilistic strategies which map the behavior of the players by mixing levels of altruism and greedy mathematically modeled by accepting and proposal functions. We obtained analytically expressions for the moments of the payoff of the players under such generalizations. We separated our analysis in two parts: (i) no memory players: players do not carry the trace of game and (ii) one-step memory players: the offers depend on previous result, in this case we also used Monte Carlo simulations to support our results. For the part (i) we show that average and variance of the payoff of the proposer and responder players are the same when the altruism level of the proposer combined with greedy level of the responder balances the altruism level of the responder combined with greedy level of the proposer. So we concentrate our analysis for both parts (i) and (ii) considering two important particular cases for the accepting: (a) fixed probability of accepting p and (b) accepting dependent on the offer. For case (a), we show specifically for the part (ii) that there is p value that maximizes the cumulative gain after n iterations. Moreover we show regions of “iso-average” and “iso-variance” of the cumulative payoff in color diagrams $n \times p$. For the case (b) we specifically show for the part (i) that there exist values of cutoff, i.e., a parameter q_6 (that controls a threshold value from which all proposals are accepted) for which the variance of the cumulative payoff of the proposer presents local maximum and minimum values while for the responder the same amount presents a global maximum. For the same case (b), part (ii), we verified via MC simulations that for the same number of iterations that responders obtain different cumulative payoffs by setting different q_6 -values by composing an interesting pattern of stripes in $q_6 \times n$ diagrams. Simultaneously looking at variance of this amount, for the responder player in similar diagram, we observe regions of iso-variance in non trivial patterns

whose depend on initial value of the proposal. Our contributions detailed by analytical and MC simulations will be very useful for the design of new experiments in ultimatum game in stochastic scenarios.

Belief Dynamics: The interplay between Wall Street and Main Street

Marcus Moldes^{1,2} and Thadeu Penna^{1,3}

¹ Universidade Federal Fluminense, Brazil

² AXON Invest, Brazil ³ National Institute of Science and Technology for Complex Systems, Brazil

Every day, thousands of Wall Street players struggle to understand new pieces of information about the economy. They dig inside piles of economic indicators from Main Street, seeking for any clue about the future path of interest rates or company earnings. But, what really move market prices are not the economic releases themselves, but the investors' belief about these figures. However, sometimes, beliefs come true, or at least sound true for a while, and in this case, they start to affect the Main Street as well. When this happens, asset prices can go far away from the equilibrium. We show some recent examples of these events around the world and study a market model built on beliefs that can replicate this behavior.

Testing the Goodwin growth-cycle macroeconomic dynamics in Brazil

N.J. Moura Jr¹ and Marcelo Byrro Ribeiro²

¹Instituto Brasileiro de Geografia e Estatística/Brazil

²Instituto de Física - Universidade Federal do Rio de Janeiro/Brazil

This work discusses the empirical validity of Goodwin's (1967) macroeconomic model of growth with cycles by assuming that the individual

income distribution of the Brazilian society is described by a Gompertz-Pareto distribution (GPD), formed by the combination of the Gompertz curve, representing the overwhelming majority of the population ($\sim 99\%$), with the Pareto power law, representing the tiny richest part ($\sim 1\%$). The Gompertzian part is identified with the workers and the Paretian component with the class of capitalists. Since the GPD parameters are obtained for each year and the Goodwin macroeconomics is a time evolving model, we use Brazilian GPD parameters, as well as unemployment data, to study the time evolution of these quantities in Brazil from 1981 to 2009 by means of the Goodwin dynamics. Our results show partial qualitative and quantitative agreement with the original Goodwin model in the studied time period. Nevertheless, it falls short of a good empirical agreement as it predicts single center cycles which were not found in the data. We discuss some points where the Goodwin dynamics must be improved in order to provide a more realistic representation of the dynamics of economic systems.

Quantifying financial risks

Paulo S. G. de Mattos Neto

Escola Politécnica de Pernambuco, Universidade de Pernambuco, Brazil

The stocks broking is based on risk and return binomial. Thus, the rational brokers just will realize the investment when define the return expectation provide by the total risk level associated with the financial operation. Observing the financial crash '90 (Metallgesellschaft (1993), Orange County (1994), Barrings (1994) and Daiwa (1995)), the technology for risks measure and management was a real necessity to be established. Therefore, the VAR methodology was implement based on statistical techniques to solve this problem. Formally, the VAR reflects for the risk manager the acceptable worst loss in the given time range, under normally market conditional in a given confidence level. The VAR became the default referential to financial risks management, but its use can not predict the Subprime Crash (2006), where in according to the Federal Deposit Insurance Corporation (FDIC) there were up to 380 bankruptcy financial institutions just in USA (2008) and consequently an economic

crisis worldwilde. Here, it is proposed a new methodology based on the VAR model that defines the level of risk of a given stock or paper in a market. With this methodology is possible classify the paper for a given broker profile.

Dynamics in two networks based on stocks of the US stock market

Leonidas Sandoval Júnior

Inspere – Instituto de Ensino e Pesquisa, Brazil

We follow the main stocks belonging to the New York Stock Exchange and to Nasdaq from 2003 to 2012, through years of normality and of crisis, and study the dynamics of networks built on two measures expressing relations between those stocks: correlation, which is symmetric and measures how similar two stocks behave, and Transfer Entropy, which is non-symmetric and measures the influence of the time series of one stock onto another in terms of the information that the time series of one stock transmits to the time series of another stock. The two measures are used in the creation of two networks that evolve in time, revealing how the relations between stocks and industrial sectors changed in times of crisis. The two networks are also used in conjunction with a dynamic model of the spreading of volatility in order to detect which are the stocks that are more likely to spread crises, according to the model. This information may be used in the building of policies that might reduce the effect of financial crises. The two networks built using the correlations between stocks of the US stock market and using the Transfer Entropy from stocks in one day to stocks on the next day proved to be very similar, indicating that a large exchange of information between stocks from one day to another is associated with their similar behavior on this next day. We could see the importance of some sectors of the US economy in the dissemination of information, like the Financial and the Industrial sectors, and the role of receivers of information like the Utilities and Energy sectors. By using moving windows, we could see how correlation and Transfer Entropy rise in times of crises and how correlation has been growing after

the crisis of 2008, what did not happen to Transfer Entropy. By building a model based on Transfer Entropy, we could simulate how volatility may propagate in a network of stocks and how sectors that occupy more central positions, like the Communications and Technology sectors, have major roles in the propagation of crises.

Thermodynamics of inequalities: from precariousness to economic stratification

Matteo Smerlak

Perimeter Institute, Canada

Increasingly large social and economic inequalities are observed throughout the world. Theorists after Pareto have studied this phenomenon in terms of the tail structure of the wealth distribution at a given time. Unfortunately, this approach leaves unaddressed the dynamics of inequalities in non-equilibrium situations, e.g. under redistribution policies. Here we introduce a thermodynamical theory of inequalities based on the analogy between economic stratification and statistical entropy. Within this framework we identify the combination of upward mobility with precariousness as a fundamental driver of inequality. We formalize this statement by a “second-law” inequality displaying upward mobility and precariousness as thermodynamic conjugate variables. Our method can be generalized to gain insight into the dynamics of inequalities in any Markovian model of socioeconomic interactions.

Financial Brownian Particle in the Layered Order-Book Fluid and Fluctuation-Dissipation Relations

Yoshihiro Yura

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Although all previous models based on the random walk picture or its continuous version for financial market involve just the price dynamics, we introduce a qualitatively novel type of model for financial price fluctuations. Rather than focusing on the dynamics of a single price for a given market that requires complicated modifications to the basic random walk model in order to account for the numerous stylized facts, we propose the picture that the observed financial motion is analogous to a genuine colloidal Brownian particle embedded in a fluid of smaller particles. With massive data analysis, we have established a fundamental analogy between the motion of a colloidal particle embedded in a fluid and the price dynamics of a financial market in the order book. Even though the market evolves by decision-making process of traders, the Langevin equation, a stochastic differential equation that describes the colloidal motion in a molecular fluid, can be applied to the fluctuation of its behaviors (i.e., traders' reactions to place their limit orders against price changes), which also validates the Fluctuation-Dissipation Theorem, used to predict the behavior of non-equilibrium systems in statistical physics, even in finance. The proposed quantitative correspondence provides a novel perspective for the analysis of financial markets. Our approach demonstrates the importance of physical intuition associated with financial insights in analyzing the big data of financial markets.

Y. Yura, H. Takayasu, D. Sornette, M. Takayasu, *Phys. Rev. Lett.* **112**, 098703 (2014)

Abstracts: Poster Session

A Monte Carlo Approach to Real Option Pricing

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– Brazil

In this work we are concerned with valuing the option to invest in a project when the available information provided to the manager comes from simulated data of cash flows under historical or subjective measures in a possibly incomplete market. It is based on the Hedged Monte Carlo strategy proposed by Potters et al. (2001) where options are priced simultaneously with the determination of the corresponding hedging. The approach is particularly well-suited to the evaluation of commodity related projects whereby the availability of pricing formulae is very rare, the scenario simulations are usually available only in the historical measure, and the cash flows can be highly nonlinear functions of the prices.

Modern High Performance Data Analysis on Modern High Performance Hardware

Maicon Faria Abax HPC – Brazil

The advance on processing hardware push the capacity of massive data analysis through new performance boundaries allowing real time analysis once impossible. Today the Graphic Processing Units GPUs use is growing and is well established as one of the most used hardware for high performance computing. In this work we show several comparisons between tools such as CUDA and OpenACC using common data analysis techniques as algebraic operations, Discrete Fourier Transforms DFT and “Random” Number Generators RNG. This analysis is extended to hardware benchmark involving Intel, Nvidia and AMD technologies.

Informational inefficiency in a linear economy model

João Pedro Jericó and Renato Vicente, Universidade de São Paulo – Brazil

We study the effects of introducing information inefficiency in a linear economies model by supposing a Bayesian representative consumer that chooses a bundle of goods by sampling a maximum entropy distribution subjected to budget constraints. Within this approach an informational inefficiency parameter, formally analogous to a physical temperature, emerges. By using techniques from statistical mechanics, we show that if the inefficiency is high enough, increasing the consumption set of a consumer will decrease his expected utility. Economic activity, however, will increase much faster despite individual welfare decrease. We also present a minimal model that shows why this happens and discuss the consequences of such behavior.

Lévy sections vs partial sums of heteroscedastic time series: the gaussian convergence of economics series

Frederico S. Passos Universidade Federal do Alagoas – Brazil

Weakly nonstationary processes appear in many challenging problems related to the physics of complex systems. An interesting question is how to quantify the rate of convergence to Gaussian behavior of rescaled heteroscedastic time series with stationary first moments but nonstationary multifractal long-range correlated second moments. Here we use the approach which uses a recently proposed extension of the Lévy sections theorem. We analyze statistical and multifractal properties of heteroscedastic time series and find that the Lévy sections approach provides a faster convergence to Gaussian behavior relative to the convergence of traditional partial sums of variables. We also observe that the rescaled signals retain multifractal properties even after reaching what appears to be the stable Gaussian regime.

Correlation and Cross-Correlation of the BOVESPA companies

Paulo S. G. de Mattos Neto Universidade de Pernambuco – Brazil

The São Paulo Stock Market Index - IBOVESPA is composed for sixty-nine companies and seventy-two assets. In market analysis is deeply important understand the relationship between the financial index and its components. This work aims to study the temporal correlation of the assets prices from two statistical techniques of long-term correlation of the absolute returns: Detrended fluctuation analysis (DFA) and Detrended cross correlation analysis (DCCA). The DFA was applied in order to analyze the forty-four companies that composes the IBOVESPA index and the own index. In analysis was verified that 97.73% of the companies presents long-term correlation persistent with mean exponent DFA and 2.27% presents anti persistent correlation, respectively. This result means that small/large values have bigger probability to be followed for small/large values and that the opposite occurs with smaller probability, in case anti persistent. When DCCA was used to measure the cross correlation between companies that composes the IBOVESPA with the own IBOVESPA index was obtained the mean exponent DCCA. Thus, each financial company that composes the IBOVESPA index has strong correlation with IBOVESPA.

Offsetting the disposition effect with a stop-loss rule

Elder Silva Universidade Federal de Santa Catarina – Brazil

We put forward an agent-based model of the stock market where the behavior of agents showing the disposition effect can be offset by that of others using a stop-loss rule. The model can also replicate data from the recent mini flash crashes.

Mapping systemic risk: critical degree and failures distribution in financial networks

Matteo Smerlak Perimeter Institute – Canada

The financial crisis illustrated the need for a functional understanding of systemic risk in strongly interconnected financial structures. Dynamic processes on complex networks being intrinsically difficult, most recent studies of this problem have relied on numerical simulations. Here we report analytical results in a network model of interbank lending based on directly relevant financial parameters, such as interest rates and leverage ratios. We obtain a closed-form formula for the “critical degree” (the number of creditors per bank below which an individual shock can propagate throughout the network), and relate failures distributions to network topologies, in particular scale-free ones. Our criterion for the onset of contagion turns out to be isomorphic to the condition for cooperation to evolve on graphs and social networks, as recently formulated in evolutionary game theory. This remarkable connection supports recent calls for a methodological rapprochement between finance and ecology.

As the morphologies Networks Influence Index Stock Market and the Distribution of Wealth on a Model of Behavioral Finance

Fischer M. Stefan and Allbens P.F. Atman CEFET-MG – Brazil

Models that consider Behavioral Finance Investors have become an important field of study in Econophysics and Finance. Different behavioral profiles (imitator, anti-copycat, indifferent and mixed) were proposed to investors who make their decisions based on their trusted network (neighborhood). Results of agent-based models have shown that the major characteristics observed in the indices of the stock market can be replicated in simulations. We present an investigation of this model considering different network morphologies (regular, random, small world) to the trusted network of investors in order to show how the complex network influences the fluctuations of the stock market index and the distribution of wealth from investors. We study the model considering

four scenarios for investors. Different initial conditions were applied to analyze its influence on the fluctuations of the stock market and the total of cash and stock after a period of buying and selling actions. Characterize the stationary limit for each tested scenario, focusing on the changes introduced when complex networks were used and calculated the Hurst exponent in some specific cases. Considering the psychological behavior of investors, simulation results showed that the profile of Anti-Imitation in a complex network is the best scenario to obtain profit.

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