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Stock Market Behaviour for Different Time Intervals with Different Volatility Levels.

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Presentation Outline

- Our Previous Work.
- Aim of this Study.
- Description of Our Method.
- Results.
- Conclusion.

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Global Co-movements¹.

- Applied wavelet-based Regression Analysis, Lee (2002)², studies co-movement between stock markets in Asia, Europe and the Americas.
- Findings:
 - Co-movements between regionwide markets (*nearest-neighbour* or *intra-continental*).
 - *Clockwise* transmissions between worldwide markets, starting with Asian markets influencing European, European impacting on the Americas, the Americas impacting on Asian ones.
 - An increase in importance of global co-movements among worldwide stock markets, in particular since the end of the 20th century.

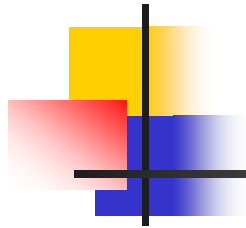
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Time-Scale Behaviour³.

- Proposed a *Time-Scale* extension of Detrended Fluctuation Analysis (TSDFA) to measure the Hurst exponent (H) for different global stock markets.
- Findings:
 - The Hurst exponent depends on both time and scale (trading day).
 - Stock markets show different memory types for different time and scale.
 - Some markets switch from one regime (or type) to another.

New Classification of Stock Market⁴.

- Developed previously: *novel algorithm*, based on the Discrete Wavelet Transform (**DWT**) combined with fractional Gaussian noise (**fGn**) to measure the degree of development of a stock market .
- Findings:
 - World Bank classification insufficient for modern markets.
 - Stock markets can be classified into three groups:
 - **Emerging**: *Argentina, Czech Republic, Ireland, Mexico and Portugal.*
 - **Young Mature (or Intermediate)**: *Australia, Canada, Hong Kong and Singapore.*
 - **Very Mature**: *Germany, Japan, the UK and the US.*



Goal

To study the nature of persistence in a stock market over different time periods with variable volatility levels

Fractional Gaussian Noise (fGn).

Defn: increment of fractional Brownian motion (fBm), with zero mean

$$fGn_H(i) = fBm_H(i+1) - fBm_H(i), \quad i \geq 1 \text{ \& } 0 < H < 1$$

$$\text{Auto-covariance } \gamma(t) = \frac{1}{2} \left[(t+1)^{2H} - 2t^{2H} + |t-1|^{2H} \right], \quad t \geq 0$$

and satisfies $\gamma(t) \approx H(2H-1)t^{2H-2}$ as $t \rightarrow \infty$

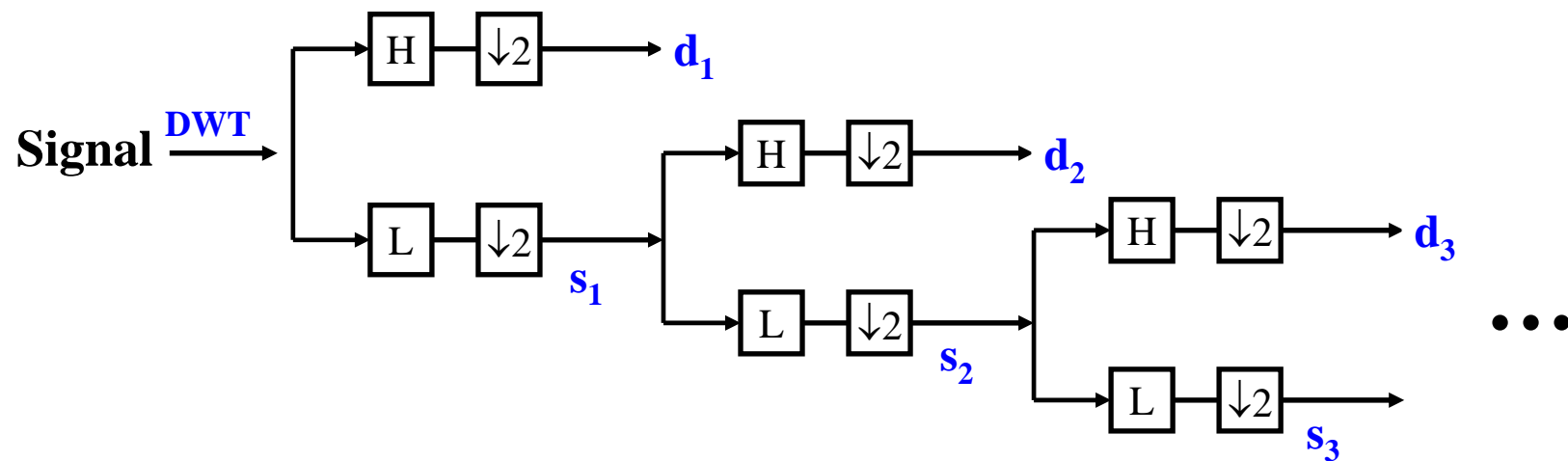
There are three cases for H:

- $H < 0.5 \Rightarrow$ *Anti-persistence* or *intermediate* memory.
- $H > 0.5 \Rightarrow$ *Persistence* or *long-term* memory.
- $H = 0.5 \Rightarrow$ *White noise* or *short-term* memory.



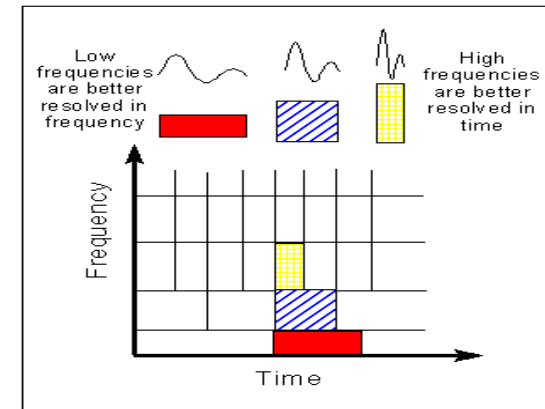
The DWT.

- Computed by *high* and *low pass* filtering of the signal (data series).
- Input signal filtered and separated into *low* (*Smooth*) and *high* (*Detail*) frequency components.

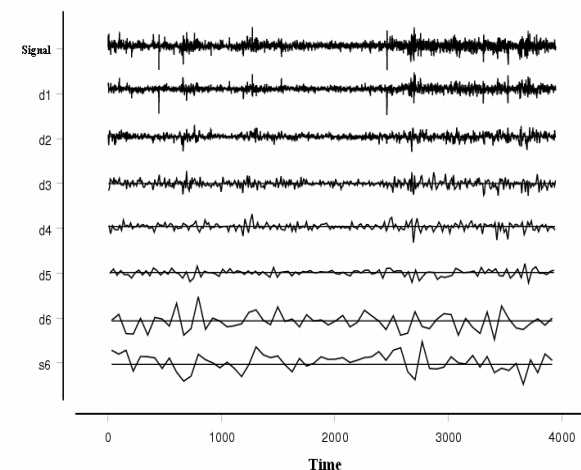


Advantages of Wavelet Transform.

- Capable of providing time and frequency information simultaneously.
- Deals with non-stationary and *noisy* time series, ⇒ useful for financial data.
- Can *split* the data series (signal) into different frequency components.
- Used to *reconstruct* the data series from some or all of these components.



Wavelet Transform



Description of Measuring Method.

- o Simulate 100 series of fGn with each $H \in \{0.4, 0.5, 0.6\}$.
- o Apply the DWT to estimate the energy percentages
 - o **for generated series. (Average these percentages).**
 - o **for the return series of stock market index.**
- o Calculate logarithms (base two) of energy percentages, ($\log_2(\text{energy } \%)$), for (d_1-d_6).
- o Compare the behaviour of returns with that for fGn series for different H.

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Data Description and Results.

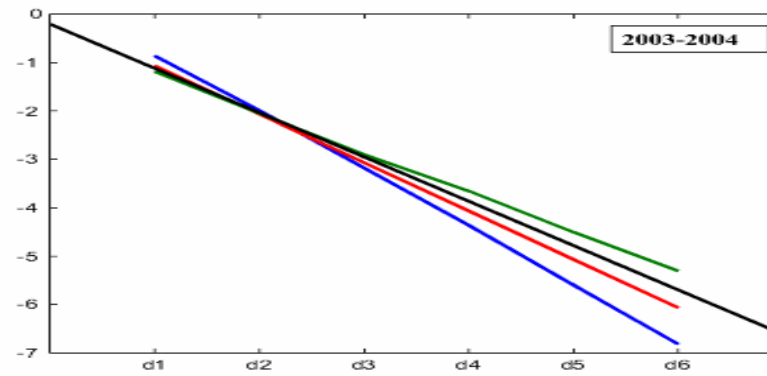
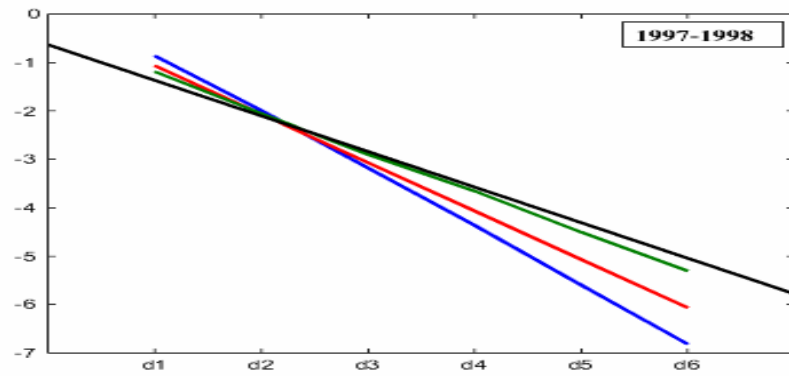
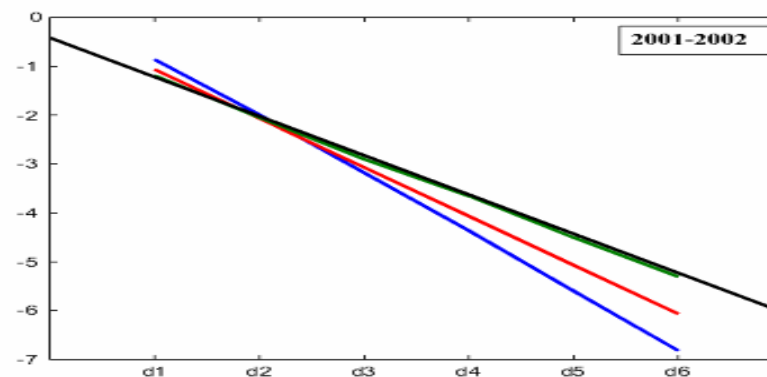
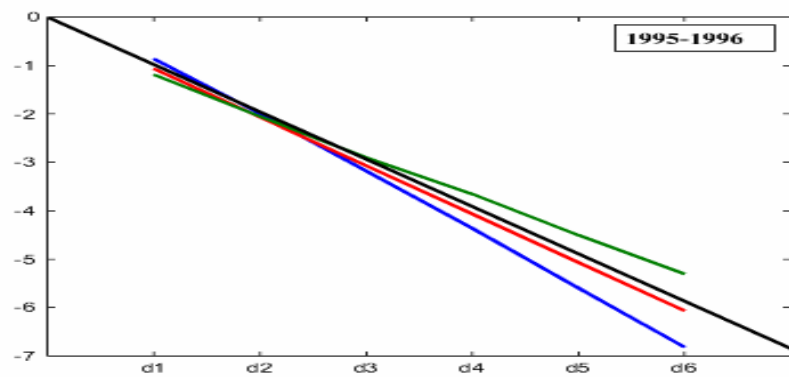
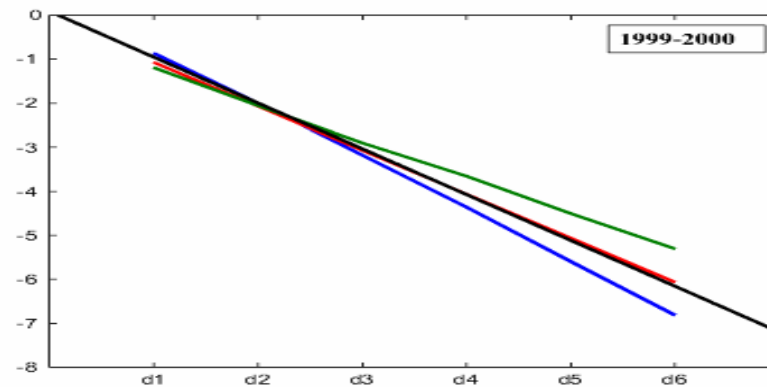
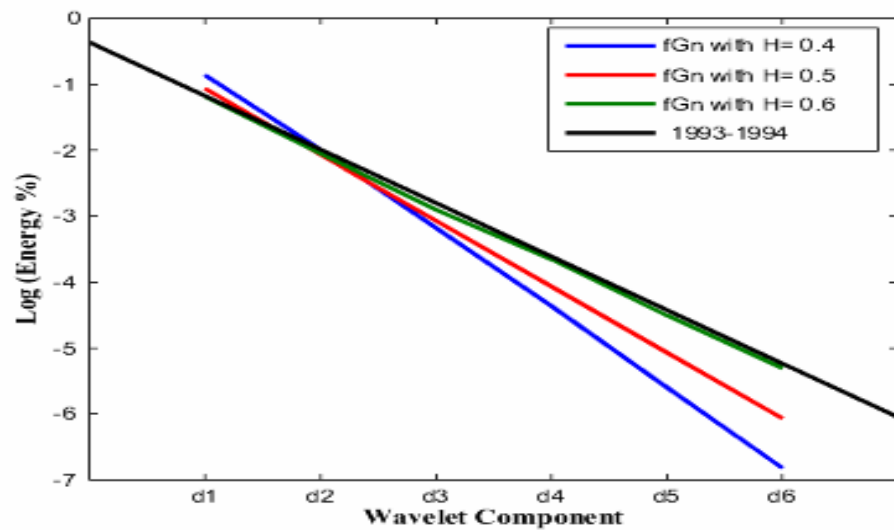
- Daily returns of market indices from 1993 to 2004 (every *two years*).
 - **ISEQ Overall (Ireland).**
 - **Hang Sang (Hong Kong).**
 - **FTSE 100 (The UK).**
 - **S&P/TSX Composite (Canada).**
 - **Nikkei 225 (Japan).**
 - **PSI20 (Portugal).**
 - **Straits Times (Singapore).**
 - **Dow Jones Industrial (The US).**

Table: Descriptive statistics of the daily returns series.

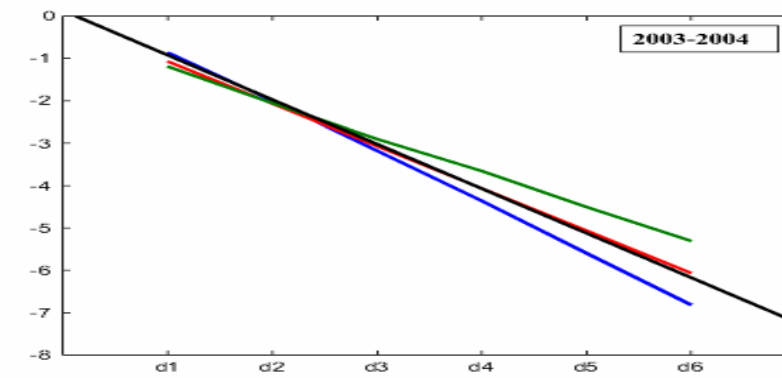
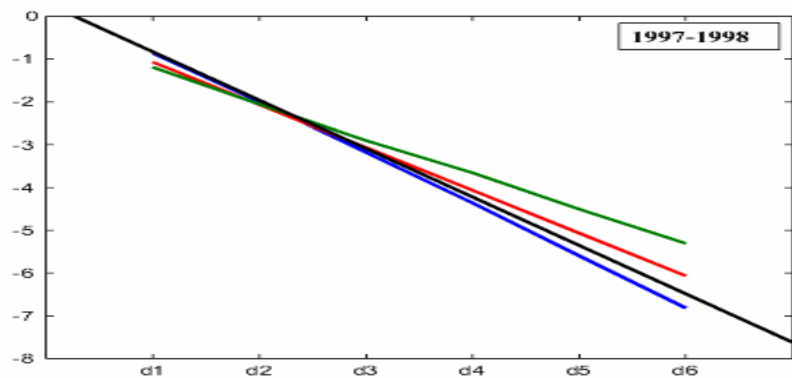
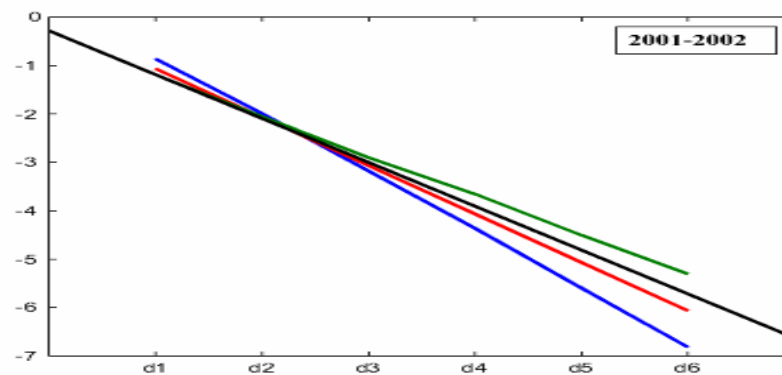
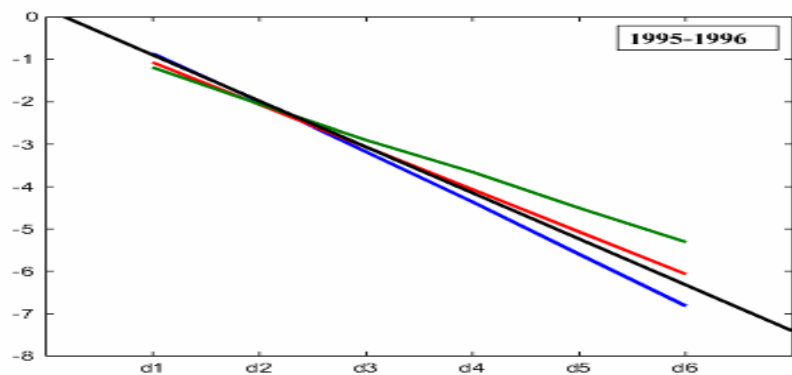
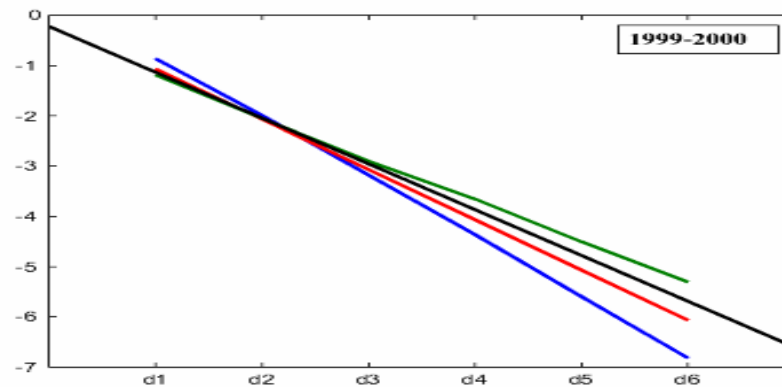
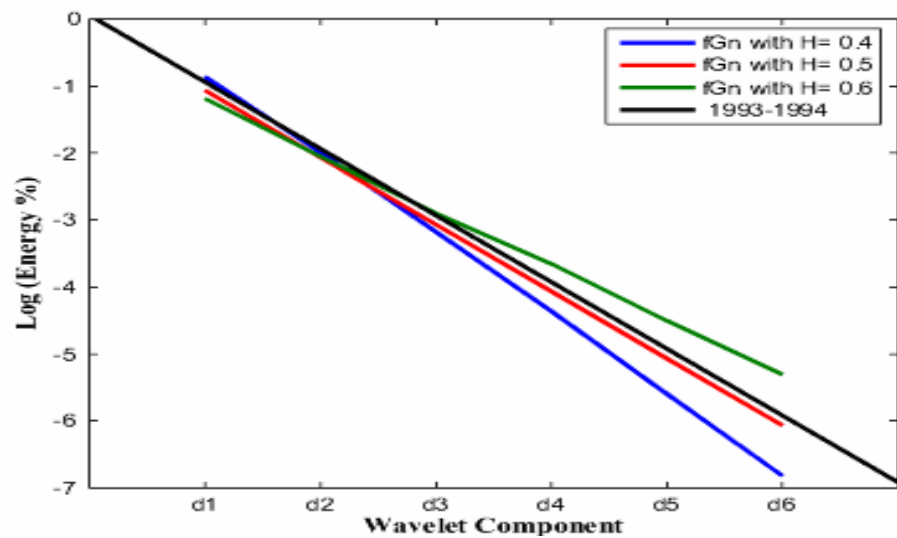
Market	Descriptive					
	Mean	Std. Dev	Minimum	Maximum	Skewness	Kurtosis
Canada	0.00034	0.0094	-0.0846	0.0468	-0.718**	6.828**
Hong Kong	0.00032	0.0173	-0.1473	0.1725	0.074	8.917**
Ireland	0.00054	0.0100	-0.0757	0.0584	-0.396**	4.544**
Japan	-0.00013	0.0145	-0.0723	0.0765	0.053	2.084**
Portugal	0.00031	0.0106	-0.1118	0.0694	-0.942**	10.693**
Singapore	0.0001	0.0134	-0.0915	0.1287	0.133**	8.381**
The UK	0.00017	0.0108	-0.0559	0.059	-0.140**	2.658**
The US	0.00039	0.0105	-0.0745	0.0615	-0.262**	4.578**

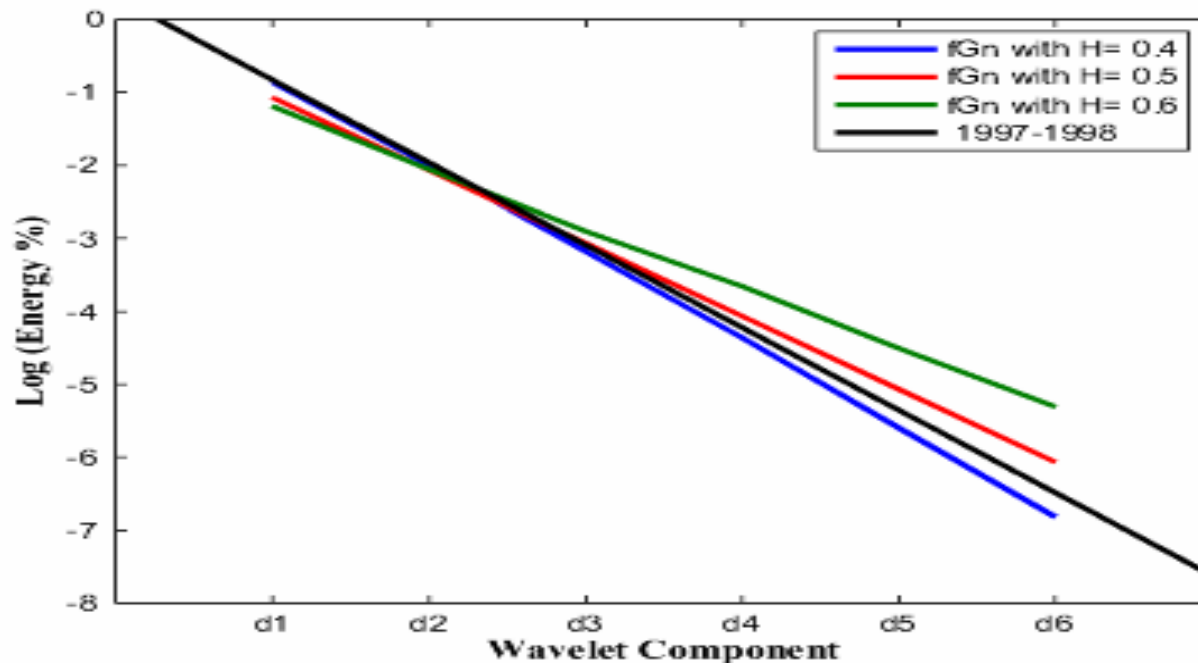
1. ** denotes significantly different from zero at 1% level.
2. All return series can not be normally distributed.

Irish Market

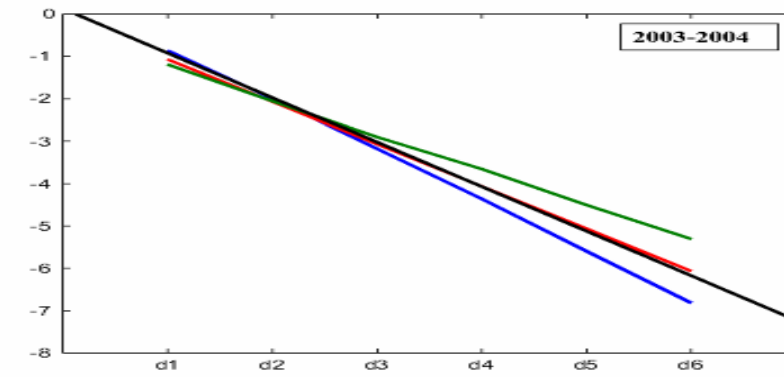
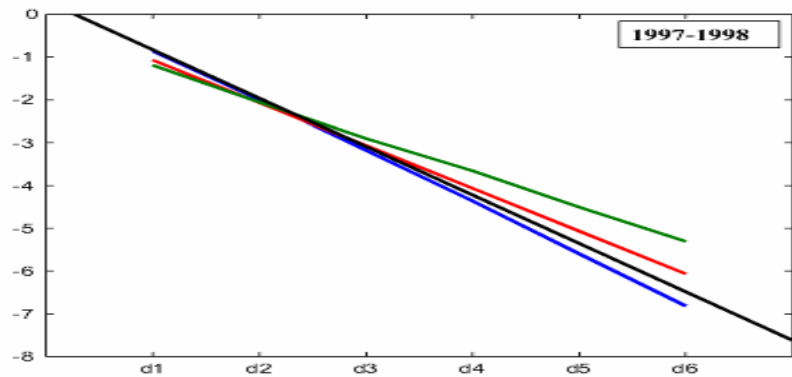
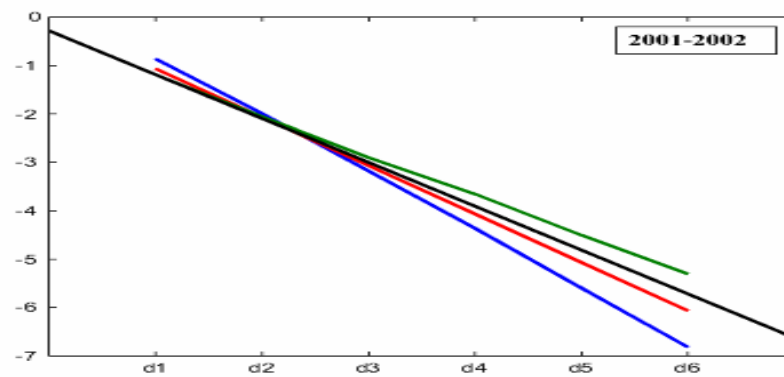
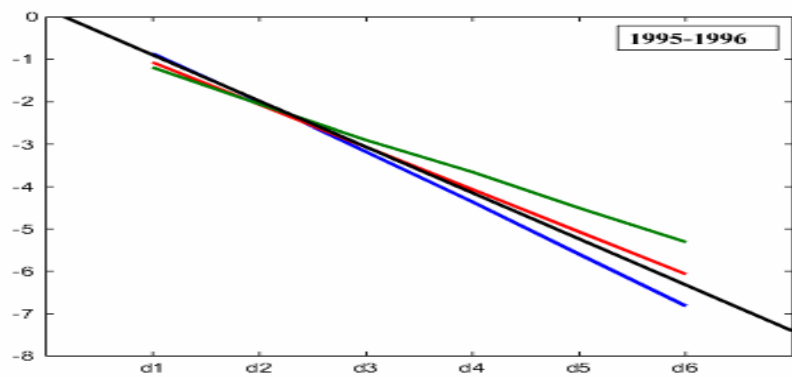
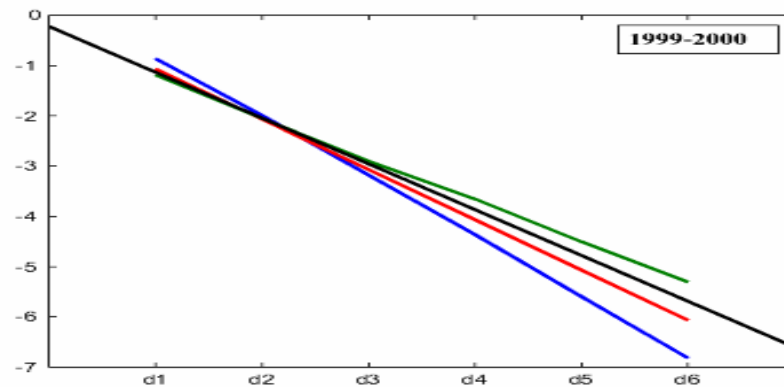
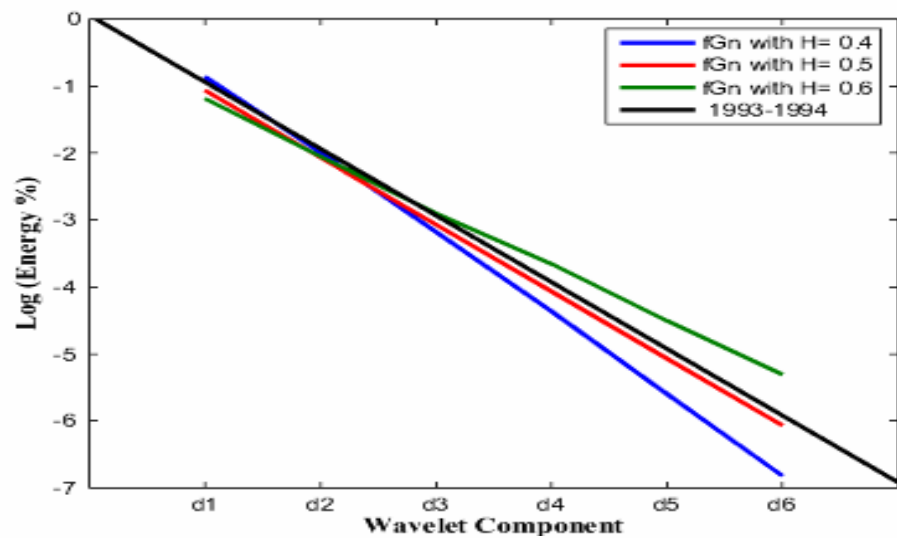


Hong Kong Market

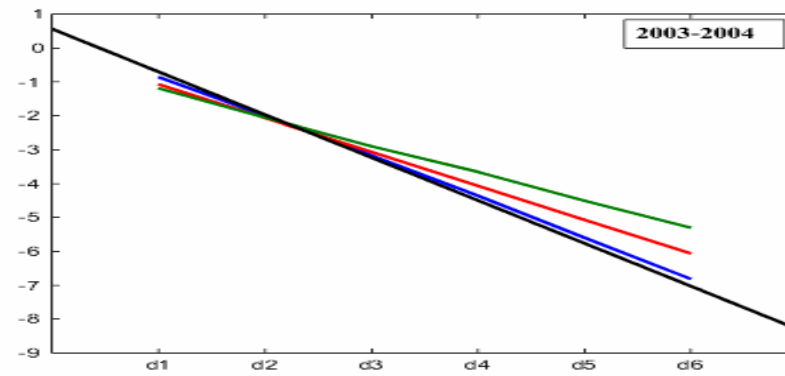
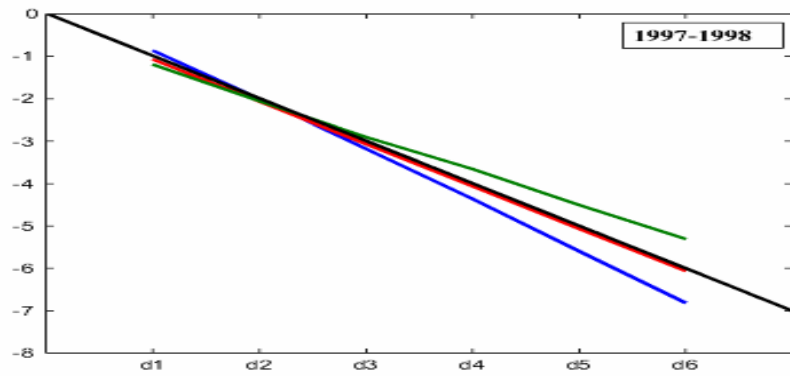
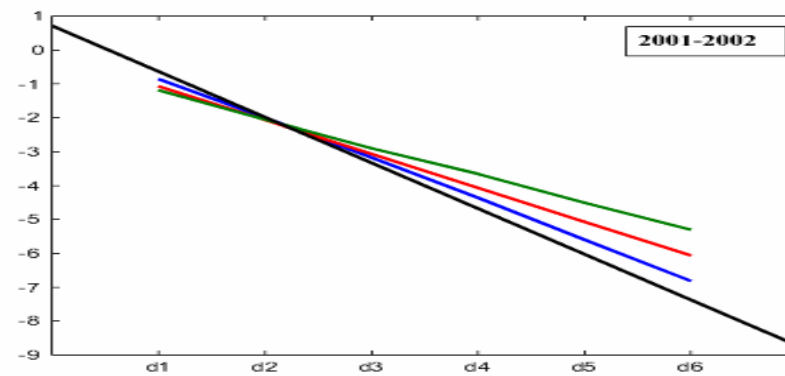
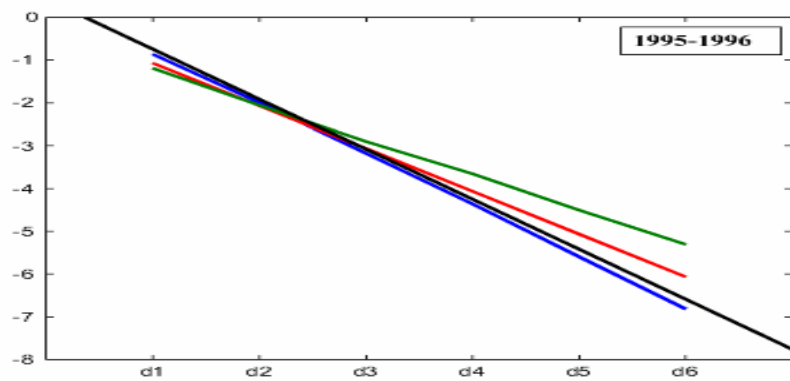
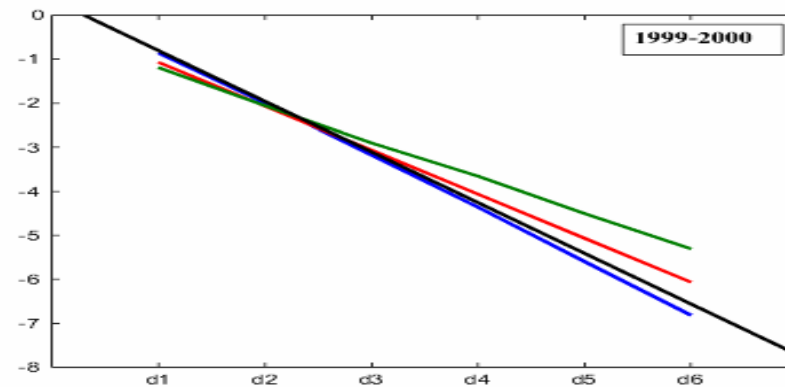
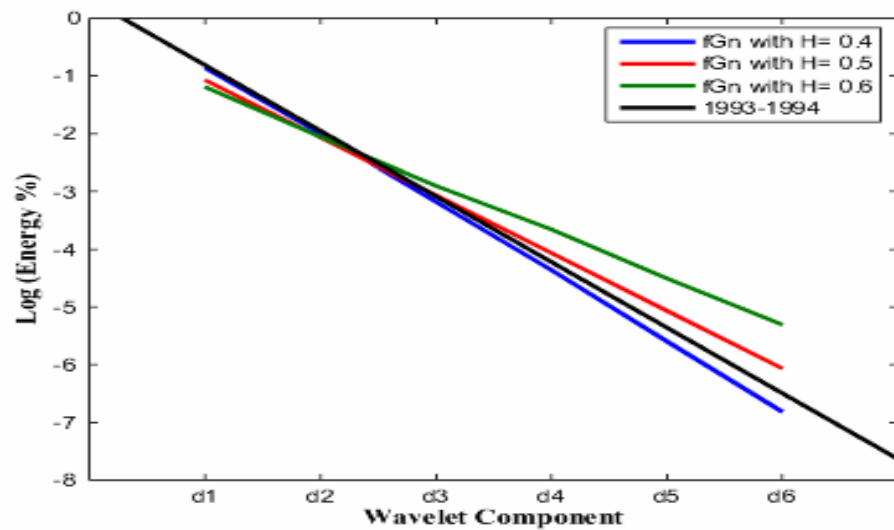




“Hedge funds in particular are known to have taken a position consistent with a possible crisis on the currency and on the stock market, by “shorting” (selling) the currency to drive it down, forcing the Hong Kong government to raise interest rates to defend it by increasing the currency liquidity, but as a consequence making equities suffer and making the stock market more unstable.” Sornette. D “Why Stock Market Crash: Critical Events in Complex Financial System”, (2003).



UK Market



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Conclusions.

- ❑ Stock market shows *persistent* or *anti-persistent* behaviour depending on:
 - Volatility of the period analysed.
 - Market type.
- ❑ Multifractal behaviour, noted by *Matia et al (2003)*, *Los and Yalamova (2004)* and *Oswiecimka et al (2005)*, can be readily explored using approach.



Acknowledgment.

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Computation and Analysis (INCA), Ireland*

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1. **Sharkasi, A., Ruskin, H. and Crane, M.**, "*Interrelationships among International Stock Market Indices: Europe, Asia and the Americas*", *International Journal of Theoretical and Applied Finance (IJTAF)*, World Scientific Publishing Co., Vol. 8, No. 5, pp 603-622, 2005.
2. **Lee, H. S** "*International Transmission of Stock Market Movements: A Wavelet Analysis on MENA Stock Market*", *Economic Research Forum, ERF Eighth Annual Conference, Cairo, Egypt, January 2002.*
3. **Matos, J. A. O., Gama, S. M. A., Ruskin, H., Sharkasi, A. and Crane, M.**, "*Correlation of worldwide markets' entropies*" has been accepted at the *5th International Conference on 'Applications of Physics in Financial Analysis, APFA5 '* to be held in Torino from June 29 - July 1 2006.
4. **Sharkasi, A., Ruskin, H., Crane, M., Matos, J. A. O. and Gama, S. M. A.**, "*Measuring the Degree of Maturity in Developed Markets*", *Condensed Matter and Materials Physics (CMMP 2006)*, 20 - 21 April 2006, University of Exeter, UK.



Thank You