Econophysics and Risk Assessment

1st Greek-Bulgarian Research Entrepreneurship Workshop in the field of Complexity Science

> Project ICoSCIS PP3 - University of Macedonia





Greece-Bulgaria 2007-2013 INVESTING IN OUR FUTURE

This Project is co-funded by the European Union (ERDF) and National Funds of Greece and Bulgaria





Team description



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Macroeconomics

- income
- capital K
- production Ρ
- production function F
- standard of living λ
- labor force Ν
- Lagrange function
- individual freedom V

Richmond, P., Mimkes, J., and Hutzler, S., (2013): *Econphysics & Physical Economics*, UK: Oxford University Press.

Physical Economics

Comparing terms

Thermodynamics

- Q heat
- E energy
- W work
- entropy
- temperature
- particle number Ν
- free energy
- atomic volume

	X	
Physics		Economics
	X	



Econophysics An emerging field

Economics is a subject about human behavior related with the management of the resources, finances, income, the production and consumption of goods and services. A social science.

Physics tries to construct a picture of the movement of the whole nature. Mechanism is the first topic cared by physicists. A natural science.

First steps in **Econophysics: the hybrid**

- empirical studies of different phenomena to discover some universal or special laws
- construct models and mechanism

describe and understand the phenomena appeared in Economics using "Physical tools"





Econophysics An emerging field

Bertrand Roehner (2005) defines it simply as: "the investigation of economic problems by physicists" (p.3)

Mantegna and Stanley (2000) in a less general definition highlight that: "The word econophysics describes the present attempts of a number of physicists to model financial and economic systems using paradigms and tools borrowed from the oretical and statistical physics" (p. 355).

The term "econophysics" is widely used (since 90s) to denote <u>a new field of interdisciplinary</u> research, where methodologies and tools from Physics, mainly Statistical Physics and dynamic systems, applied to solve several financial puzzles.







How coherent may be the traditional measures of risk?

Marks & Spencer 0.15 0.1 0.15 -0.2 -0.25 -0.3 -0.35





Risk Assessment



Standard deviation

Alternative tools





Measures

Traditional tools

$$rac{1}{r_t} (r_t - \overline{r})^2$$

 $\Gamma - 1$

highly dependent to sample size all events are equally weighted linear generating process

distribution-free measure of dispersion and disorder mixed underlying dynamics





Critical Phenomena & Financial Crises



A sample of the international financial network, where the nodes represent major financial institutions and the links are both directed and weighted and represent the strongest existing relations among them. Node colors express different geographical areas: European Union members (red), North America (blue), other countries (green). Even with the reduced number of links displayed in the figure, relative to the true world economy, the network shows a high connectivity among the financial institutions that have mutual share-holdings and closed loops involving several nodes. This indicates that the financial sector is strongly interdependent, which may affect market competition and systemic risk and make the network vulnerable to instability.

Schweitzer, F., Fagiolo, G., Sornette, D., Vega-Redondo, F., Vespignani, A., and White, D., (2009): Economic Networks: The Challenges, Science, 325(422).





Bubbles and Financial Risk

*Risk in finance is not unique but rather multifaceted, since it is related to qualitative characteristics of the markets such as microstructural properties and investors' behaviour.

* More uncertain phases (darkened areas) are met at the extremes of the bubbles.





Kyrtsou, C., and Mikropoulou, C., (2013): Diversity, Uncertainty, and Stock Market Dynamics, 12eme Journée d'Économétrie - Développements Récents de l'Econométrie Appliquée à la Finance, Université Paris Ouest, December 2013.



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Calendar Anomalies and Financial Risk ATHEX Monday's risk







The severity of a calendar anomaly (aka Monday effect) is more evident in the estimation of Entropy.
Traditional risk measure fails to capture such an abnormal behaviour.

Kyrtsou, C., Malliaris, A., and Mikropoulou, C., (2013): Informational content of Monday returns and the role of dynamic invariants, *5th Symposium on Recurrence Plots*, Loyola University Chicago, August 2013.



Job openings Risk management IT programming Financial analysis Production planning

On behalf of UoM team Thank you!





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