Relevant information in microstructure of BUND future : some non-linear analyses

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Plan of the talk

- First-passage process(FPP) in financial markets
- Modeling of the FPP for financial data

A short review of our previous studies

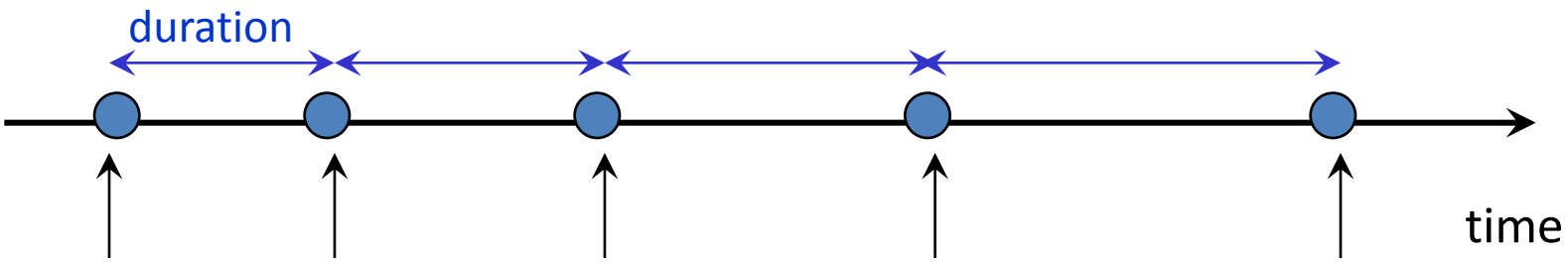
- Data analysis of BUND future in microstructure
- Non-linear analysis of BUND future
  - Hurst exponent
  - Recurrence plot

Core parts of this talk

- Summary

Fluctuations in intervals of events

	ISI in a single neuron	BUND future ("Bond" in German word)	Sony bank rate
Average time interval	~3 [ms]	~10 [s]	~ 20 [min]
PDF of duration	Gamma	Mittag-Leffler	Weibull

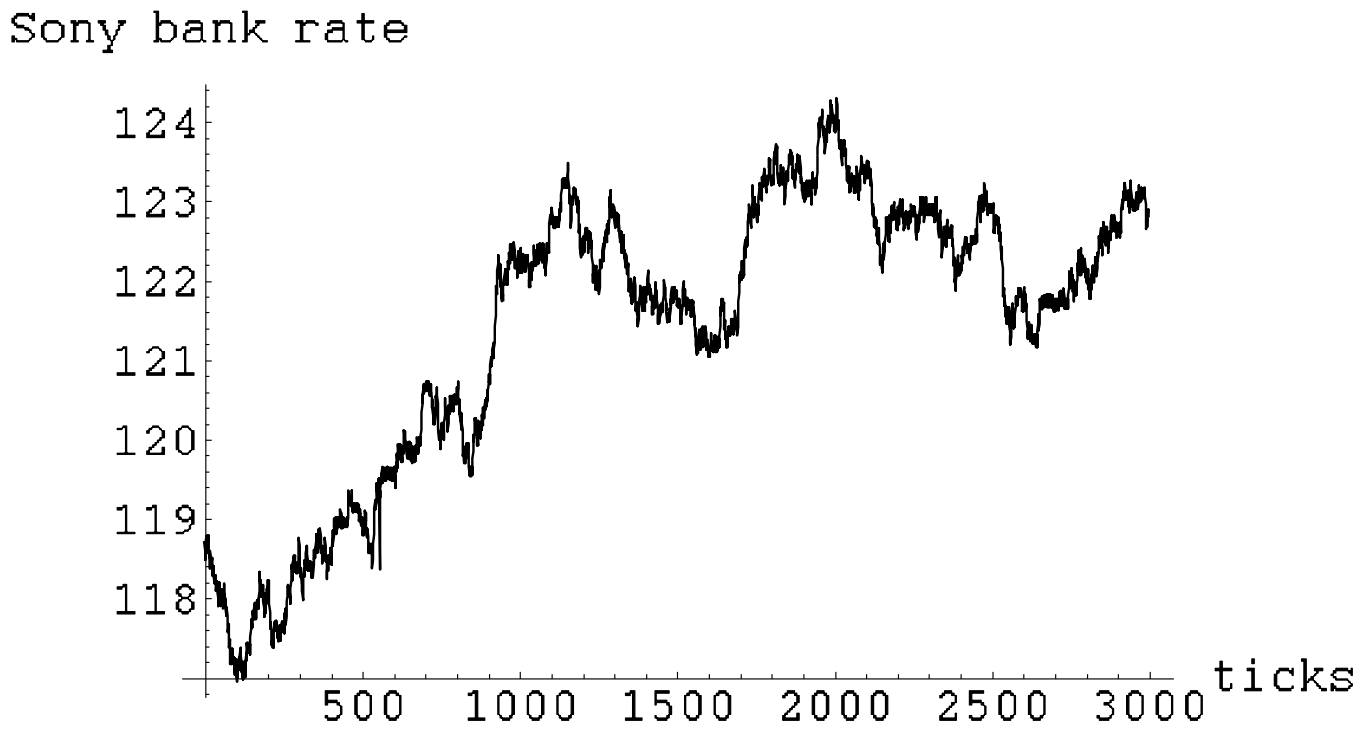


Price change, Neuronal spikes, etc..

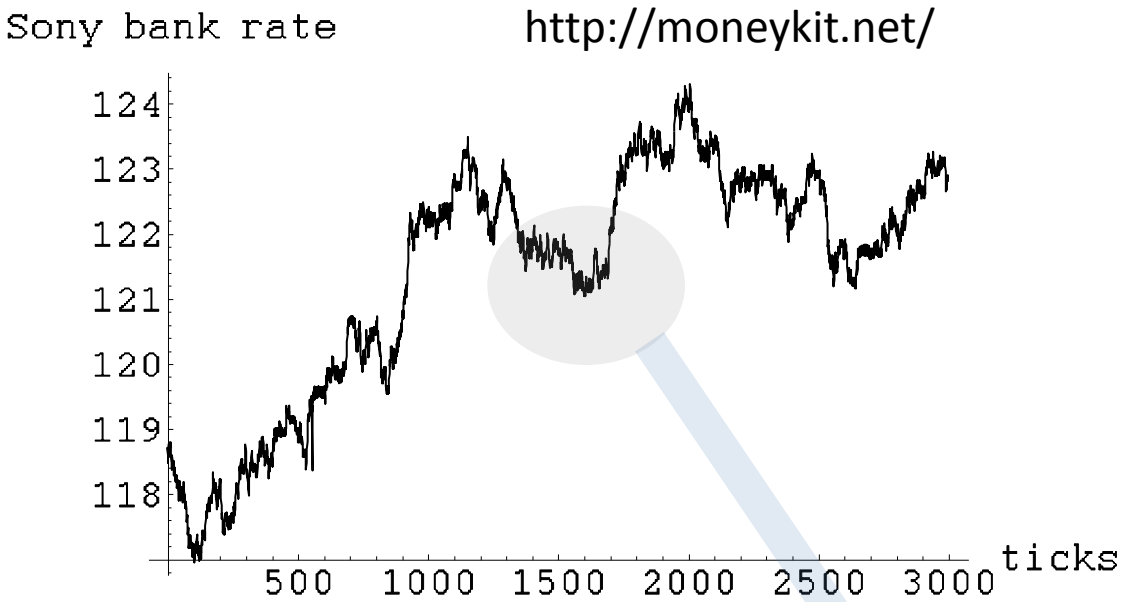
Example: Sony Bank rate

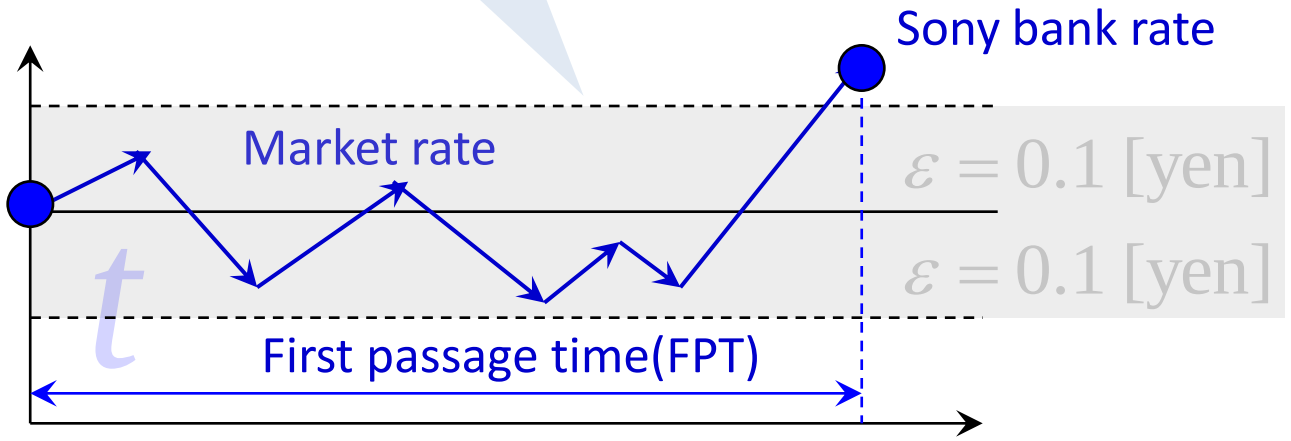
Sony bank USD/JPY exchange rate:

- Rate for individual customers of the Sony bank (http://moneykit.net/)
- Tradable on the web 24 hours a day
- The rate depends on the market rate, not customers' order



FPP in financial markets





Modeling of FPP for financial data

Data: Old BTP future from January 1997 to June 1997

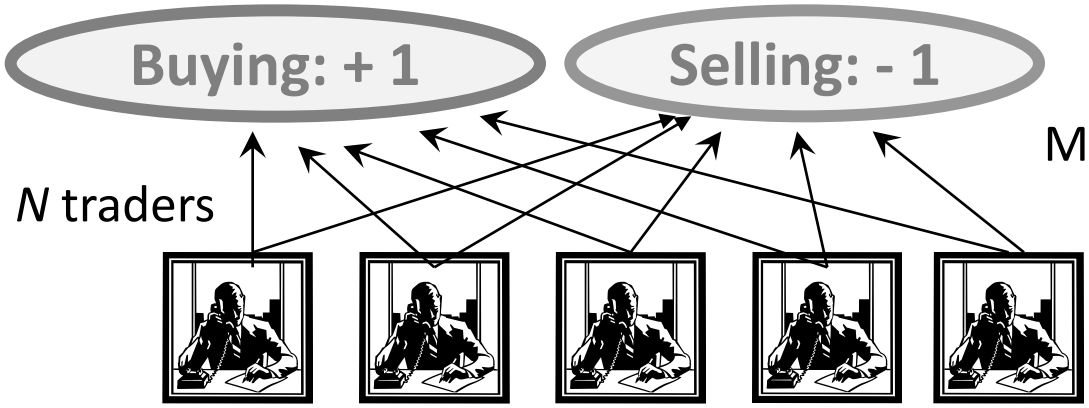
（Middle and long term Italian Government bonds)

We model the underlying stochastic process of Data via

◆ **Minority game with market history**

The results are compared with the empirical data analysis

FPP of the MG dynamics



Minority game with market history

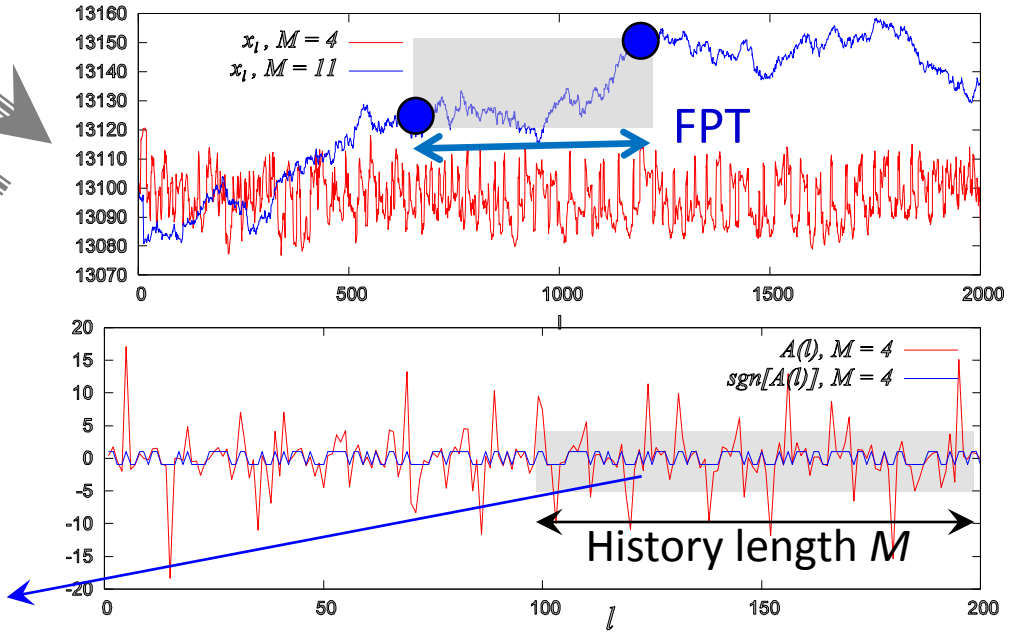
Microscopic variable

$$b_i(l) = \pm 1$$

Macroscopic variable

$$A(l) = \frac{1}{\sqrt{N}} \sum_{i=1}^{N} b_i(l)$$

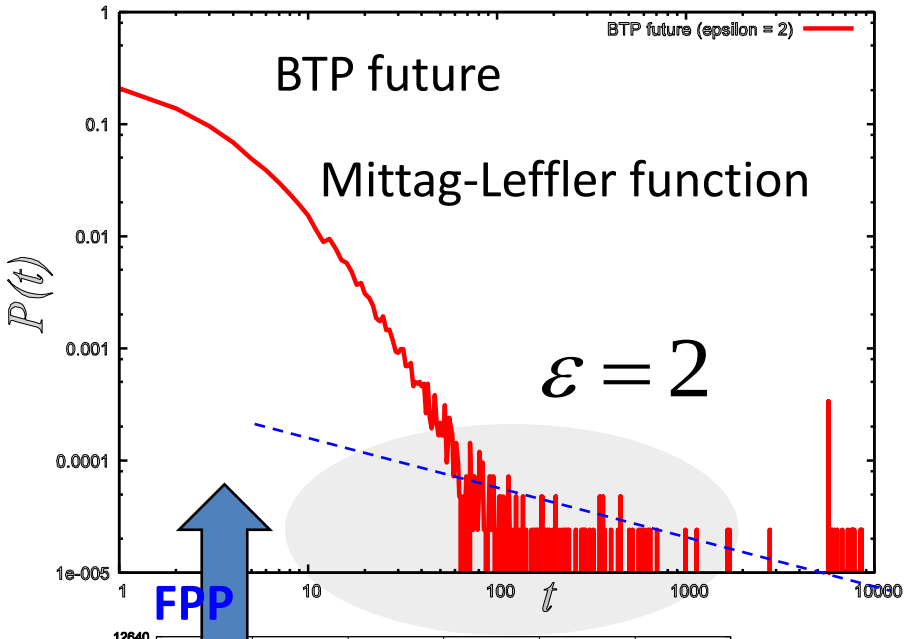
$$\underbrace{x_{l+1}}_{\text{Price}} = x_l + \underbrace{A(l)}_{\text{Return}}$$



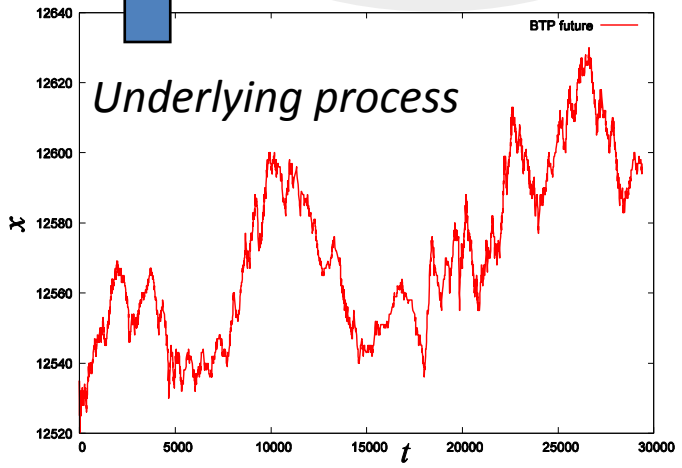
Each trader uses the information about "***up-down structure***" of the market in the previous *M* steps

FPT distribution of the MG

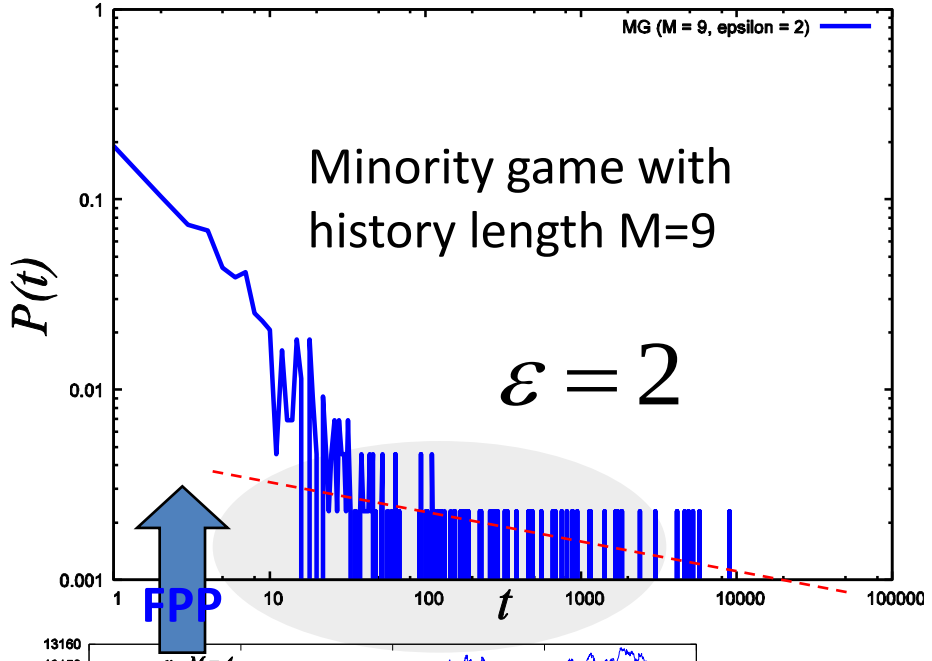
Empirical findings



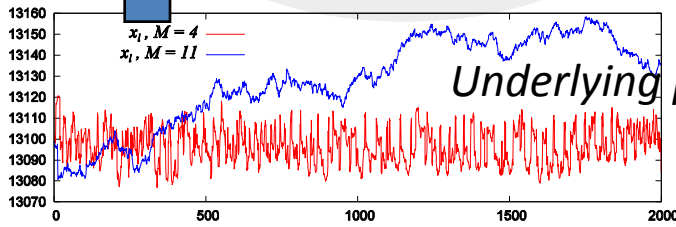
FPP

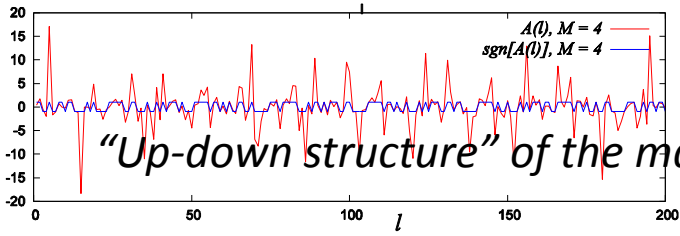


Modeling results



FPP





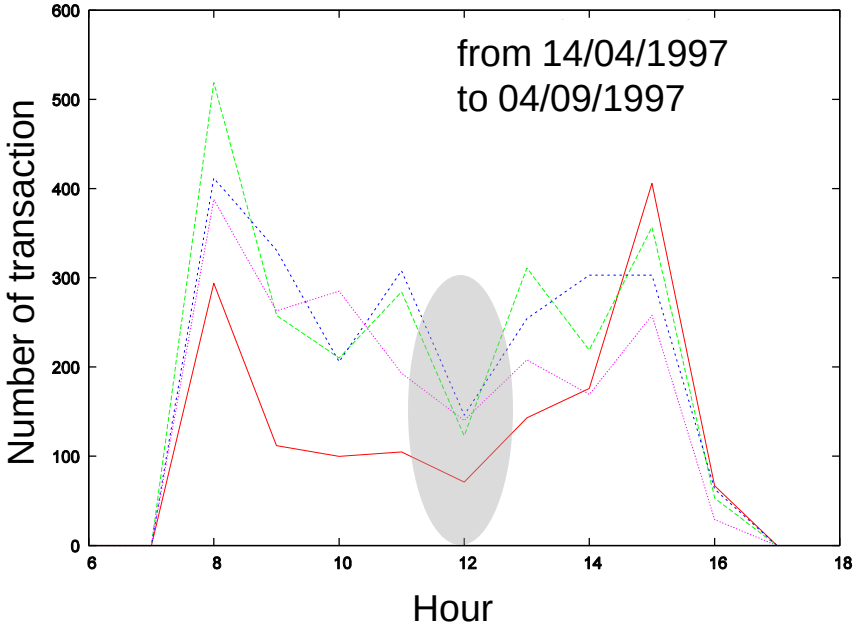
Aim of this study

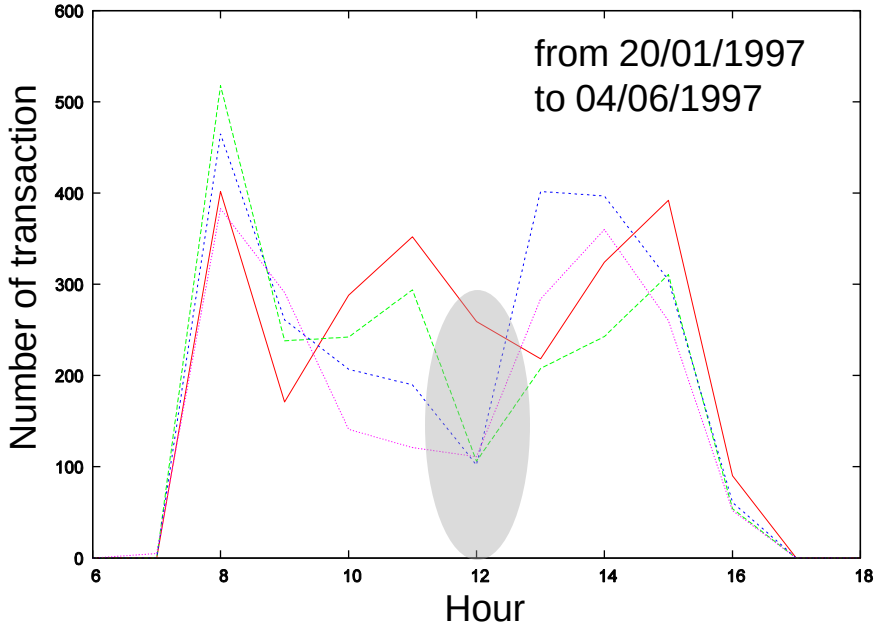
- We investigate information in microstructure

- We use non-linear data analysis to understand information in the microstructure
  - ◆Hurst exponent
  - ◆Recurrence plot

Example:number of transaction process

- Number of transactions in a day

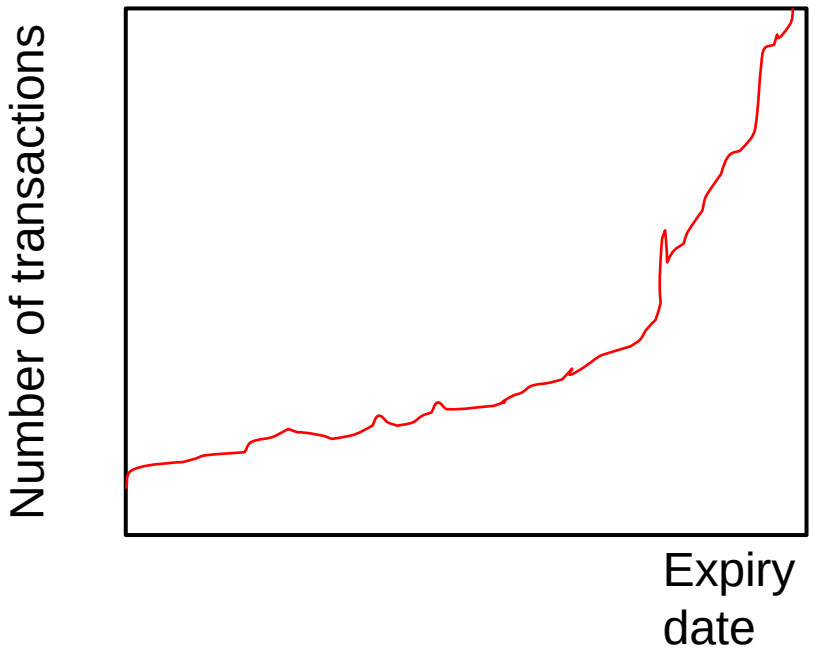




transactions less frequent at lunch time

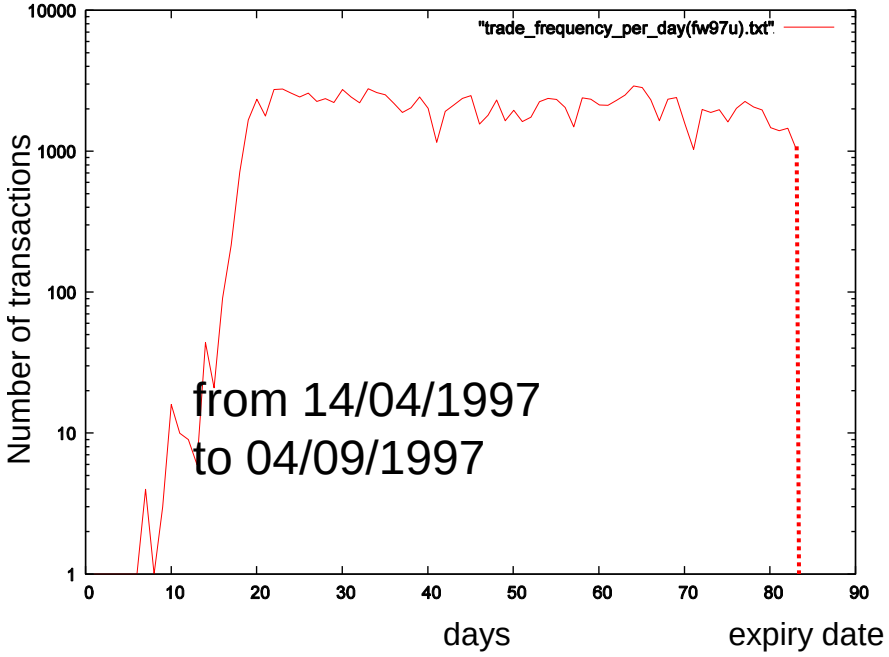
Example:number of transaction process

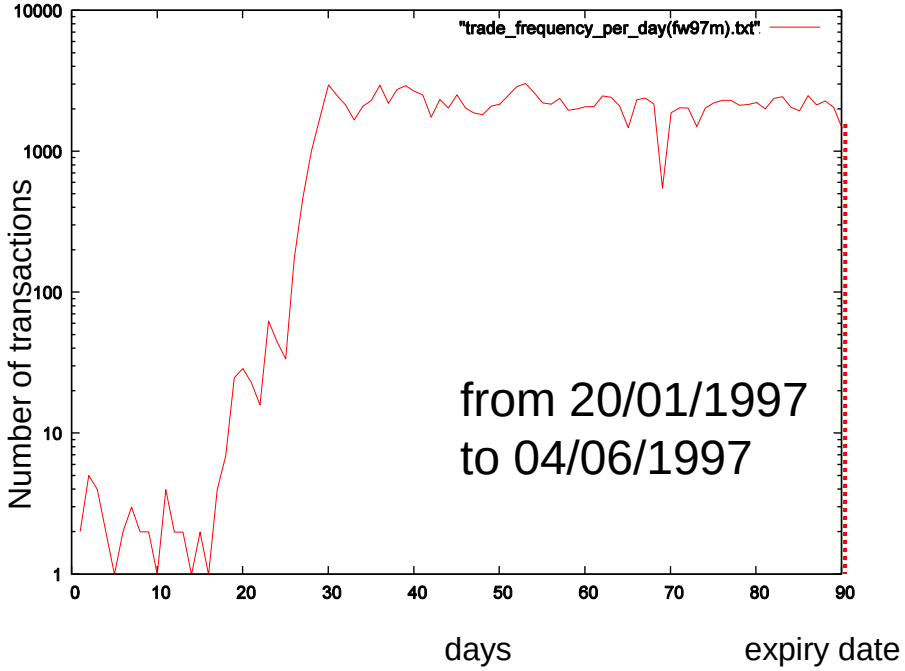
- Number of transactions in total period



Example:number of transaction process

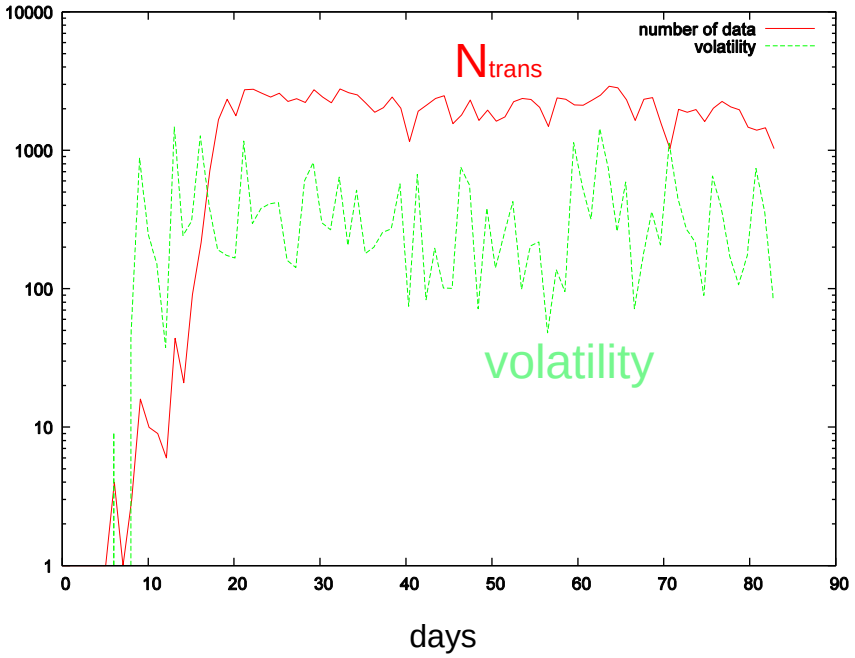
- Number of transactions in total period



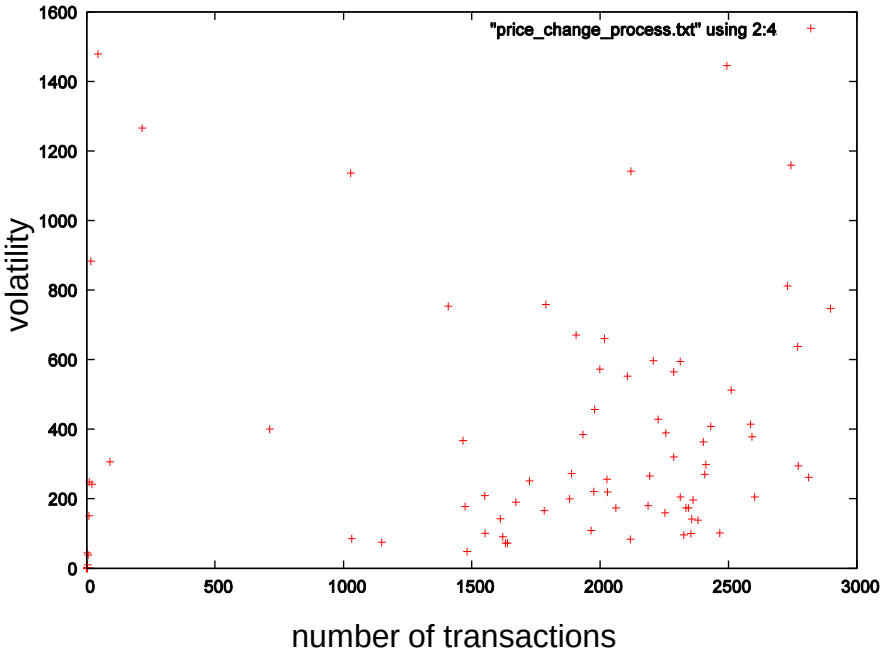


Relation of the number of transactions(N_{trans}) and the volatility of the prive(σ^2)

Time dependence of N_{trans} and σ^2



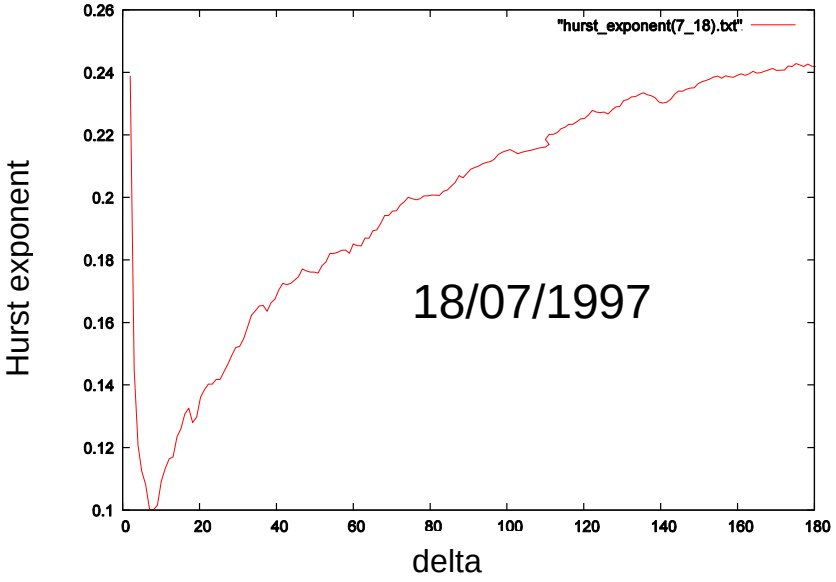
Relationship between N_{trans} and σ^2



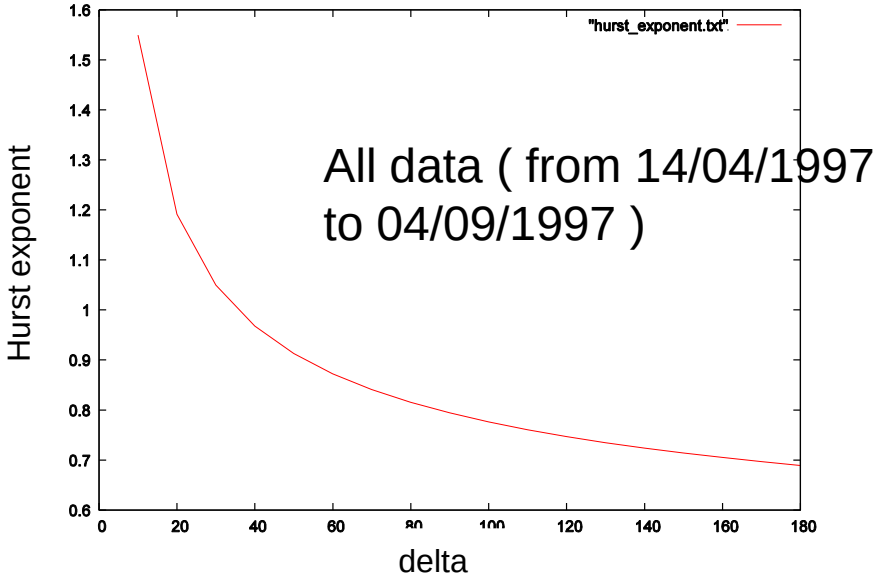
Hurst exponent

$$\left\langle \left| x(t+\delta) - x(t) \right|^2 \right\rangle \sim \delta^{2H} \Rightarrow H = \frac{1}{2}\left(\frac{\log \langle | x(t+\delta) - x(t) | \rangle}{\log \delta} \right)$$

Process of Hurst exponent in a specific day



Process of Hurst exponent in total period

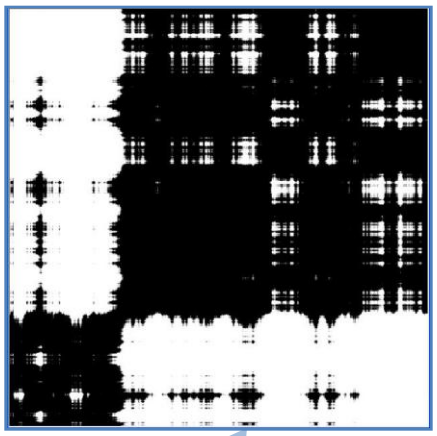


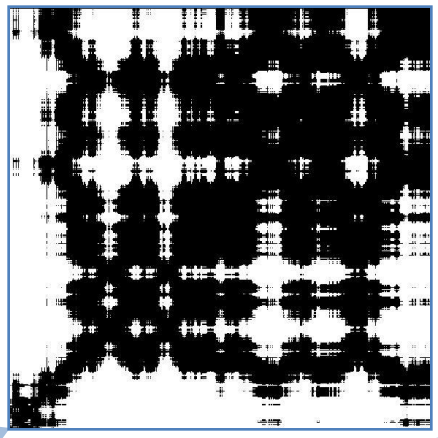
Strong memory effect does not appear in a specific day, but appears in total period by the expiry

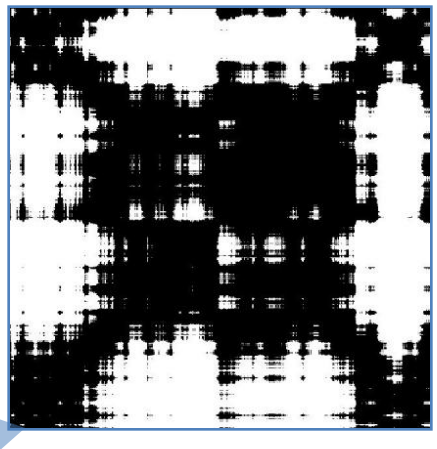
Recurrence plot

$$s_{i,j} = \Theta\left(D_{i,j} - \theta\right) \qquad D_{i,j} = \left|x\left(t_i\right) - x\left(t_j\right)\right| + \left|x\left(t_i + \tau\right) - x\left(t_j + \tau\right)\right|$$

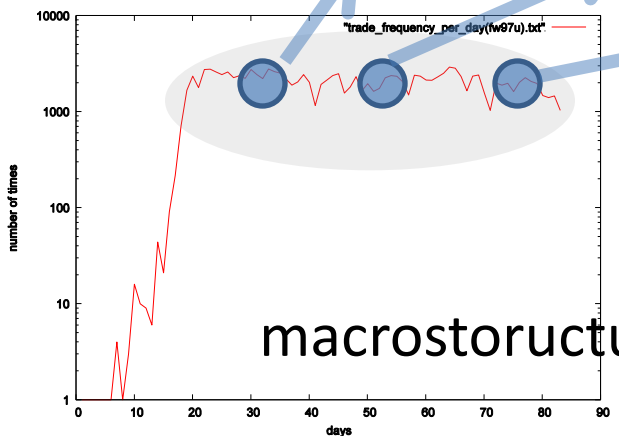
$$\theta = \frac{1}{N^2}\sum_{i,j} D_{i,j}$$







microstoructure



macrostoructure

Summary

- Transaction in the BTP future doesn’t become much more frequent as approaching the expiry date.
- BTP future has not Strong memory effect in a specific day, but appears in total period by the expiry
- To understand individual Recurrence plot different is an issue in the future work.