


APPLIED FINANCE



WHAT IS ECONOPHYSICS?

- ▶ Biophysics, geophysics study physical processes in biology or geology
 - ▶ Econophysics tries to apply physics methods to economics
 - ▶ Price fluctuations look like a particularly promising subject:
 - ▶ large and non-gaussian
 - ▶ long temporal correlations
 - ▶ scaling and power laws
 - ▶ universal
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- A decorative graphic consisting of several parallel white lines of varying lengths, slanted upwards from left to right, located in the bottom right corner of the slide.

Agricultural Economics

American Economic Review

American Journal of Agricultural Economics

American Journal of Economics and Sociology

Annales d'Economie et de Statistique

Annals of Public and Cooperative Economics

Annals of Regional Science

Applied Economics

Applied Economics Letters

Applied Financial Economics

Applied Mathematical Finance

Aquaculture Economics and Management

Asia-Pacific Economic Review

Asian Economic Journal

Asian Survey

Asian-Pacific Economic Literature

Asia Pacific Journal of Economics and Business

Atlantic Economic Journal

Australian Economic History Review

Australian Economic Papers

Australian Economic Review

Australian Journal of Agricultural and Resource Economics

Briefing Notes in Economics

Brazilian Electronic Journal of Economics

Brookings Papers on Economic Activity

Bulletin of Economic Research

Bulletin of Indonesian Economic Studies

Business History

Business History Review

Cambridge Journal of Economics

Canadian Journal of Economics

Carnegie-Rochester Conference Series on Public Policy

China Economic Review

China Economic Survey

China Economic Journal

China Economic Review

China Economic Review

D

De Economist
Derivatives, Use, Trading and Regulation
Development and Change
Development Policy Review
Discrete Dynamics in Nature and Society

E

Eastern Economic Journal
East European Politics and Societies
Ecological Economics
Econometrica
Econometric Reviews
Econometrics Journal
Econometric Theory
Economia Politica Rivista di Teoria e Analisi
Economica
Economic Affairs
Economic and Industrial Democracy
Economic Development and Cultural Change
Economic Development Quarterly
Economic History Review
Economic Inquiry
Economic Issues
Economic Journal
Economic Modelling
Economic Outlook
Economic Policy
Economic Record
Economic Systems
Economics and Philosophy
Economics and Politics
Economics Letters
Economics of Education Review
Economics of Innovation and New Technology
Economics of Planning
Economic Systems
Economic Systems Research
Economic Theory
Economic Appliquee
Economies et Societes
Economy and Society
Education Economics
Electronic Journal of Business and Organization Ethics
Electronic Journal of Evolutionary Modelling and Economic Dynamics (e-JEMED)
Empirica
Empirical Economics
Energy Economics
Energy Journal
Environmental and Resource Economics
Environment and Development Economics
Environment and Planning
European Economic Review
European Finance Review
European Journal of Finance
European Journal of Industrial Relations
European Journal of Law and Economics
European Journal of Political Economy
European Journal of the History of Economic Thought
European Review of Agricultural Economics
European Review of Economic History
Experimental Economics
Explorations in Economic History

F

Federal Reserve Bank of Richmond Economic Quarterly
Feminist Economics
Finance and Development
Finance and Stochastics
Financial Counseling and Planning
Financial History Review
Finnish Journal of Business Economics
Fiscal Studies

G

Games and Economic Behavior
Geneva Papers on Risk and Insurance Theory
Global Business and Economics Review
Global Economy Quarterly
Growth and Change

H

Health Economics
History of Economic Ideas

I

IMF Staff Papers
Indian Economic Journal
Indian Economic and Social History Review
Industrial and Corporate Change
Industrial and Labor Relations Review
Industry and Innovation
Information Economics and Policy
Insurance Mathematics and Economics
International Advances in Economic Research
International Economic Review
International Finance
International Game Theory Review
International Journal of Finance and Economics
International Journal of Forecasting
International Journal of Game Theory
International Journal of Industrial Organization
International Journal of Islamic Financial Services
International Journal of Production Economics
International Journal of Social Economics
International Journal of the Economics of Business
International Journal of Theoretical and Applied Finance
International Organization
International Regional Science Review
International Review of Applied Economics
International Review of Economics and Finance
International Review of Finance
International Review of Financial Analysis
International Tax and Public Finance
International Trade Journal
Investigaciones Economicas



B

C

- ▶ Lemma/theorem style is required
- ▶ Little effort to compare theoretical predictions to “experimental data” - say, price record from real stock markets
- ▶ Bulk of papers are inaccessible and of no interest to “experimentalists” - practitioners of the field

**THEORETICAL ECONOMICS IS
DOMINATED BY PURE
MATHEMATICS:**

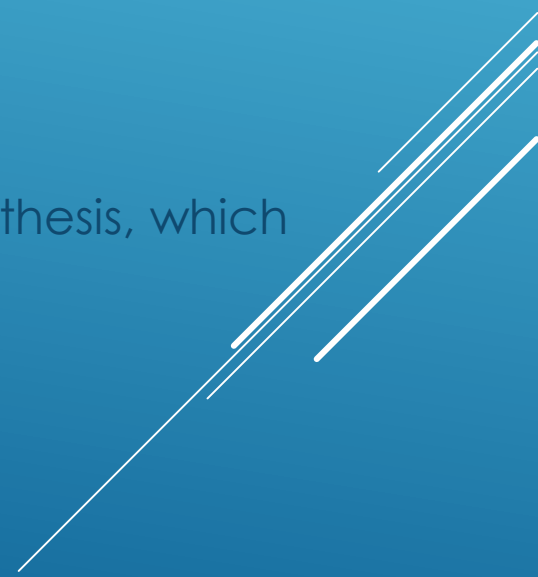
“Existing theories about the behavior of stock prices are remarkably inadequate. They are of so little value to the practitioner that I am not even fully familiar with them. The fact that I could get by without them speaks for itself.”

G. Soros, “Alchemy of Finance” 1994


GEORGE SOROS ON THEORETICAL ECONOMICS



WHAT PURE MATHEMATICS HAS CONTRIBUTED TO ECONOMICS?

- ▶ Game theory approach
 - ▶ Concept of Nash equilibrium, where no player can improve on his/her strategy
 - ▶ Assumptions about stock price fluctuations
 - ▶ Gaussian
 - ▶ Uncorrelated. Justification: Efficient Market Hypothesis, which states that all correlations are arbitrated away
- 

OBSERVATIONS DISAGREE:

- ▶ Short term fluctuations are strongly non-gaussian
 - ▶ Price increments are correlated:
 - ▶ signs of price increments are uncorrelated in agreement with Efficient Market Hypothesis
 - ▶ magnitude of price fluctuations has long temporal correlations
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WHY PHYSICS CAN CONTRIBUTE TO ECONOMICS?

- ▶ We can work with real market data derive empirical laws and construct phenomenological theories
- ▶ Statistical physics has useful approaches to systems, composed of many interacting parts

Drawbacks:

- Interacting units in economics are thinking agents with adaptive strategies and not “mindless” particles obeying simple microscopic laws

WHY BOTHER?

- ▶ Lots of high quality data:
 - ▶ www.nyse.com has free daily volumes and closing values of DJIA for 1966-1998
 - ▶ Trades and Quotes Database: a monthly CD-ROM with every transaction at NYSE, AMEX, and NASDAQ
 - ▶ Journals to publish your results:
 - ▶ International Journal of Theoretical and Applied Finance
 - ▶ Physica A
 - ▶ Nature (if you feel lucky)
 - ▶ PRL, PRE (if your paper satisfies a set of rather restrictive conditions)
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SHORT-TERM PRICE FLUCTUATIONS

- ▶ Basic object of study: historical record of price increments
 $\delta p(t) = p(t + \Delta t) - p(t)$
or returns $r(t) = \delta p(t) / p(t) = p(t + \Delta t) / p(t) - 1$ depend on time-lag Δt

- ▶ Short term (small Δt) increments do not depend on trends and politics but tell us something about the market

DJIA at 1min resolution



9am 1/18/2000

4pm 1/19/2000

MAINSTREAM THEORETICAL ECONOMY ON PRICE FLUCTUATIONS

- ▶ $p(t)$ is a multiplicative random walk, i.e. $\ln[p(t+\Delta t)] = \ln[p(t)] + \eta_{\Delta t}(t)$, where $\eta(t)$ is a gaussian uncorrelated random variable

