¿Tienen algo que hacer los Físicos en las Áreas de Economía y Finanzas?

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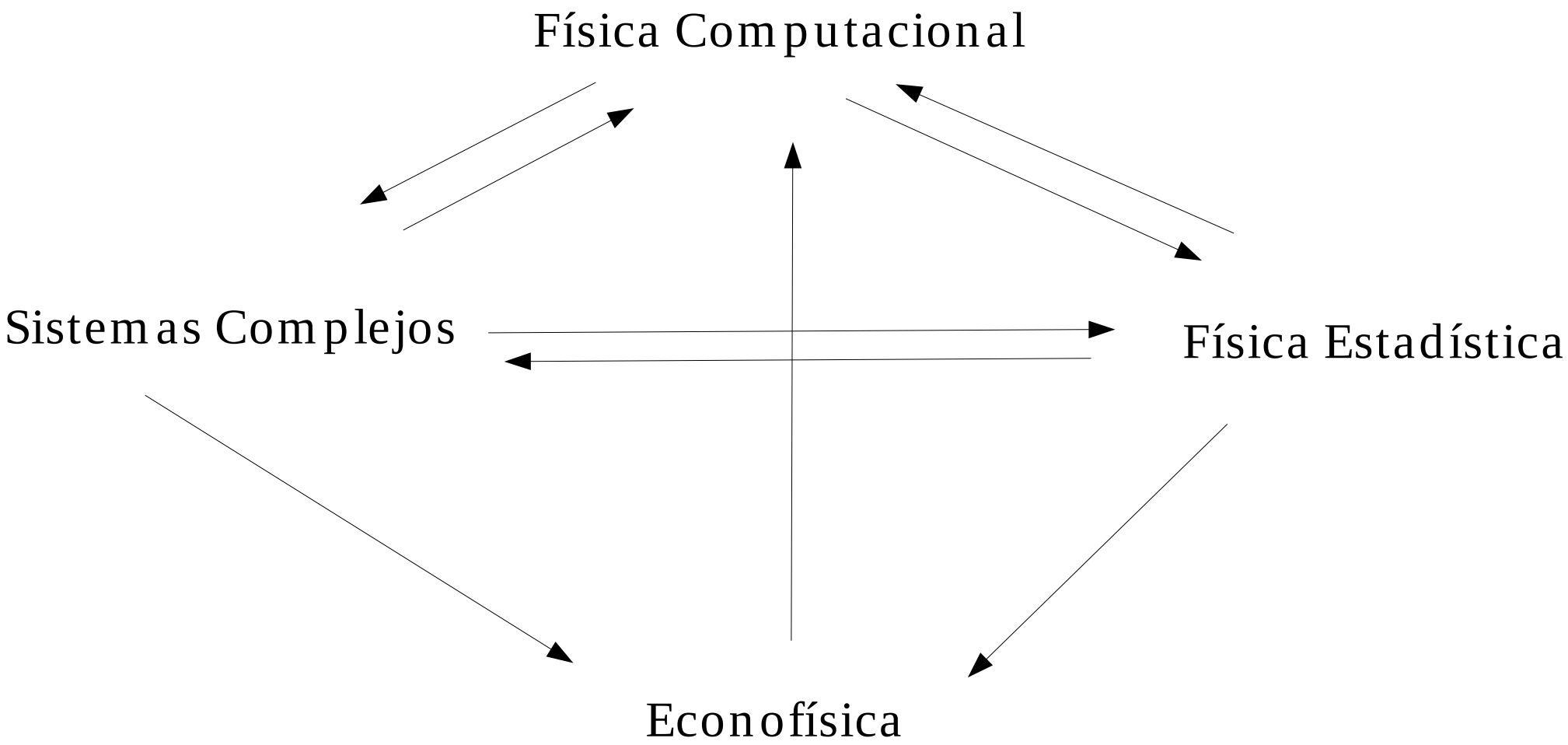
México D.F. 4/Junio/2007



Primeros Artículos publicados 1995.

¿Qué es la Econofísica?

- Estudio de los sistemas Económicos vistos como sistemas complejos mediante técnicas utilizadas en la Física (Física Estadística principalmente).
- Otro término propuesto: Phynance
- Uso sistemático de la observación empírica (datos).

Econofísica (1995-hoy)

- Se empiezan a publicar artículos científicos sobre temas económicos en revistas de Física:
Physica A, EPJ B, Int. Journal. Phys B, Phys, Rev. Lett. E

- La European Physical Society organiza una primera reunión internacional de Econofísica en Dublin.

- Físicos (Academia) $ <-------> Quants (Finanzas) $$$$
Ver: "Physicist graduate from Wall Street" Jennifer Ouellete
The Industrial Physicist. Diciembre de 1999.

- Universidades importantes abren posgrados en Econofísica (Carnegie Melon U, Pardue, MIT, Columbia U, Cornell, U de Mich., U de Chicago, NY University.

..y hasta licenciaturas....

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Physica A ■ (■■■) ■■–■■

PHYSICA A

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Licentiate studies in econophysics at the University of Silesia

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Received 15 December 2003

Abstract

The program of the 3-year licentiate studies in econophysics is presented. We discuss details of the program and prospects for graduates. Some aspects of our cooperation with ING-Bank Śla,ski concerning the program of these studies and its realization are also given.

PACS: ■; ■; ■

Keywords: Studies in econophysics

1. Motivation—instead of introduction

Interactions between financial markets, complexity of stock functioning, and the overall rapid development in economy, requires a mathematically complicated description. Recently, an increasing interest in the application of physics techniques to economic problems (this approach is commonly called "econophysics") can be observed. Physicists are more often employed in the "economy sector" where, after

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0378-4371/$ - see front matter
doi:10.1016/j.physa.2004.06.147

¿Pero cómo funcionan los Mercados Financieros?

Ejemplo: General Electric:

$37.45 la acción el viernes pasado.

Econophysics:
Areas de investigación actuales.

1) Estudio de las series de tiempo financieras (stocks, divisas, etc).

2) Tamaño de firmas, distribución de la riqueza , PIB.

3) Análisis de redes de fenómenos económicos.

4) Crashes bursátiles.

5) Propiedades distribucionales de las variaciones del stock market usando high frequency data (stylized facts, volatilidad, correlaciones, etc).

6) Modelos Microscópicos de Sistemas Económicos.

Stylized Facts:
Propiedades estadísticas de las series de tiempo financieras:

1) Ausencia de autocorrelaciones.

2) Fat tails

3) Asimetría ganancia/pérdida.

4) Gausianidad Agregacional.

5) Intermitencia

6) Volatility Clustering.

7) Fat tails condicionales.

8) Decaimiento lento de la autocorrelación en returns absolutos.

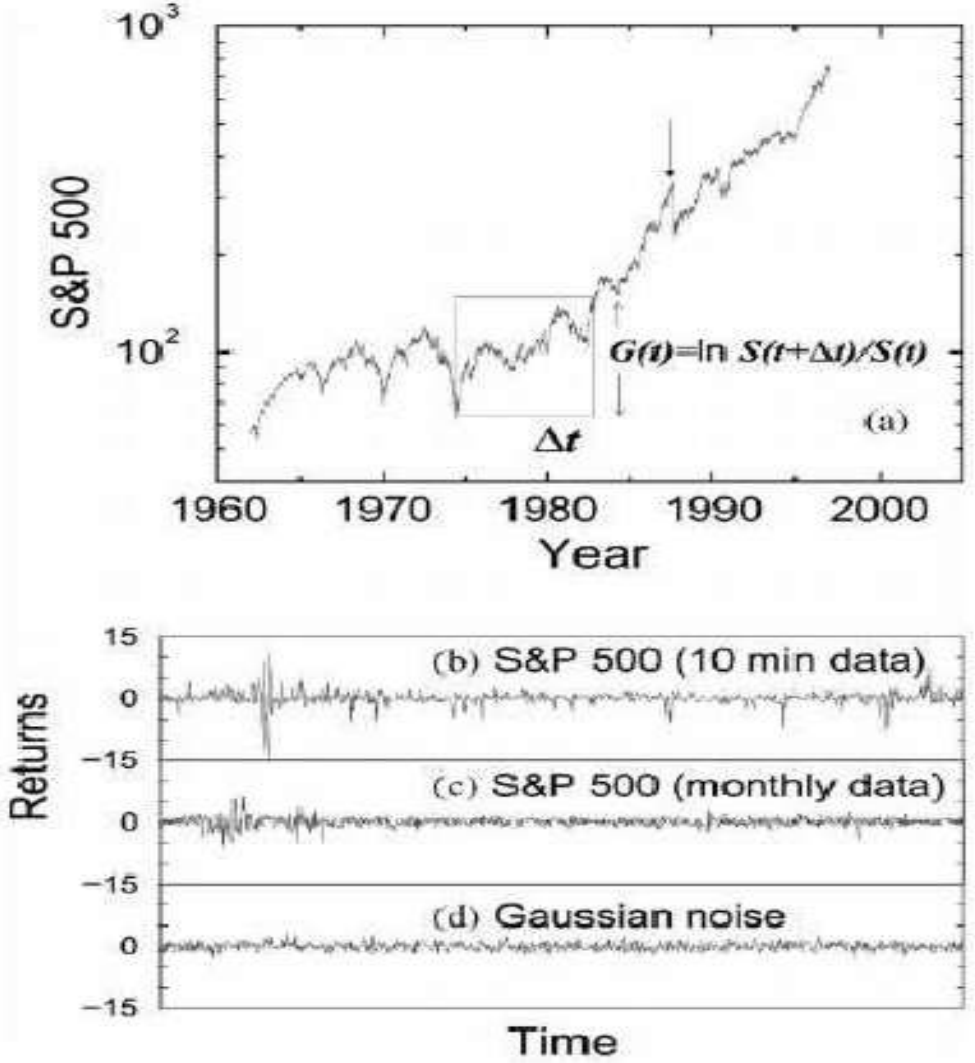
9) Leverage effect.

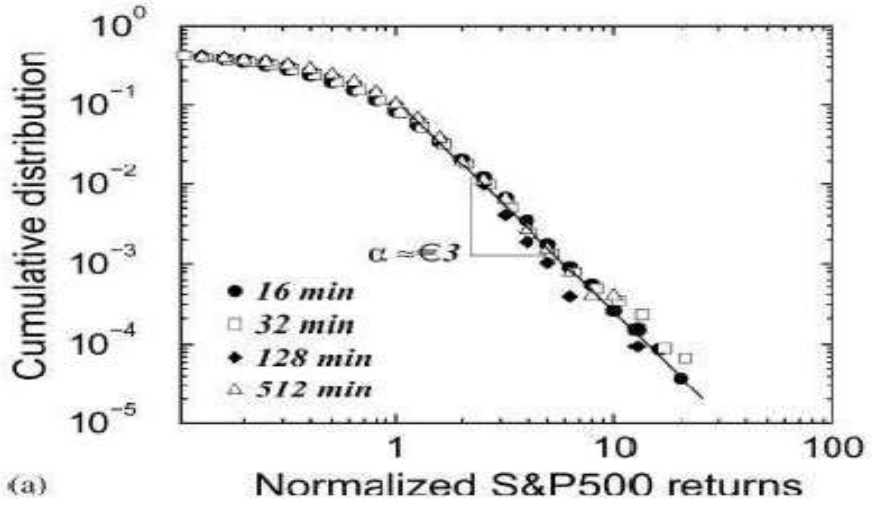
10) Correlaciones volatilidad/volumen.

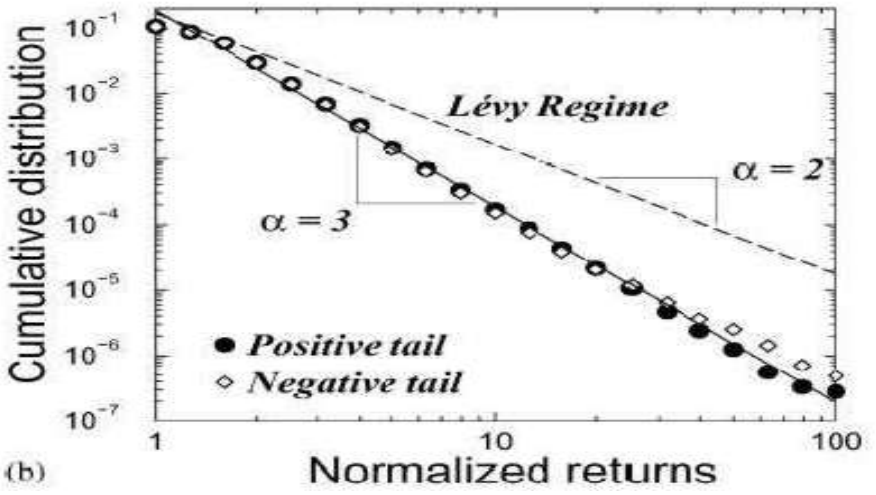
11) Asimetría en escalas de tiempo.

Fat tails

H.E. Stanley et Al.
"Quantifying Fluctuations in economic systems by adapting methods of Statistical Physics". Physica A 287,339-361 (2000).

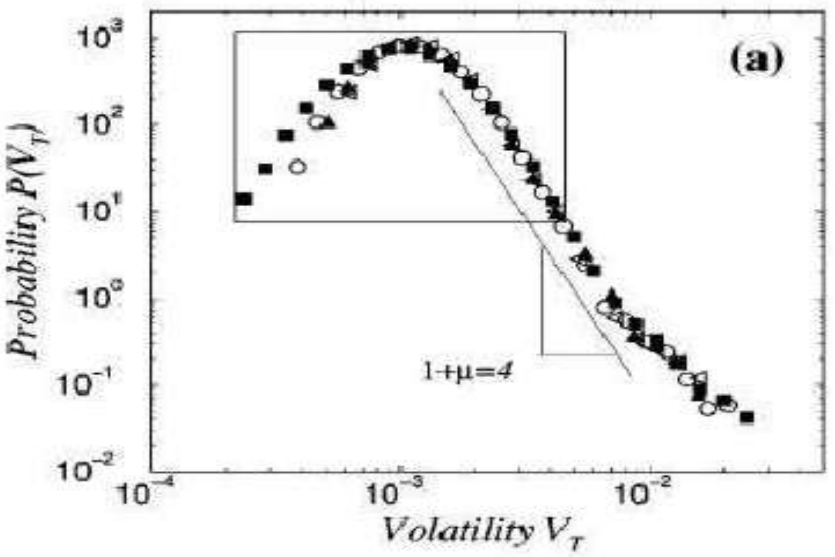






Volatilidad

Y. Liu et Al. “Statistical Properties of the volatility of price fluctuations”
Phys.Rev E 60 1390-1400 (1999).



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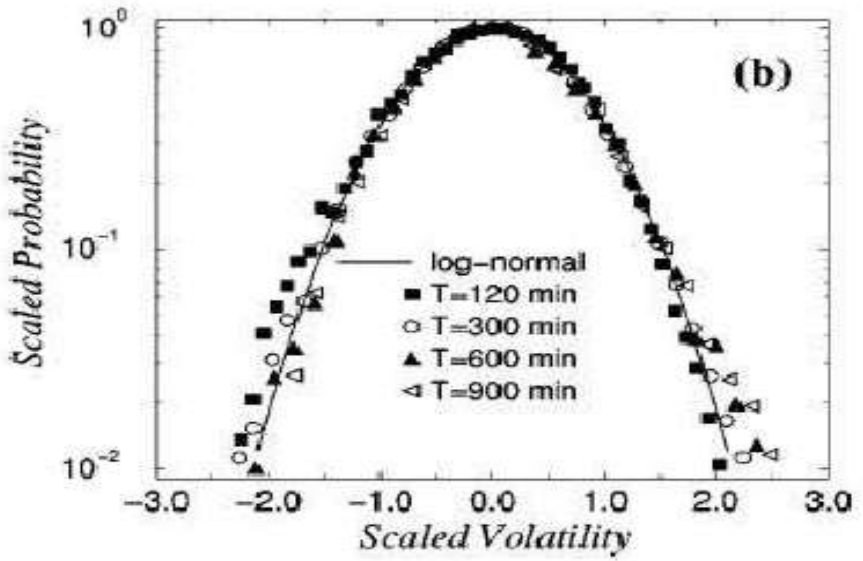
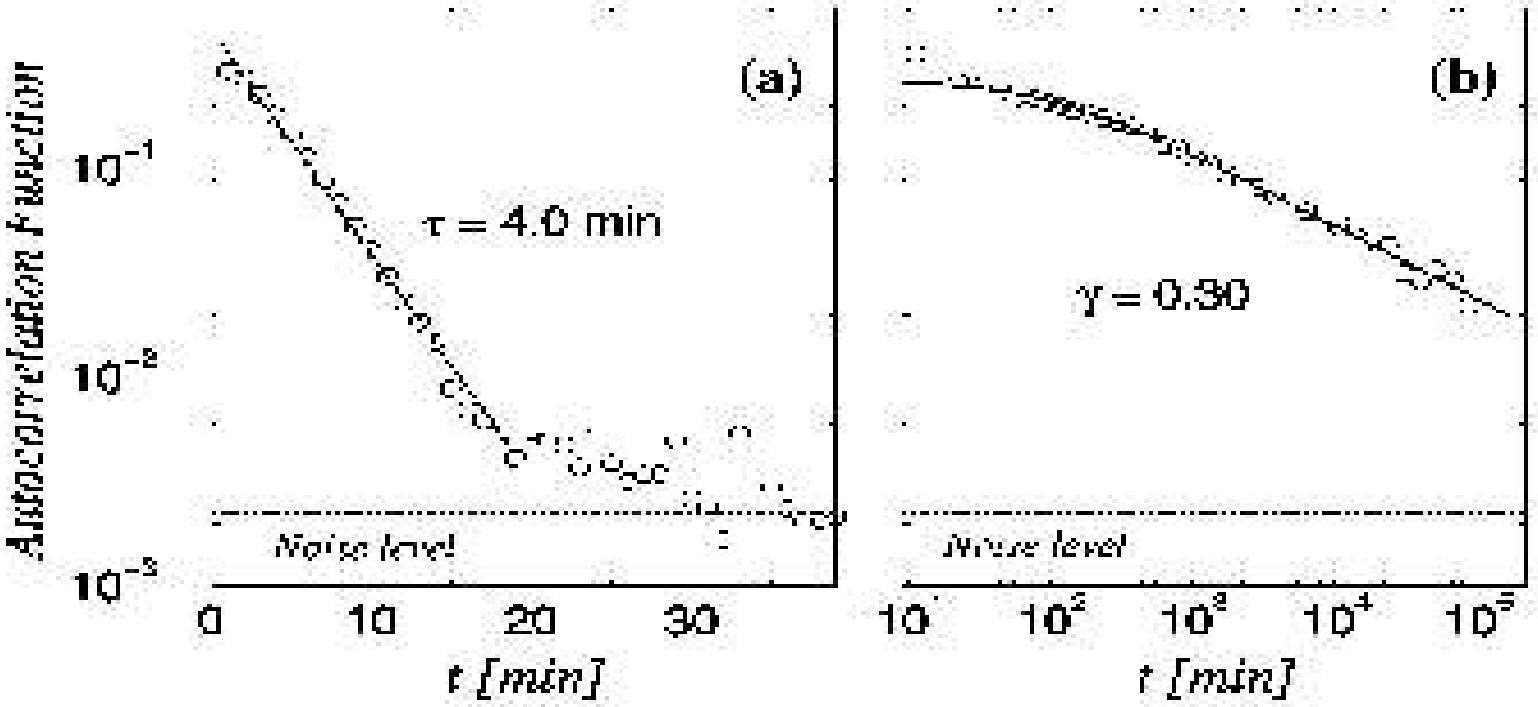


Autocorrelaciones

Y. Liu et Al. “Statistical Properties of the volatility of price fluctuations” Phys.Rev E 60 1390-1400 (1999).



$$C(\tau) = \frac{\langle G(t-\tau)G(\tau)\rangle - \langle G(t-\tau)\rangle\langle G(t)\rangle}{\langle G(t)^2\rangle - \langle G(t)\rangle^2}$$

Nuestro Trabajo

INVESTIGACIÓN REVISTA MEXICANA DE FÍSICA 51 (1) 27–31 FEBRERO 2005

Asymptotic behavior of the daily increment distribution of the IPC, the mexican stock market index

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In this work, a statistical analysis of the distribution of daily fluctuations of the IPC, the Mexican Stock Market Index is presented. A sample of the IPC covering the 13-year period 04/19/1990 - 08/21/2003 was analyzed and the cumulative probability distribution of its daily logarithmic variations studied. Results show that the cumulative distribution function for extreme variations, can be described by a Pareto-Levý model with shape parameters $\alpha = 3.634 \pm 0.272$ and $\alpha = 3.540 \pm 0.278$ for its positive and negative tails, respectively. This result is consistent with previous studies, where it has been found that $2.5 < \alpha < 4$ for other financial markets worldwide.

Keywords: Econophysics; stock market; Power-Law; stable distribution; Levý regime.

Presentamos un análisis estadístico de la distribución de fluctuaciones diarias del índice de la Bolsa Mexicana de Valores, el llamado IPC (Índice de Precios y Cotizaciones). Estudiamos la función de distribución acumulativa de las diferencias logarítmicas diarias calculadas a partir de una muestra del IPC que cubre un periodo de 13 años, que empieza el 19/04/1990 y finaliza el 21/08/2003. Hallamos que esta función de distribución acumulativa puede describirse para los valores extremos de estas diferencias mediante una distribución de Pareto-Levý (ley potencia) con exponentes $\alpha = 3.634 \pm 0.272$ y $\alpha = 3.540 \pm 0.278$ en sus colas positiva y negativa respectivamente. Este resultado es consistente con estudios previos que muestran que $2.5 < \alpha < 4$ para los mercados financieros de diferentes partes del mundo.

Descriptores: Econofísica; bolsa de valores; ley potencia; distribución estable; régimen de Levý.

PACS: 01.75.+m; 02.50.-r; 89.65.Gh; 89.90.+n

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Variaciones diarias del IPC

Fig. 1. IPC development for the 13 year period 04/19/1990-08/21/2003.

Asymptotic behavior of the Daily Increment Distribution of the IPC, the Mexican Stock Market Index. H.F. Coronel-Brizio, A.R. Hernández-Montoya, Revista Mexicana de Física 51 (1) 27-31 (2005).

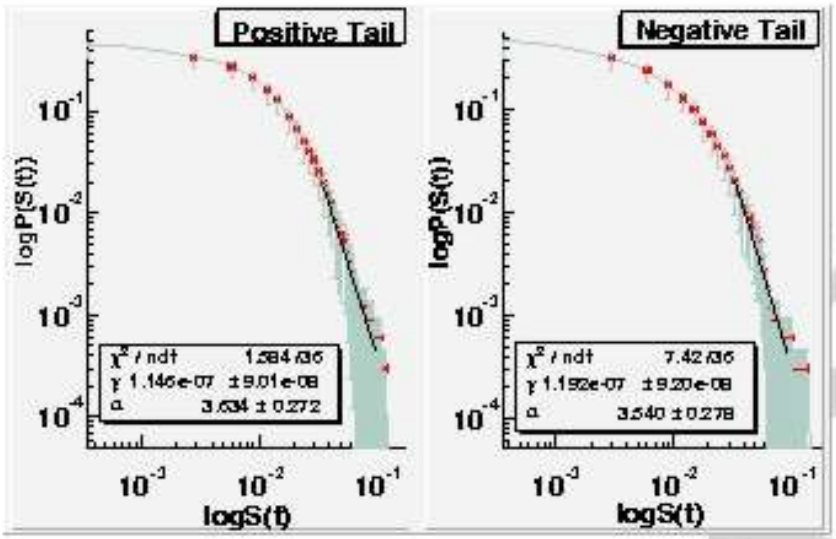

Fig. 4. Linear fitted tails in a log-log plot of the cumulative distribution function $P(S(t))$ on $S(t)$. Right image positive tail. Left image negative tail. Fitted parameters are shown.

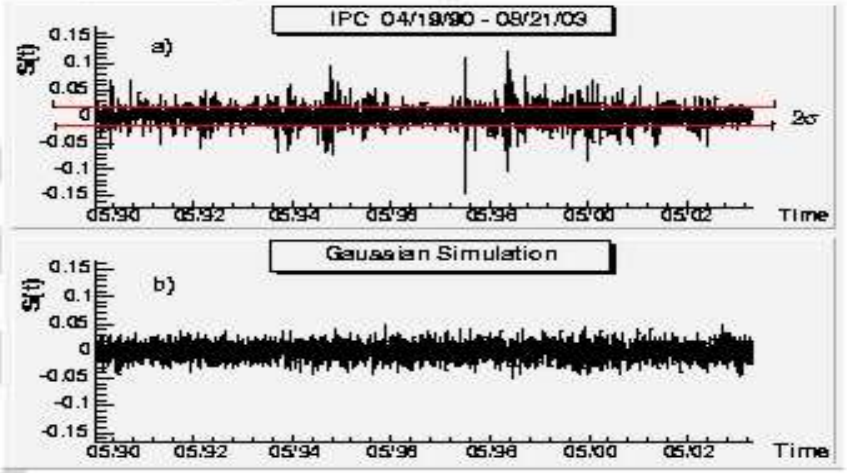

Fig. 3. a) $S(t)$ behavior for the period of time under study. Large variations in $S(t)$, some of them as far as eight standard deviations from its mean, can be appreciated. It can also be seen that large variations tend to form clusters in time; this phenomena is called clustered volatility. b) Gaussian simulation already shown as a broken line in figure 2c. Clustering is virtually not present.

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On fitting the Pareto–Levy distribution to stock market index data: Selecting a suitable cutoff value

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Received 15 November 2004; received in revised form 11 February 2005
Available online 9 April 2005

Abstract

The so-called Pareto–Levy or power-law distribution has been successfully used as a model to describe probabilities associated to extreme variations of stock markets indexes worldwide. The selection of the threshold parameter from empirical data and consequently, the determination of the exponent of the distribution, is often done using a simple graphical method based on a log–log scale, where a power-law probability plot shows a straight line with slope equal to the exponent of the power law distribution. This procedure can be considered subjective, particularly with regard to the choice of the threshold or cutoff parameter. In this work, a more objective procedure based on a statistical measure of discrepancy between the empirical and the Pareto–Levy distribution is presented. The technique is illustrated for data sets from the New York Stock Exchange (DJIA) and the Mexican Stock Market (IPC).

PACS: 02.50.−r; 02.50.Ng; 89.65.Gh; 89.90.+n

Keywords: Econophysics; Power-law; Returns distribution; Goodness-of-fit; Empirical distribution function

Sobre el ajuste de la ley potencia: seleccionando un parámetro de corte óptimo.

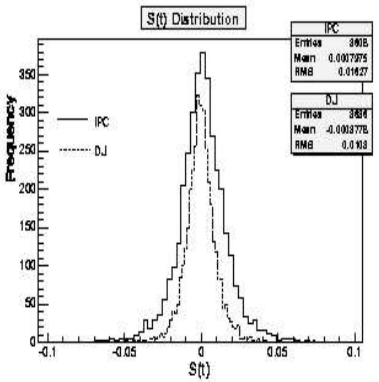

Fig. 2. Density histogram for daily logarithmic differences of the Dow Jones index, from April 19 1990 to September 17 2004.

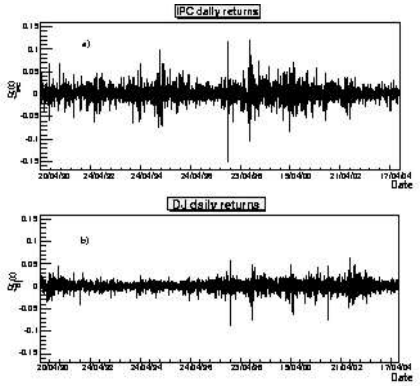

Fig. 1. Daily logarithmic differences series of the Mexican IPC index (a) and American Dow Jones Industrial Average Index (b), both from April 19 1990 to September 17 2004.

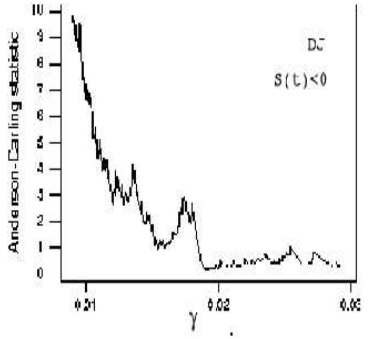

Fig. 6. Anderson-Darling A^2 statistic versus selected values of the threshold parameter γ, corresponding to the negative values of the series $S(t)$, computed from the Dow Jones index data. The minimum value 0.18, is attained for $\gamma = 0.0191$.

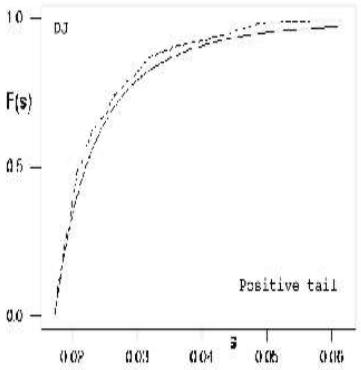

Fig. 8. Empirical (dash) and fitted (solid) cumulative distribution functions for the positive tail of the Dow Jones $S(t)$ series, using $\gamma = 0.0173$ and $\alpha = 2.85$.

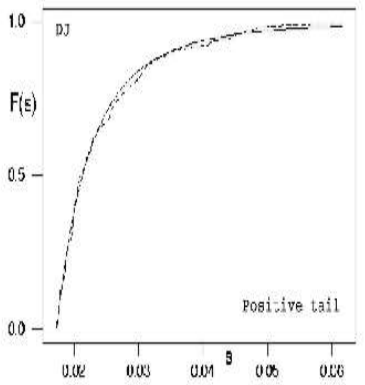

Fig. 9. Empirical (dash) and fitted (solid) cumulative distribution functions for the positive tail of the Dow Jones $S(t)$ series, using $\gamma = 0.0173$ and $\alpha = 3.33$.

Conclusiones

Mostramos un método objetivo para determinar el mejor parámetro de corte y óptimizar el ajuste a la distribución de Pareto.

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Assessing symmetry of financial returns series

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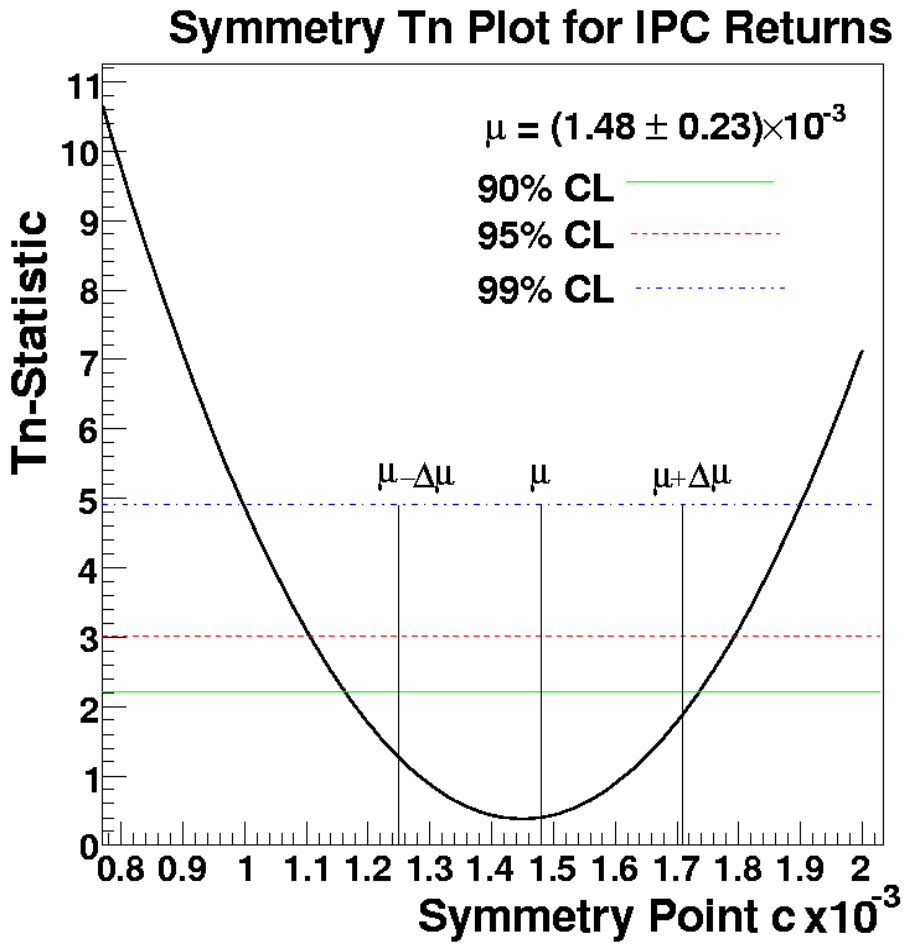
Abstract

Testing symmetry of a probability distribution is a common question arising from applications in several fields. Particularly, in the study of observables used in the analysis of stock market index variations, the question of symmetry has not been fully investigated by means of statistical procedures. In this work a distribution-free test statistic T_n for testing symmetry, derived by Einmahl and McKeague, based on the empirical likelihood approach, is used to address the study of symmetry of financial returns. The asymptotic points of the test statistic T_n are also calculated and a procedure for assessing symmetry for the analysis of the returns of stock market indices is presented.

Keywords: Econophysics; Statistical test; Symmetry test; Returns distribution; Gain/loss asymmetry

Physica A en prensa (2007)

Simetría



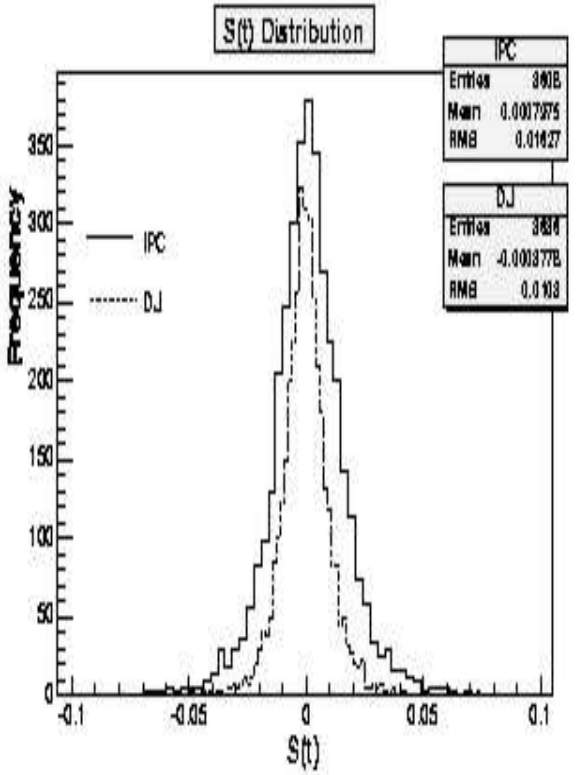


Fig. 2. Density histogram for daily logarithmic differences of the Dow Jones index, from April 19 1990 to September 17 2004.

Assessing symmetry of financial return series.
H.F. Coronel-Brizio et al. Physica A (2007) En prensa.

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Evidence of increment of efficiency of the Mexican Stock Market through the analysis of its variations

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[a]*Facultad de Física e Inteligencia Artificial, Universidad Veracruzana, Sebastián Camacho 5, Xalapa, Veracruz 91000, México*
[b]*Departamento de Física Aplicada, Centro de Investigación y de Estudios Avanzados del IPN, Unidad Mérida, Antiguo Camino a Progreso km. 6, Mérida, Yucatán 97310, México*

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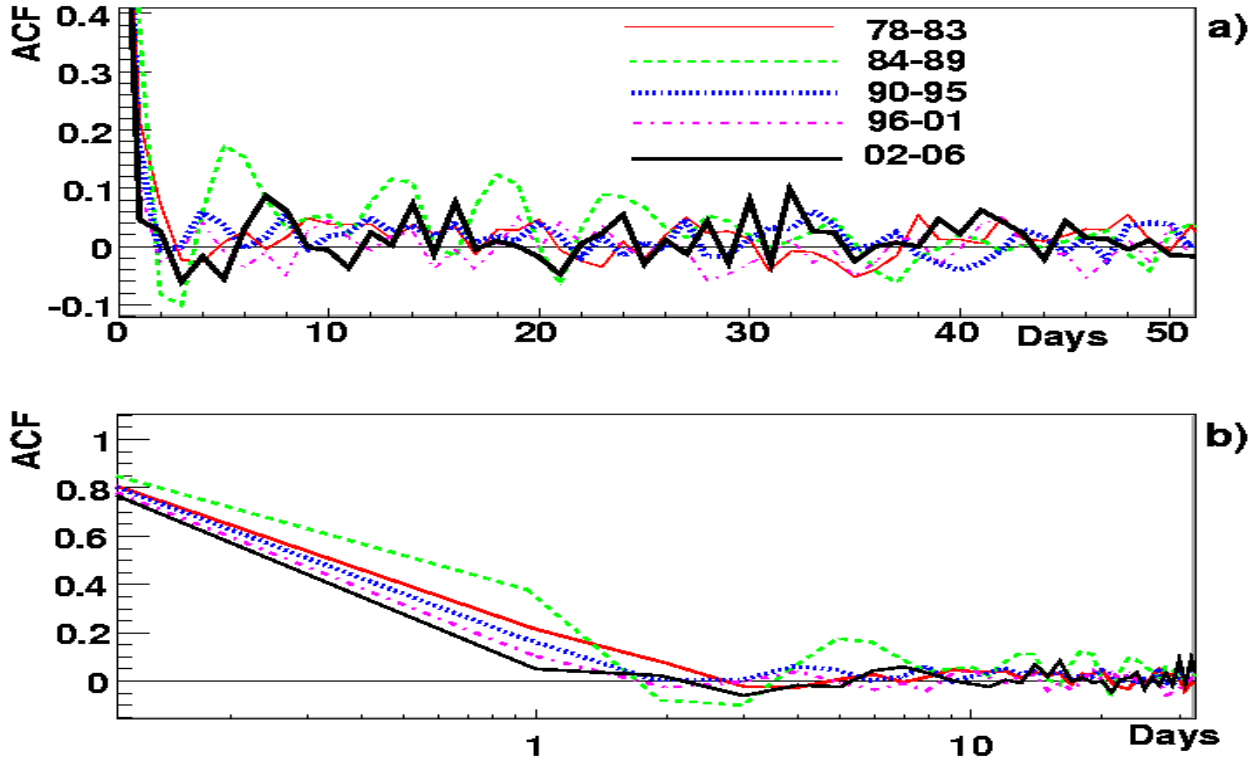
Available online 12 March 2007

Abstract

It is well known that there exist statistical and structural differences between the stock markets of developed and emerging countries. In this work, and in order to find out if the efficiency of the Mexican Stock Market has been changing over time, we have performed and compared several analyses of the variations of the Mexican Stock Market index (IPC) and Dow Jones industrial average index (DJIA) for different periods of their historical daily data. We have analyzed the returns autocorrelation function (ACF) and used detrended fluctuation analysis (DFA) to study returns variations. We also analyze the volatility, mean value and standard deviation of both markets and compare their evolution. We conclude from the overall result of these studies, that they show compelling evidence of the increment of efficiency of the Mexican Stock Market over time. The data samples analyzed here, correspond to daily values of the IPC and DJIA for the period 10/30/1978–02/28/2006.

Keywords: Econophysics; Market efficiency; Emerging market; Returns; Autocorrelation function (ACF); Detrended fluctuation analysis; Volatility

Decaimiento de la ACF de el IPC



Evidence of Increment of Efficiency of the Mexican Stock Market Through the Analysis of its Variations.
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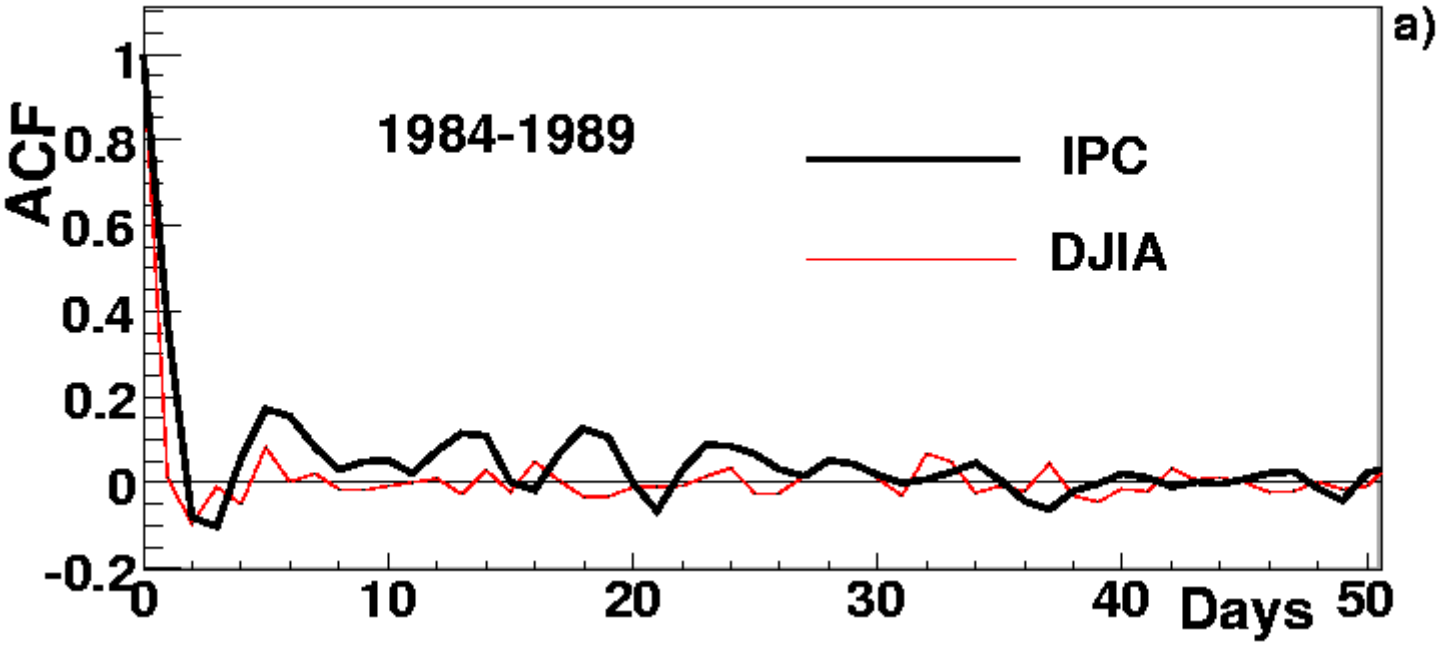
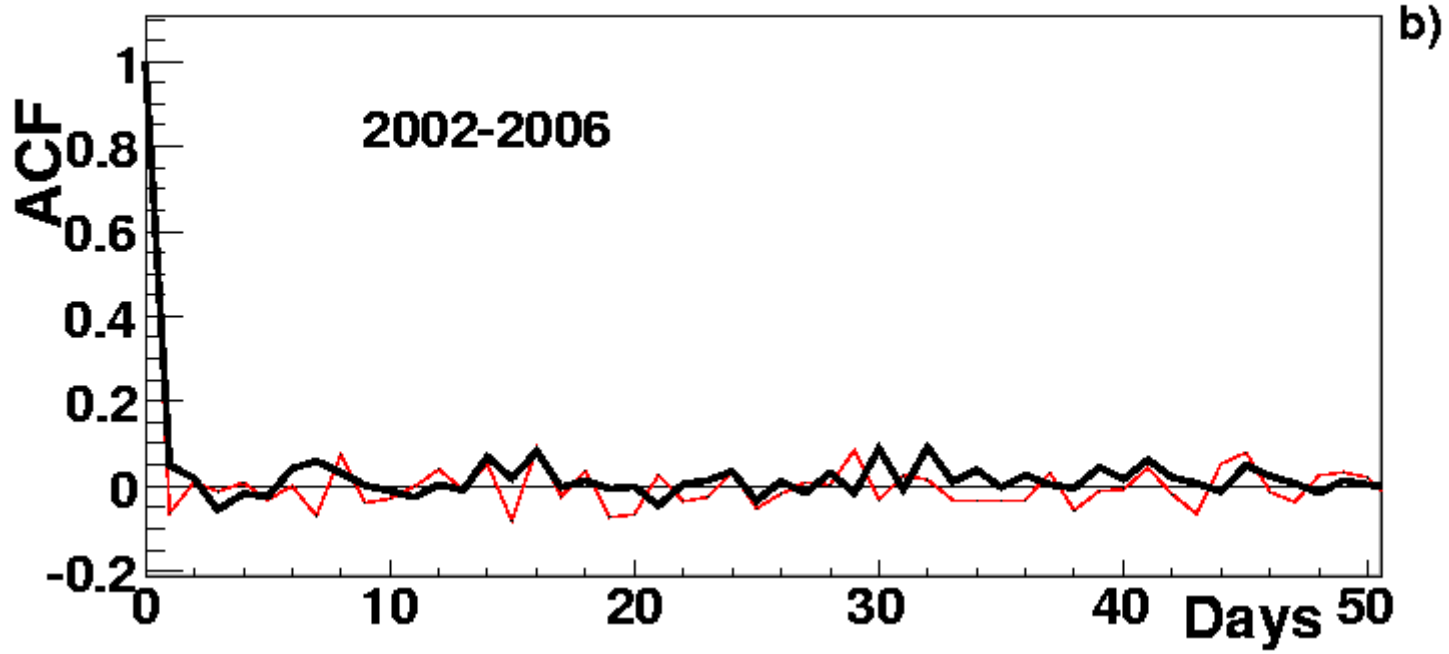
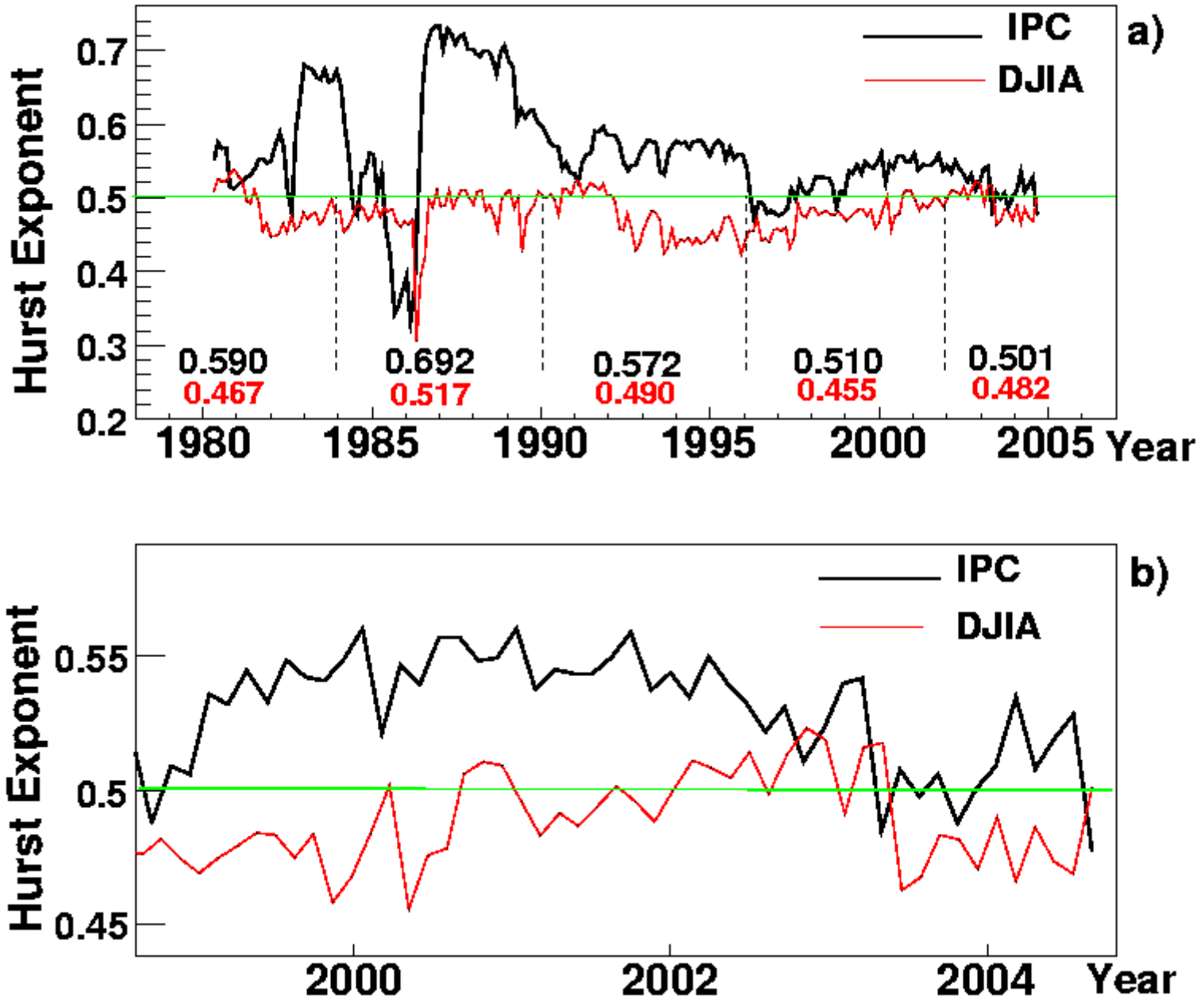
Physica A. En prensa (2007)


a)
1984-1989
IPC
DJIA
ACF
1
0.8
0.6
0.4
0.2
0
-0.2
0
10
20
30
40
50
Days


b)
2002-2006
ACF
1
0.8
0.6
0.4
0.2
0
-0.2
0
10
20
30
40
50
Days


a)
IPC
DJIA
Hurst Exponent
0.7
0.6
0.5
0.4
0.3
0.2
0.590
0.467
0.692
0.517
0.572
0.490
0.510
0.455
0.501
0.482
1980
1985
1990
1995
2000
2005
Year
b)
IPC
DJIA
Hurst Exponent
0.55
0.5
0.45
2000
2002
2004
Year

Autómatas Celulares

Sistemas Dinámicos Discretos que constan de los siguientes elementos:

Una malla n-dimensional (n=1,2)

Una celda o sitio que puede tomar estados que corresponden a valores discretos o continuos.

Una regla de actualización sobre una vecindad de cada celda.

El tiempo en que se actualiza el valor de cada celda del CA.

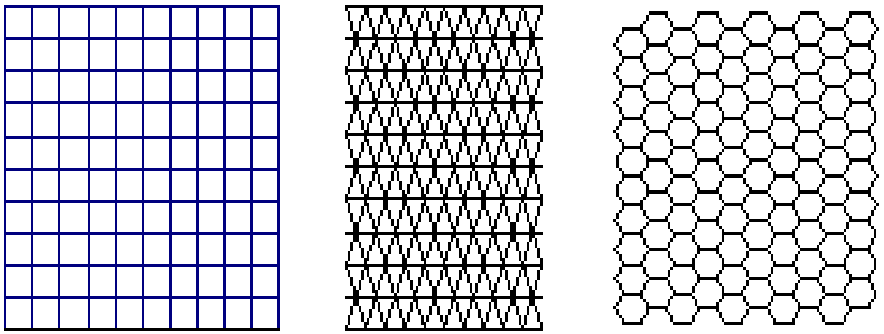


Figura 2.1: Algunos tipos de mallas (para AC en dos dimensiones).

Ejemplo de una regla para un AC unidimensional

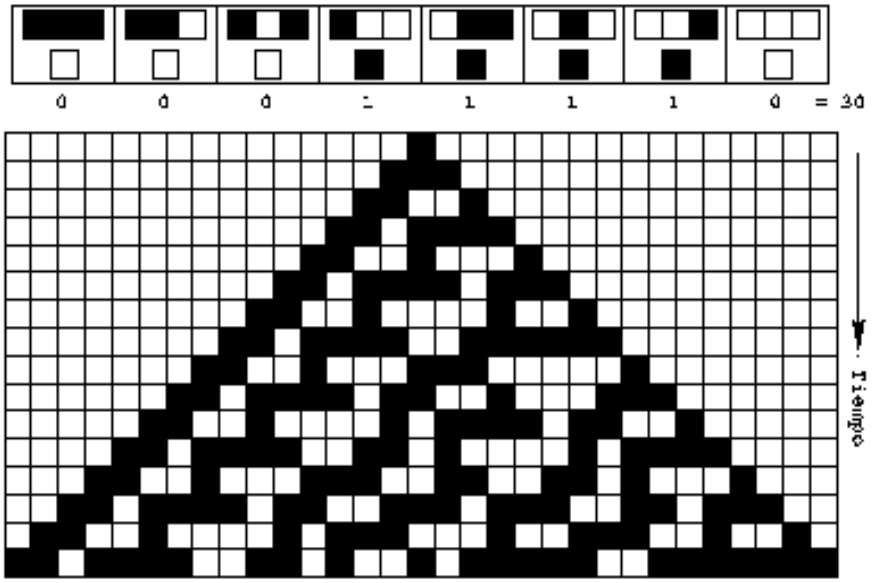


Figura 2.6: 16 pasos de la evolución de la regla 30.

Algunas vecindades para CAs bidimensionales

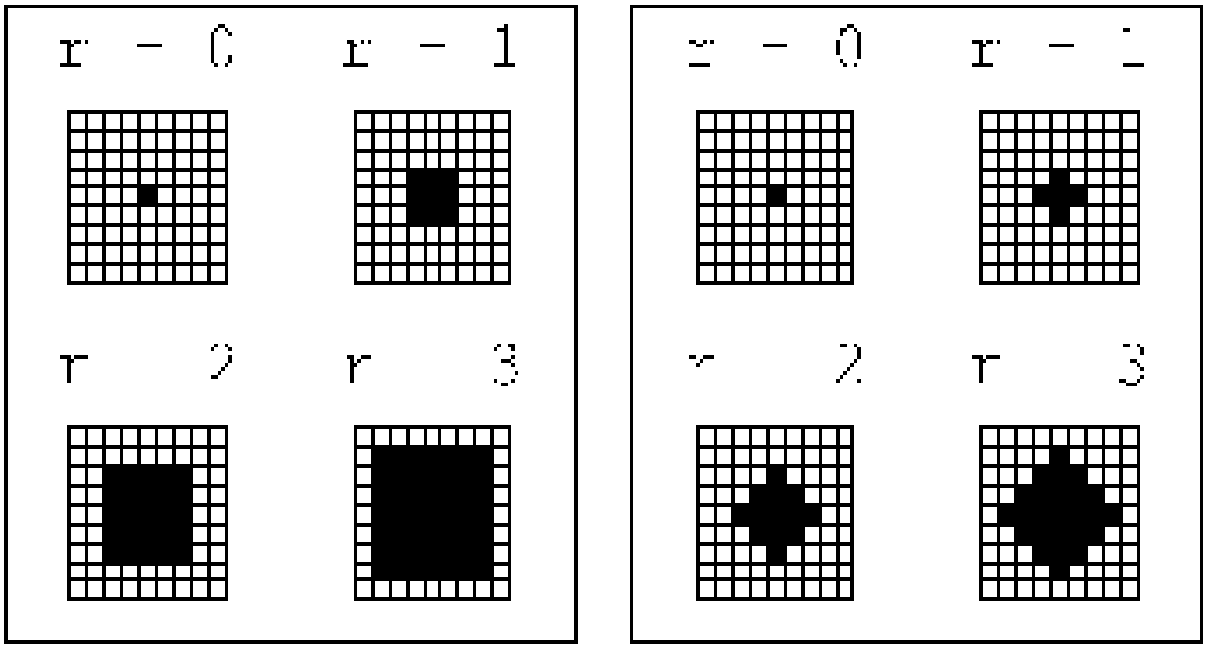


Figura 2.2: Izquierda: vecindario de Moore - Derecha: vecindario de von Neumann (r = radio de vecindad).

“It is probable, given a large enough Life Space, initially in a random state, that after a long time , intelligent self-reproducing animals will emerge and populate some parts of the space”

Jonh H. Conway

Reglas de actualización para el GOL

GOL: CA bidimensional con vecindad de Moore
cada celda puede tener uno de dos estados posibles
1 o 0 o mas sugestivamente viva o muerta.

1) Una celda muerta nacera si en su vecindad tenemos exactamente tres celdas vivas

2) Una celda viva sobrevivirá si en su vecindad tenemos dos o tres celdas vivas

3) Una celda viva morirá en cualquier otro caso.

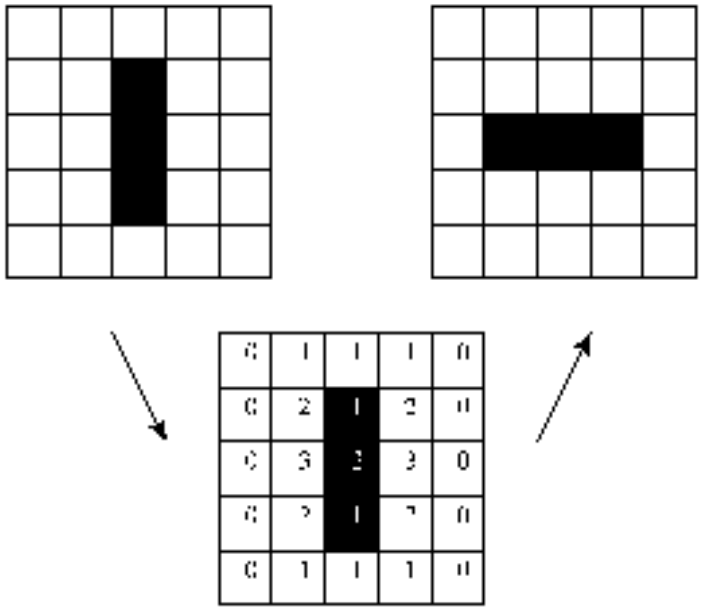
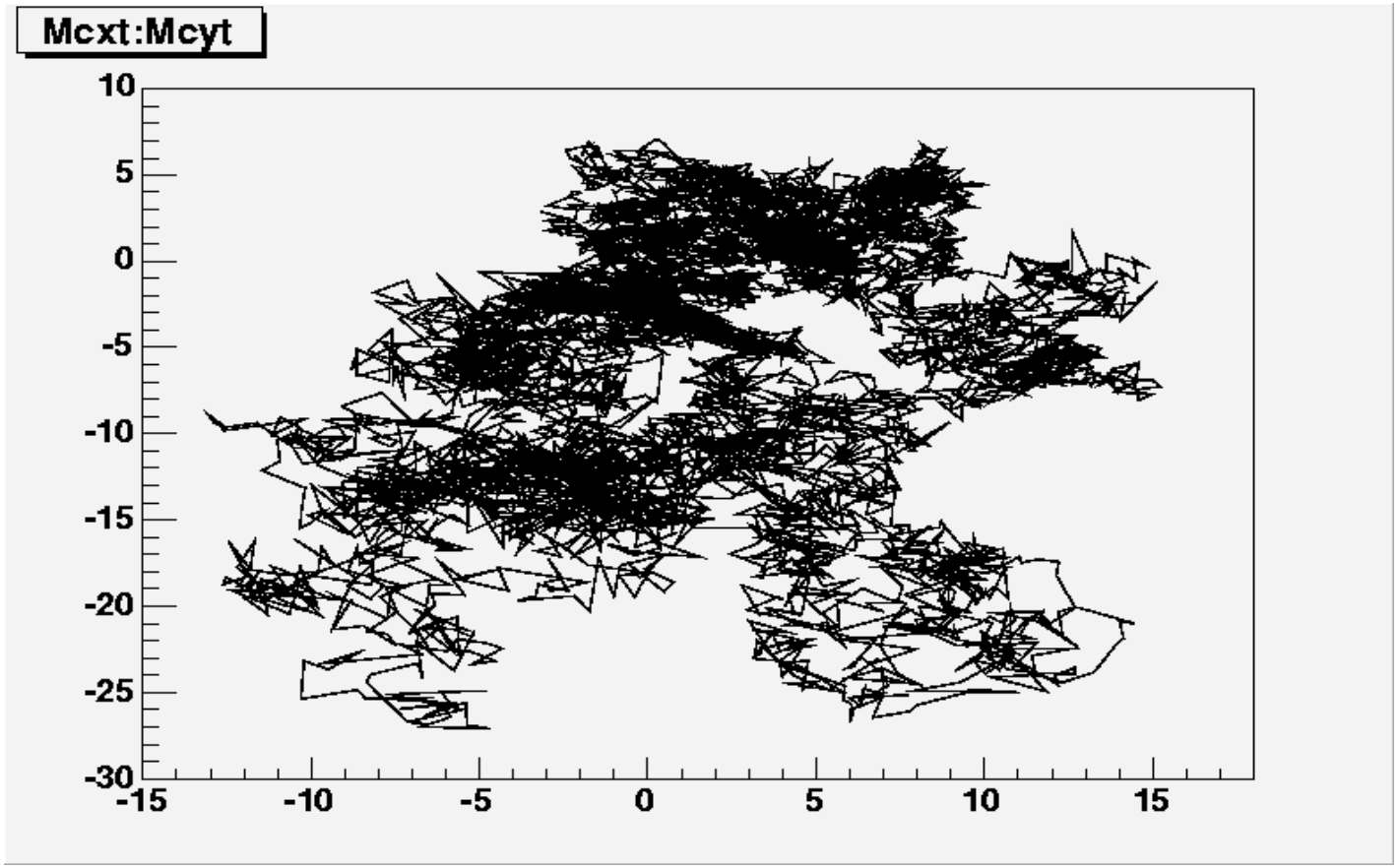
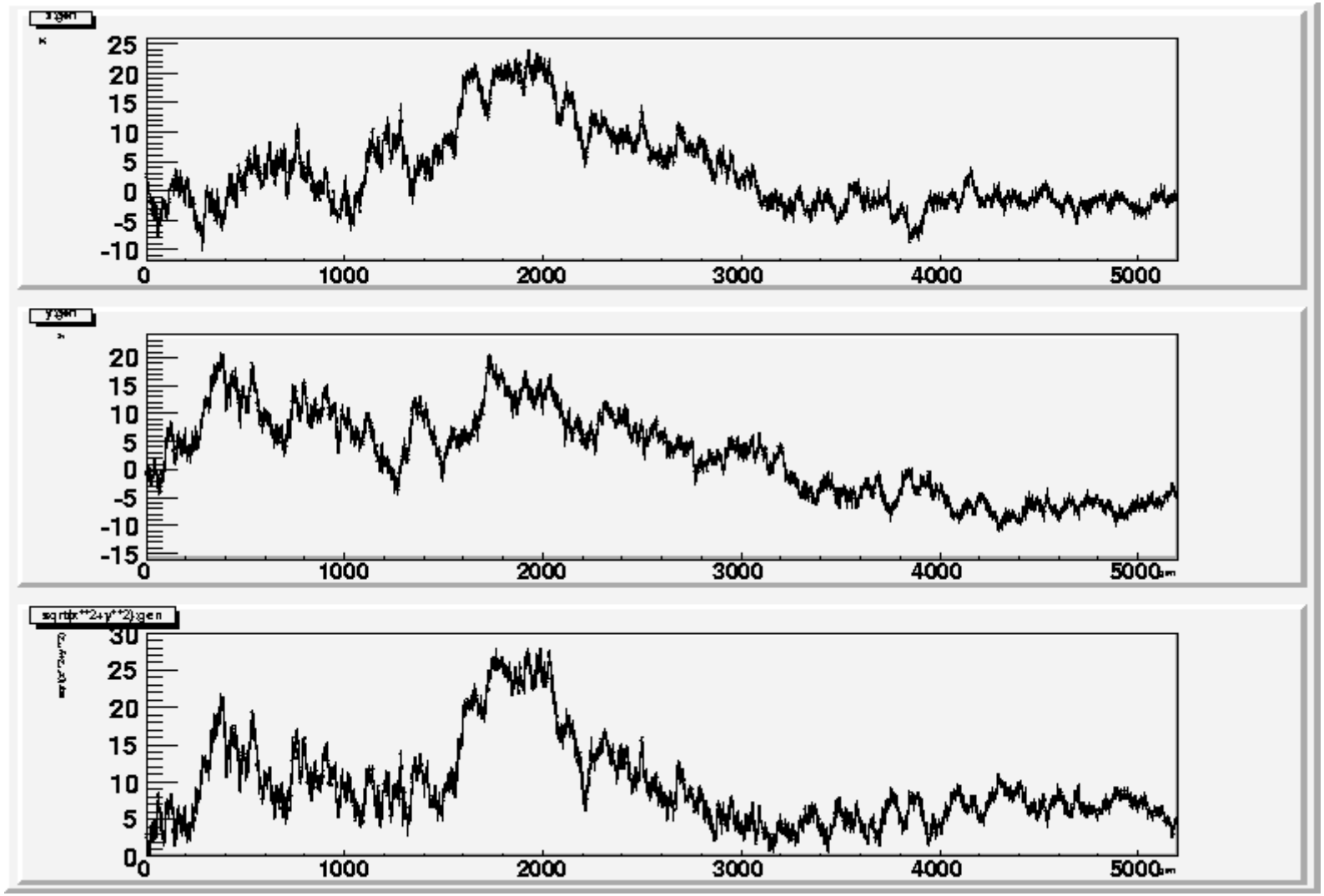


Figura 3.1: Aplicación de las reglas de Game of Life (los números indican la cantidad de vecinos activos en cada celda).

Caminata Aleatoria generada mediante el Juego de la Vida

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20
15
10
5
0
-5
-10
0
1000
2000
3000
4000
5000
y:gen
20
15
10
5
0
-5
-10
-15
0
1000
2000
3000
4000
5000
sqrt(x**2+y**2):gen
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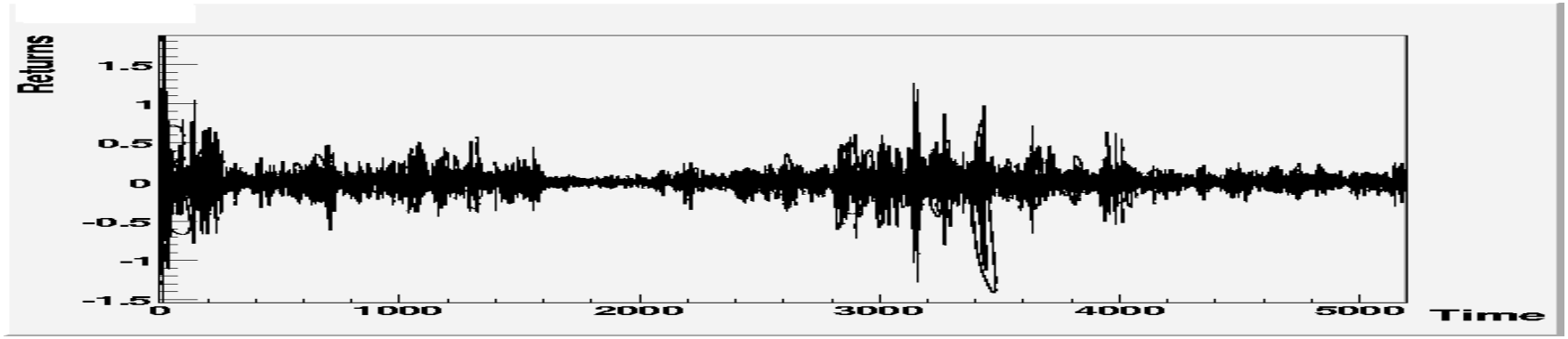
25
20
15
10
5
0
0
1000
2000
3000
4000
5000



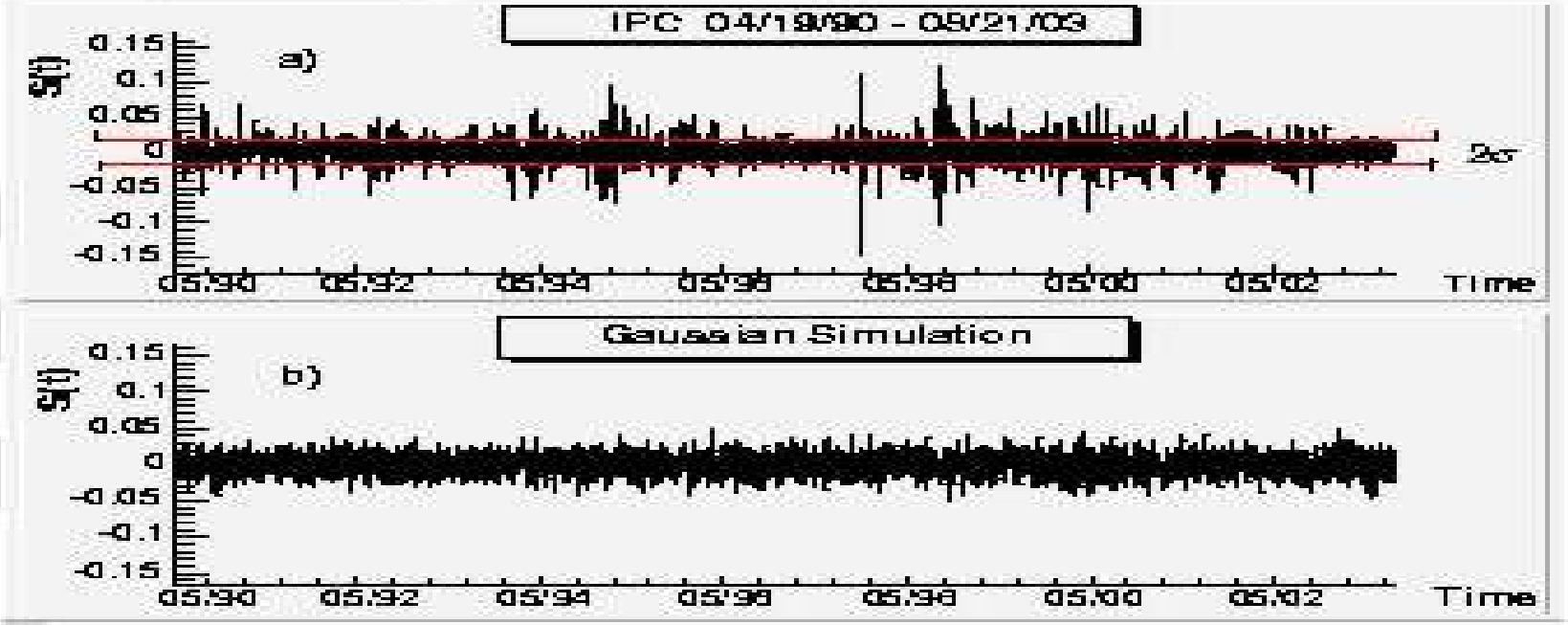
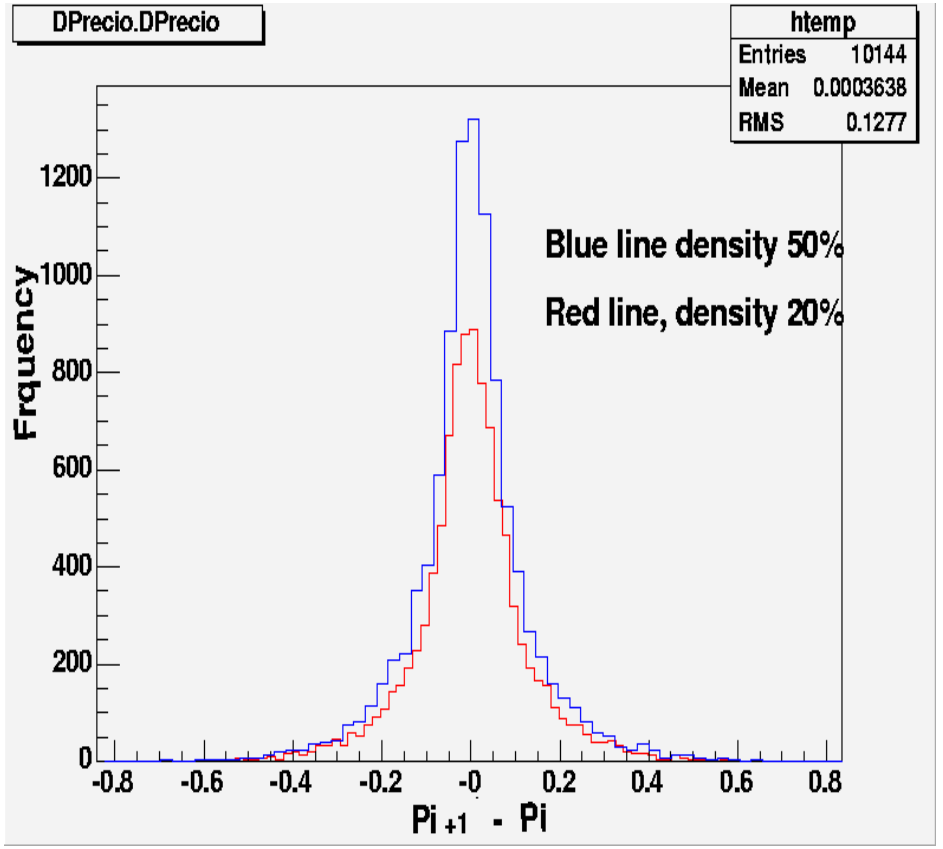


Fig. 3. a) $S(t)$ behavior for the period of time under study. Large variations in $S(t)$, some of them as far as eight standard deviations from its mean, can be appreciated. It can also be seen that large variations tend to form clusters in time; this phenomena is called clustered volatility. b) Gaussian simulation already shown as a broken line in figure 2c. Clustering is virtually not present.



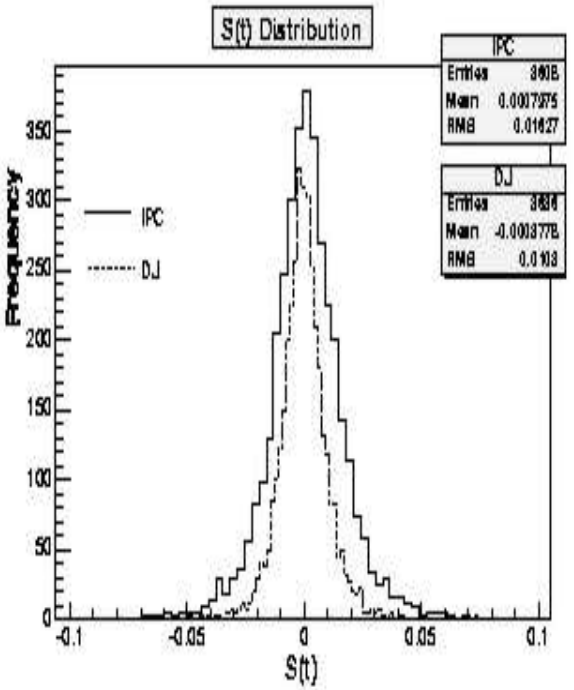
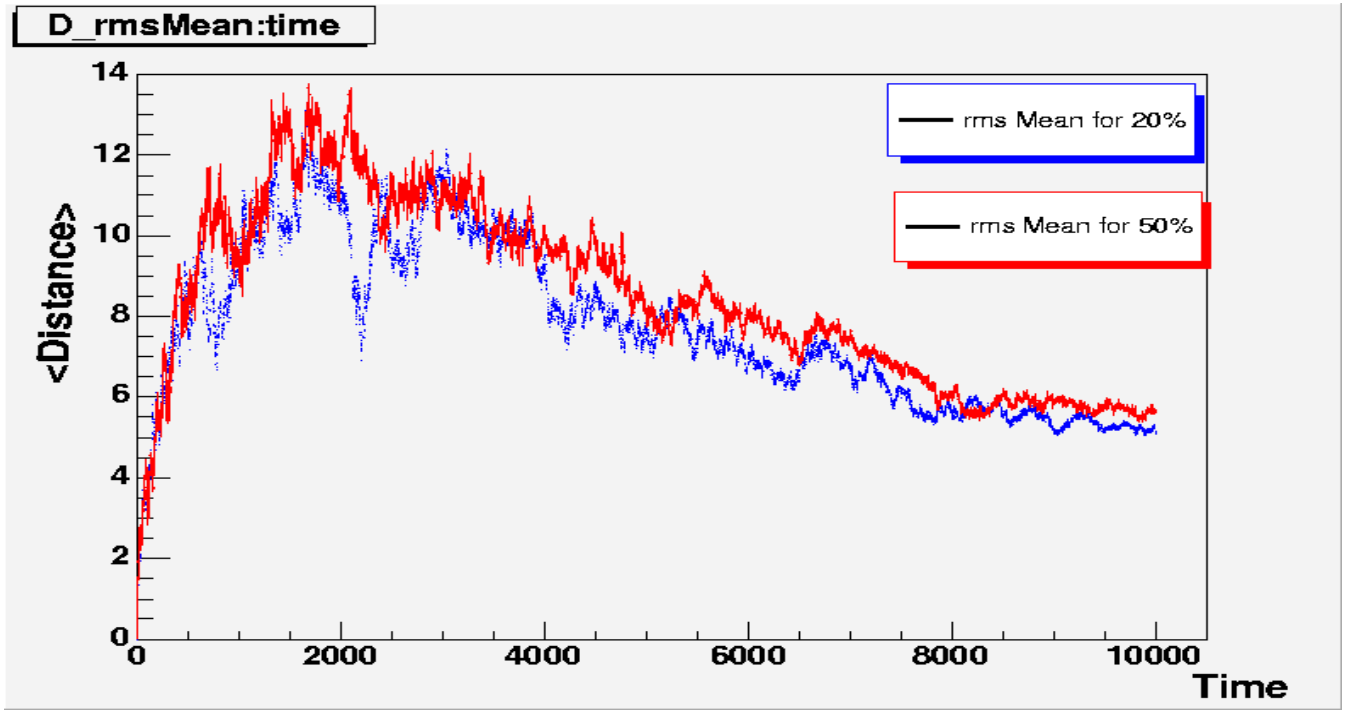


Fig. 2. Density histogram for daily logarithmic differences of the Dow Jones index, from April 19 1990 to September 17 2004.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rms Mean for 20%
rms Mean for 50%
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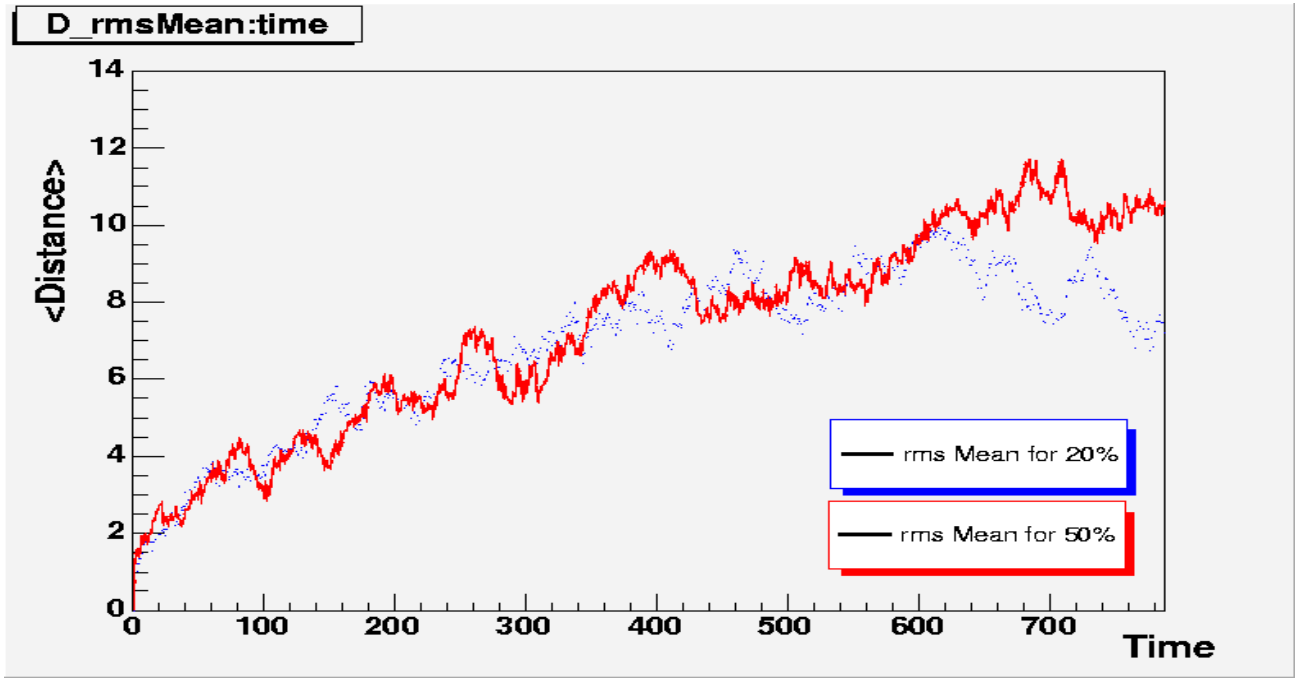
4
6
8
10
12
14
0
2000
4000
6000
8000
10000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12
14
0
100
200
300
400
500
600
700

Conclusiones

1) Los Físicos estudian la economía y los mercados financieros porque presentan fenómenos y retos muy interesantes.

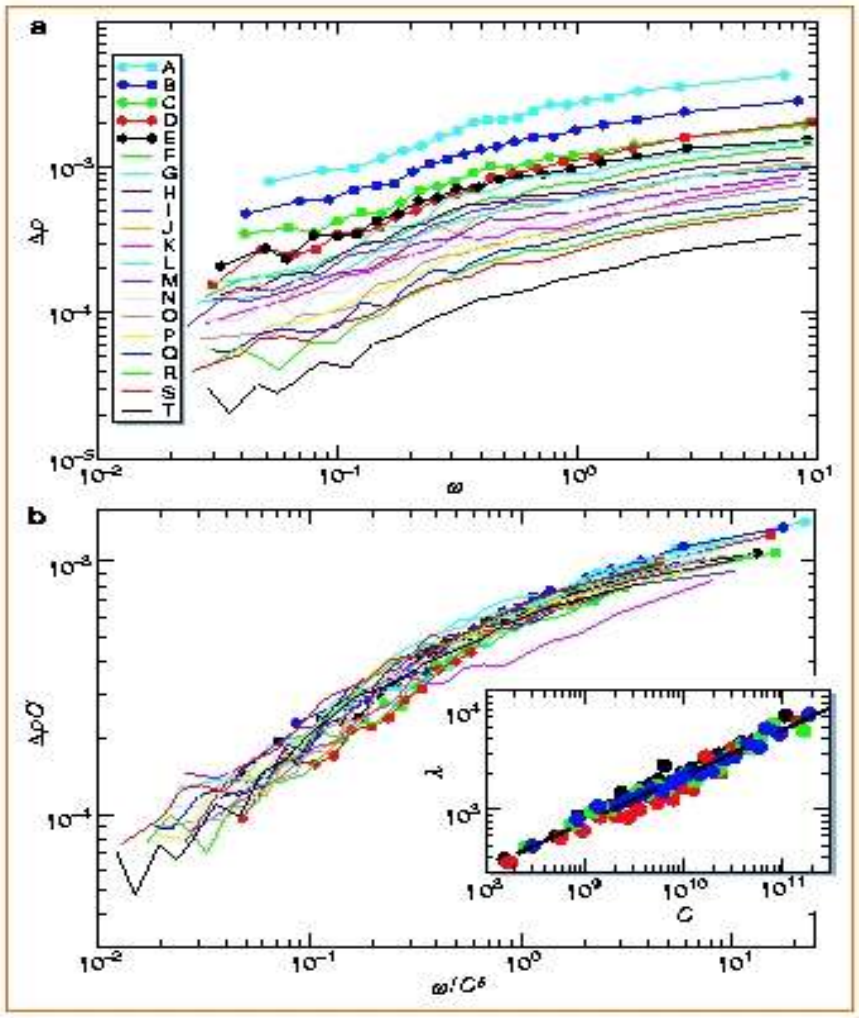
2) Des-ideologizar la Economía.

3) Aunque la diferencia de caracteres y temperamento entre las comunidades de Físicos y Economistas a veces son muy grandes, ambas comunidades se han acercado en los últimos años.

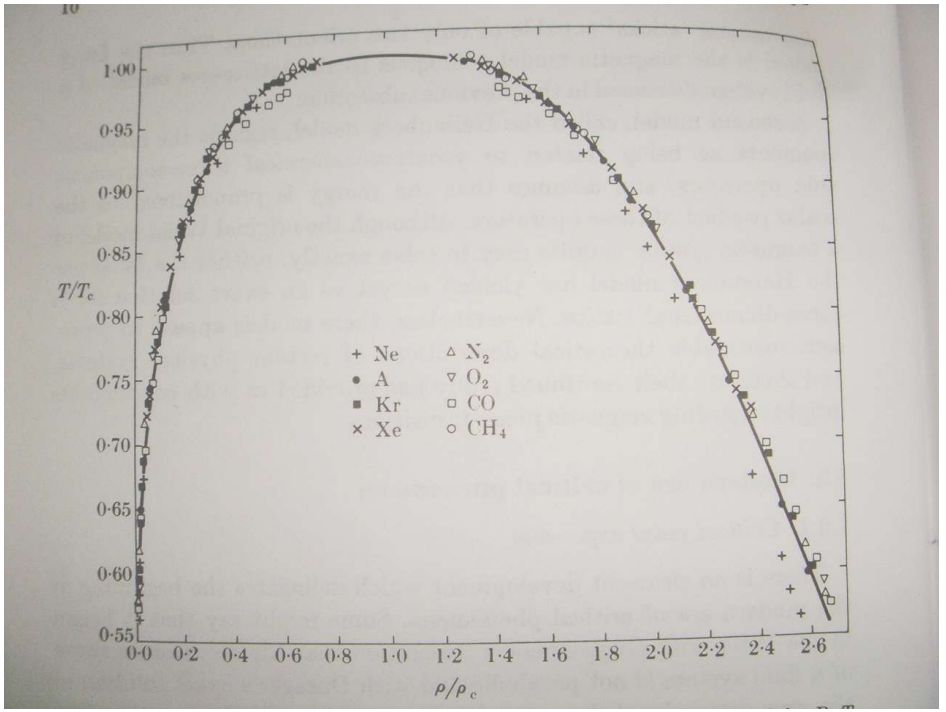
4) Físico <-----> Quants

5) Gran cantidad de herramientas y conceptos usados en Física han encontrado aplicación en Economía y Finanzas (Estadísticas no Extensivas, Transiciones de Fase, Caminatas Aleatorias, Curvas Maestras, etc.

La Econofísica ha producido, mediante el uso de conceptos y técnicas usadas en la física, resultados muy interesantes sobre los mercados financieros. Ejemplos Master Curve y Scaling:



Master Curve for Price
Impact Function
Nature 421,129-130 (2003)
L. Farmer, R. Mantegna.



Transiciones de fase:

Two Phases Behaviour of Finanial Markets
Nature 421,139 (2003) V. Plerou, P. Gopikrishnan, H.E. Stanley.