Human behavior in marketing
マーケティングに見られる人間の行動

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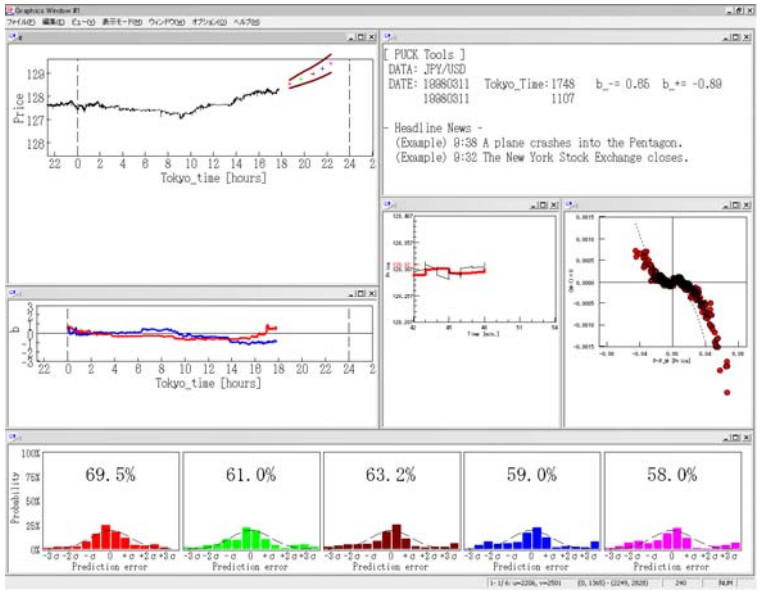

Potential of
Unbalanced
Complex
Kinetics

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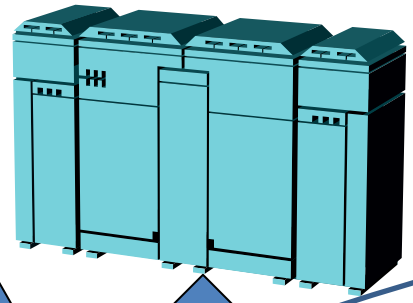
Point-of-Sale data of Convenience stores



Basically, there is no bargain sales at convenience stores.

Server

No Bargain Sales

Comprehensive POS Data
+ Disposal Data:
Receipt information
Shop location, time stamp,
Customer ID #,
Buying-in price,
Sell-out price,
Names (codes) of items,
Volume,
and time of disposed items

About 1,000 Convenience Stores for 1 year (sec)

1. Confirmation of random assumption
ランダム仮説の検証

Each person behaves on purpose (non-randomly).
一人一人の人間はそれぞれの理由があって行動している(ランダムではない)

It looks random when the number is large.
たくさんの人間を観察するとランダムに見える

Random occurrence is modeled by Poisson process.
ランダムな事象の発生はポアソン過程で近似できる

Occurrence intervals follow exponential distribution.
事象の間隔は指数分布に従う

From the convenience POS data, we confirm…
コンビニのPOSデータからわかること

- Time intervals between sales are approximated by Poisson process.

  秒単位の販売の発生間隔はポアソン過程で近似できる

- Poisson parameter changes within about 1 hour time scale.

  1時間程度の時間スケールでパラメータは変化している

How does people rush to bargain sales?

Point-of-Sale data of supermarkets

How much does sales depend on the price change? (Elasticity)

Nikkei digital media Inc.提供

# of stores	373 supermarkets in Japan
JANCODE	1,487,860 comodities
period	1988/03/01～2008/04/30
# of record	3,734,886,348

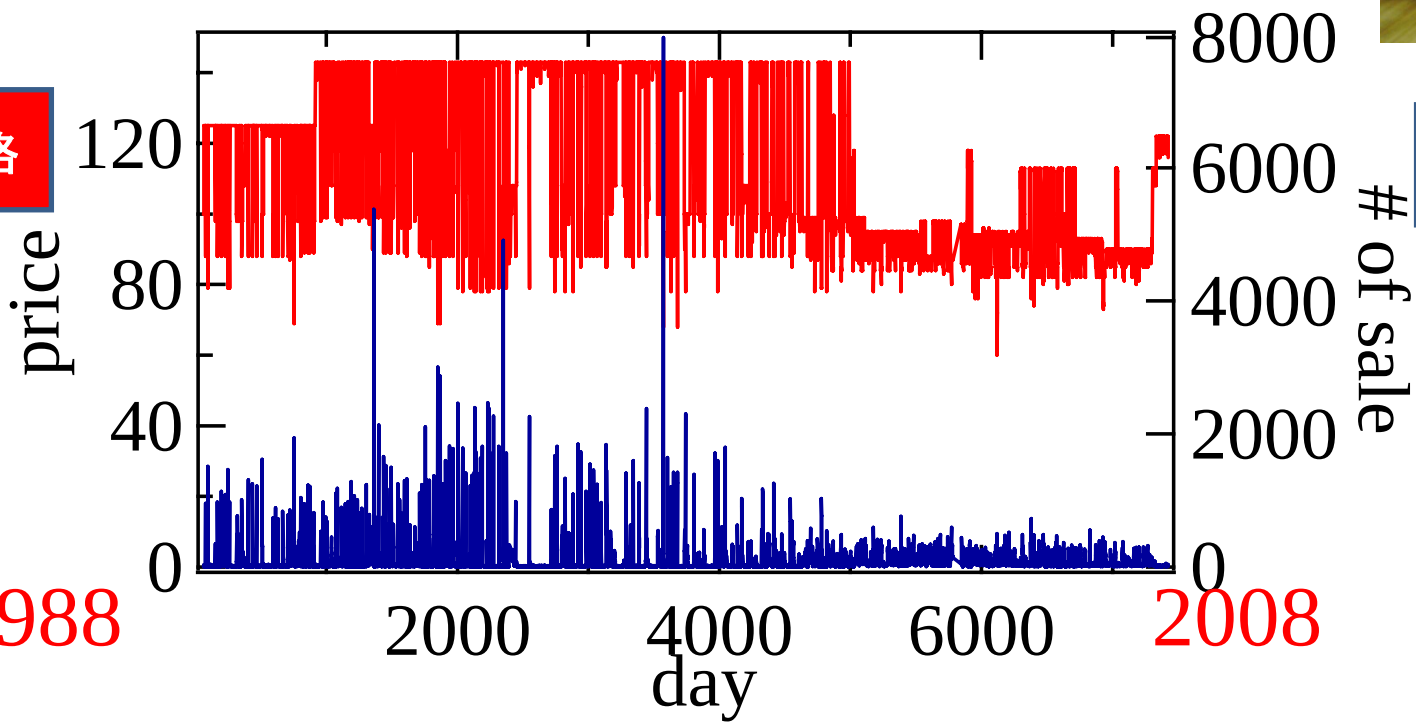
商品種150万
データ数40億

Relation between price and # of sales.

Case : pot noodle A at store 2

販売価格

販売量



s[t] : # of sales at t, p[t] : price at t.

We analyze the relation between the relation s[t+1]/s[t] and p[t+1]/p[t].

From the supermarket POS data, we confirm…
スーパーマーケットのPOSデータからわかること

- People overreact to price reduction.
  Relation of Price and Sales follows nonlinear function.

  客は、バーゲンセールに過敏に反応する。

- Longer the expiration date, stronger the nonlinear effect.

  賞味期限が長い商品ほど、バーゲンセールの効果がある。
  買いだめがきく！！！

Buy and sell in financial markets

Prices always change in financial markets
金融市場では秒単位で価格が変わる

Buyers can be sellers, sellers can be buyers.
さらに、売り手にも買い手にもなれる
Buy at low price, sell at high price.
安く買って高く売りたい。

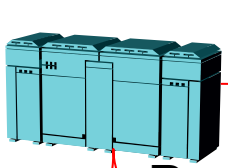
Foreign Exchange Market (inter-bank trading)

Deal by using computer networks

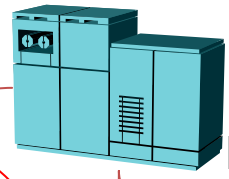
Providers

Major banks

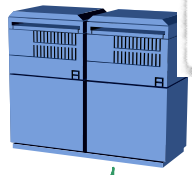
Orders from individuals, companies, governments



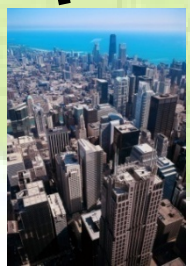
Reuters

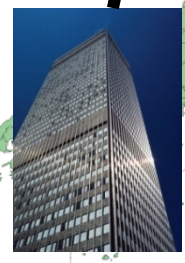


EBS



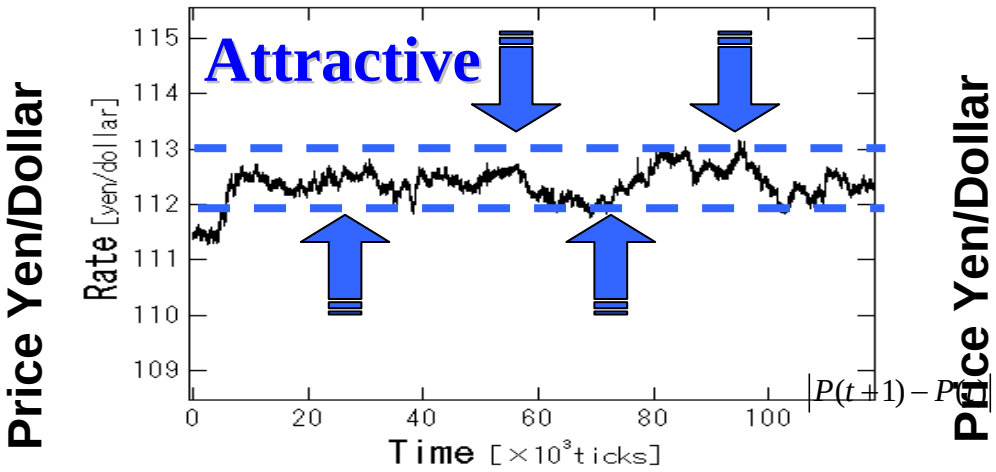
Bloomberg

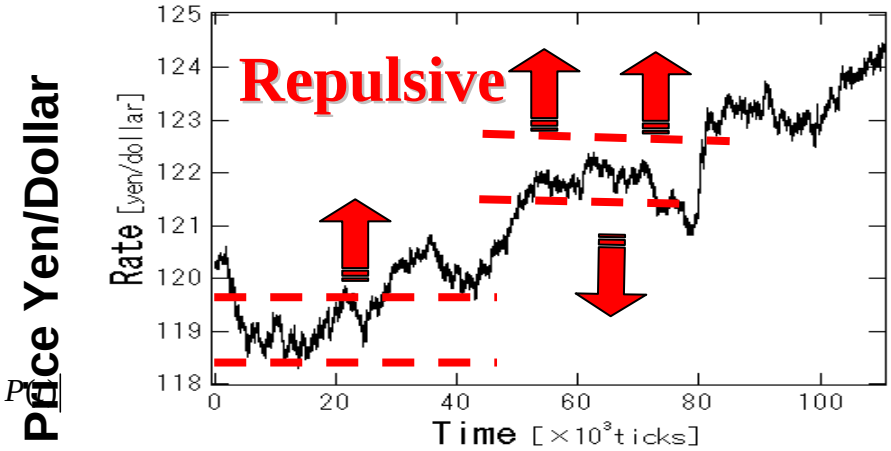




Algorithmic trading are now increasing, millisecond makes difference

It is known that there is considerable amount of deviation from random walk. This deviation can be described by physics concept of potentials.

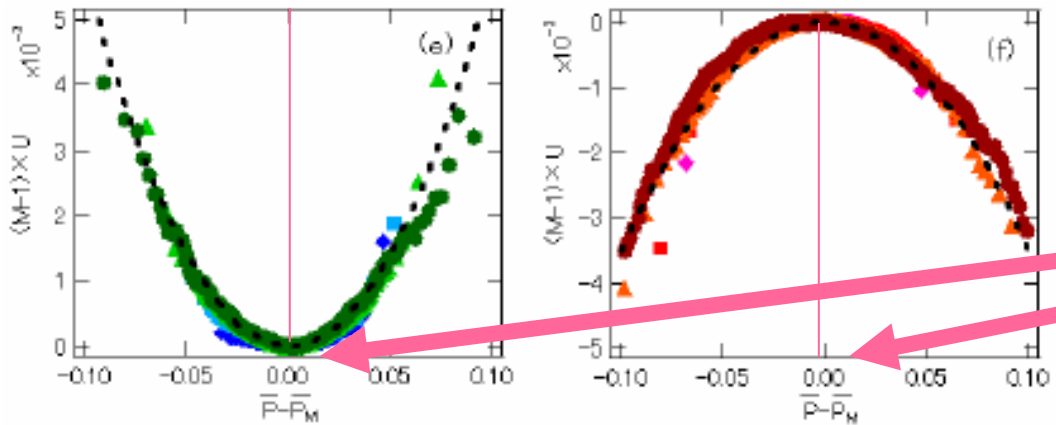




Time(×10 ^{3} ticks)

Time(×10 ^{3} ticks)

市場のポテンシャル

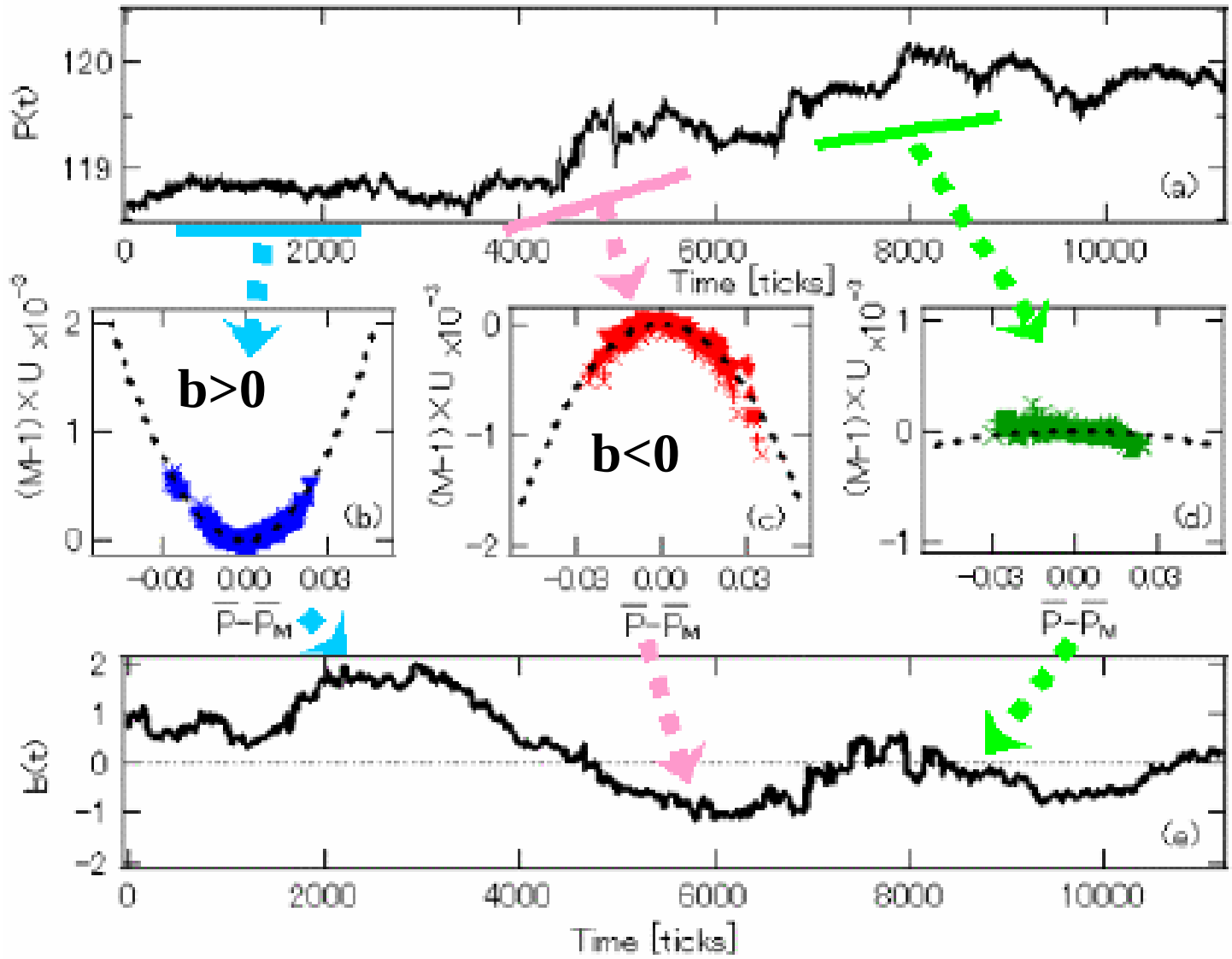


Quadratic potentials observed in real market

The center of the force is given by a moving average of market prices

An example of Potential Analysis for a typical day (24 hours)

PUCK analysis (Potentials of Unstable Complex Kinetics)



Price chart

Potential

Potential coefficient

Diffusion in the Potential model

市場価格の異常拡散

Random walk

in Attractive Potential

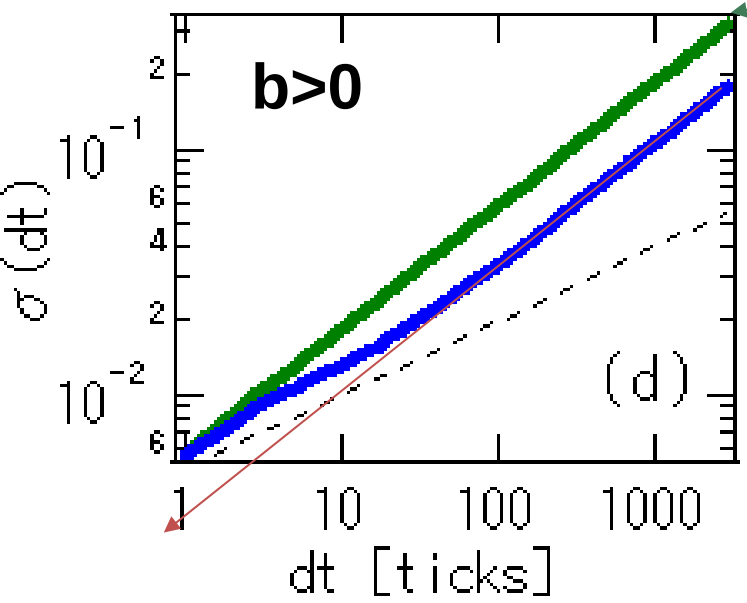
in Repulsive Potential

Large scale behaviors are normal diffusion

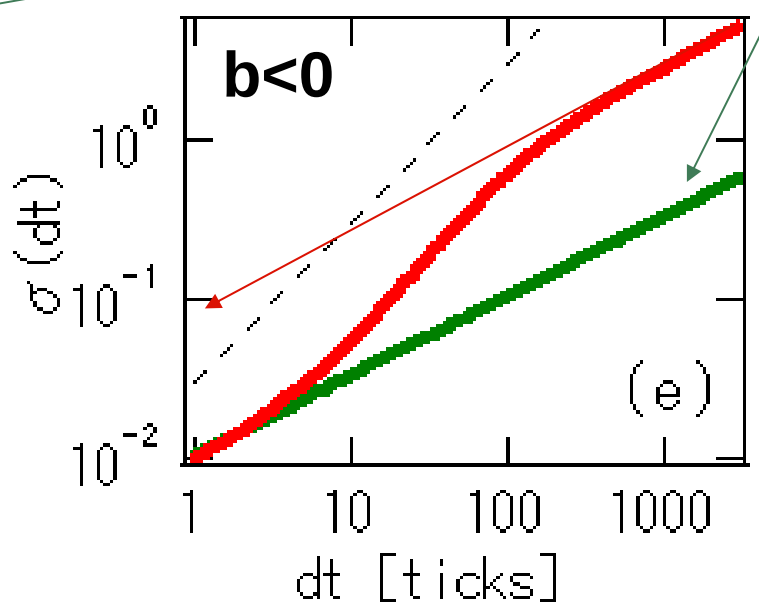
$$\sigma(t)^2 = <(\overline{P(T+t)} - \overline{P(T)})^2> = D \cdot t^{2\alpha}$$

α =1/2

Slow



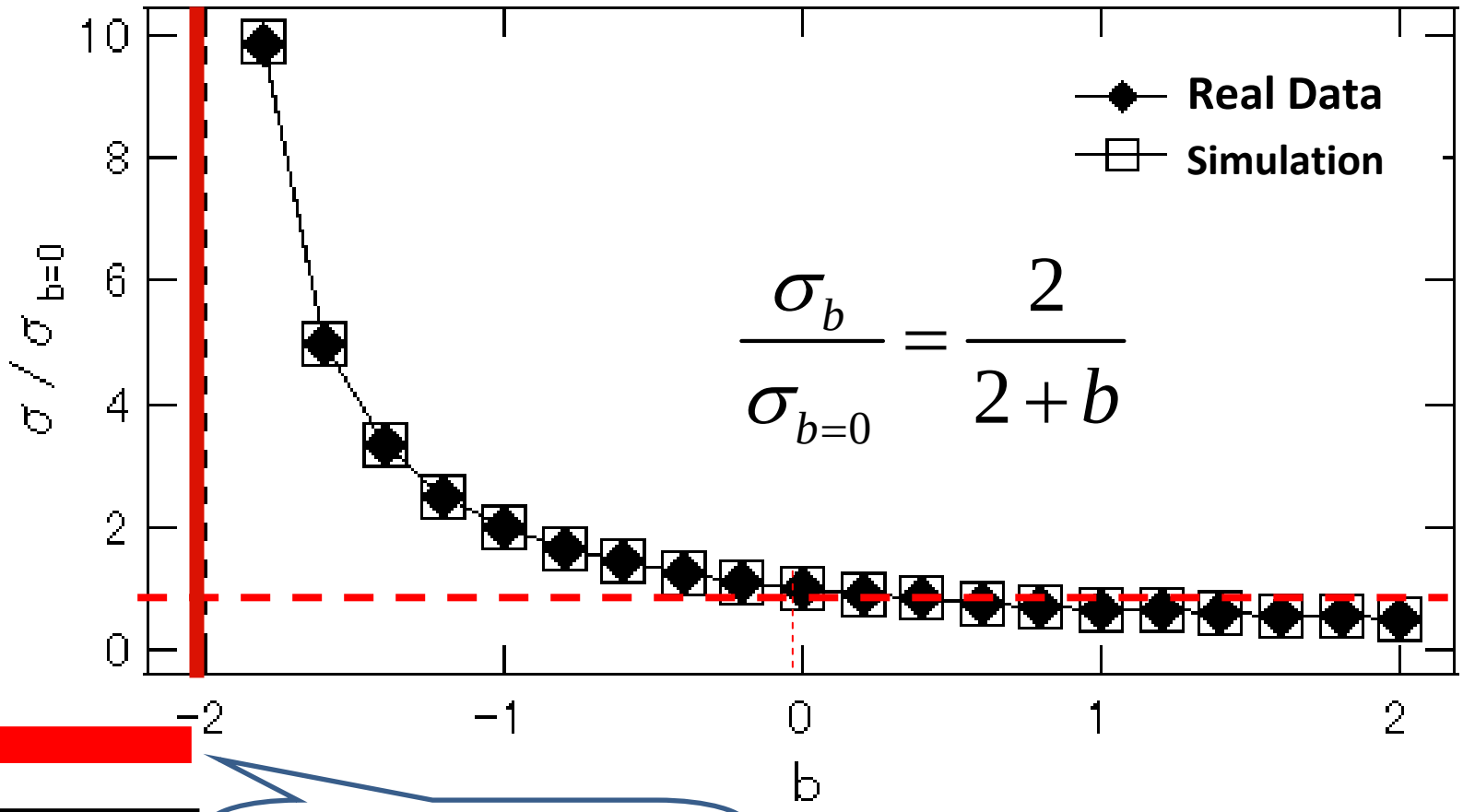
fast



$$\frac{\sigma_b}{\sigma_{b=0}}$$

log (time-difference) vs. **log (standard deviation)**

Price diffusion and the coefficient b



Price diverges exponentially

Divergence of diffusion constant

The diffusion constant is given by

$$\frac{D_b}{D_{b=0}} = \left(\frac{2}{2+b}\right)^2$$

General Form of the Potential

Potential of
Unbalanced
Complex
Kinetics

$$\overline{P}(t+1)-\overline{P}(t)=-\frac{\partial}{\partial x}\phi(x)\Big|_{x=\frac{\overline{P}(t)-\overline{P_M}(t)}{M-1}}+F(t)$$

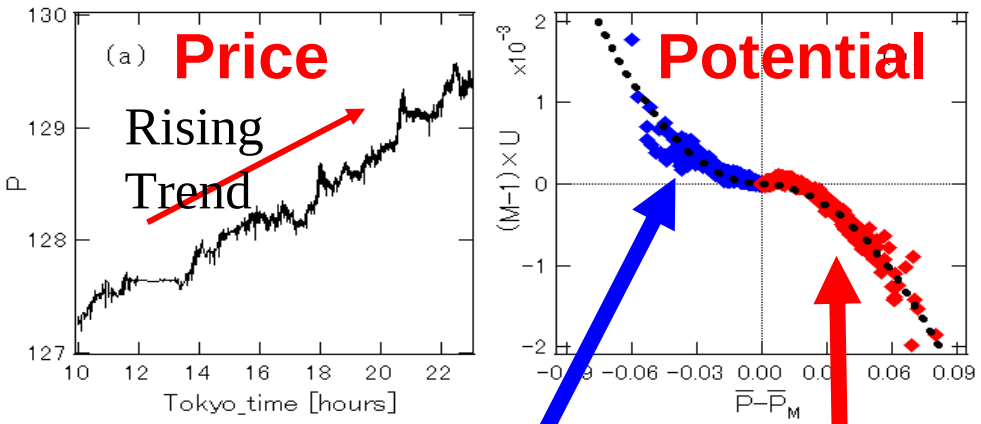
Harmonic?
Cubic?
Quartic?

$$\phi(x)=\sum_{n=1}^{\infty}\frac{b_n(t)}{n}x^n$$

$b_n(t)$: **the potential coefficient (independent of M)**

$F(t)$: **random noise**

Cubic Potential: Asymmetric case



Attractive Force

Repulsive Force

If such an asymmetric potential can be observed, we can use it for prediction.

Relation to ARCH model

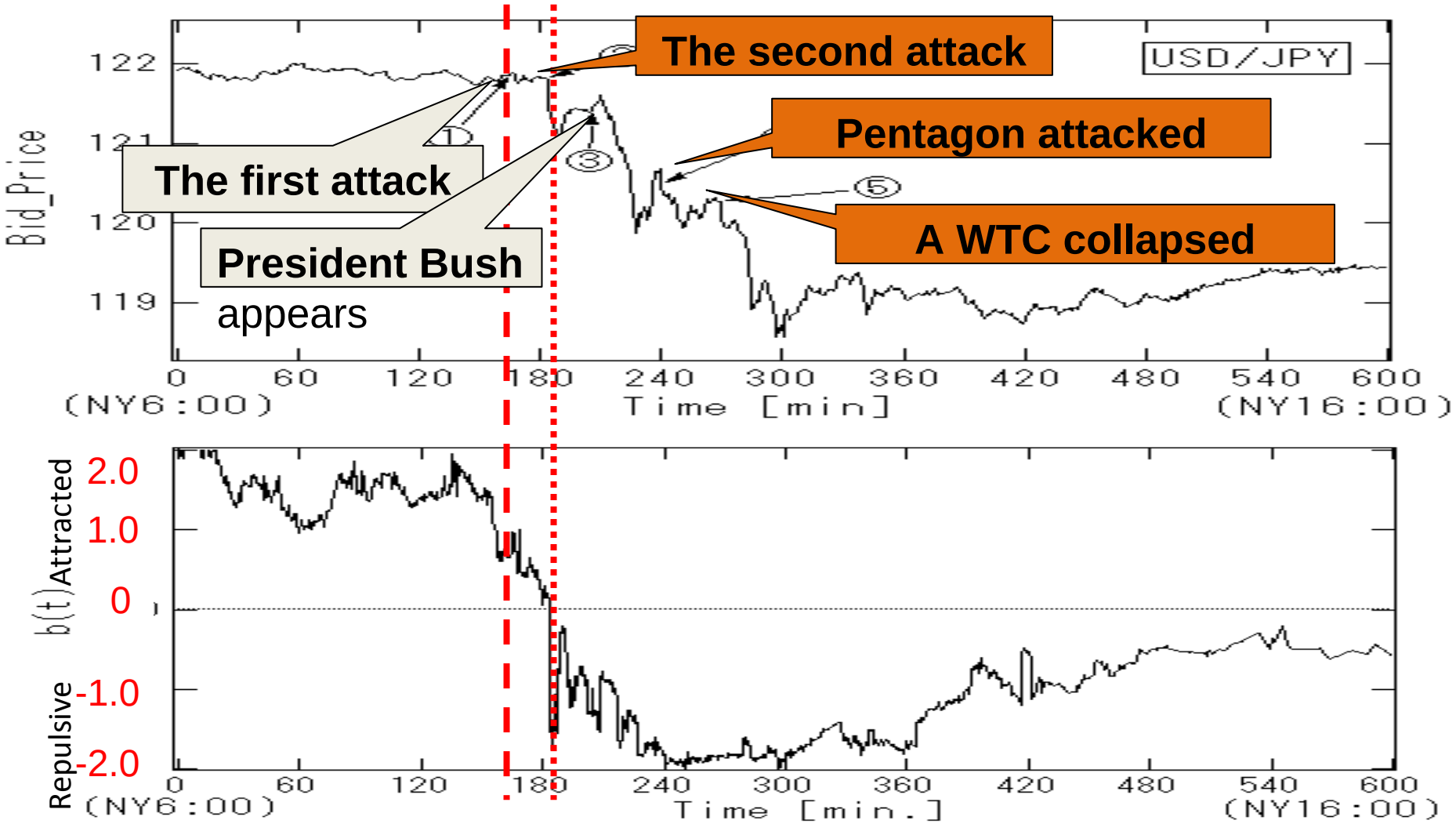
Relation to Dealer model

Hyper-inflation …

Practical application!

News Effects in Real Markets 9.11.2001

Real markets are not statistically stationary; 9.11.2001



The market was stable. It became very unstable It gradually stabilized

Recent results from the study of high-frequency market data
高頻度市場データの研究からわかったこと

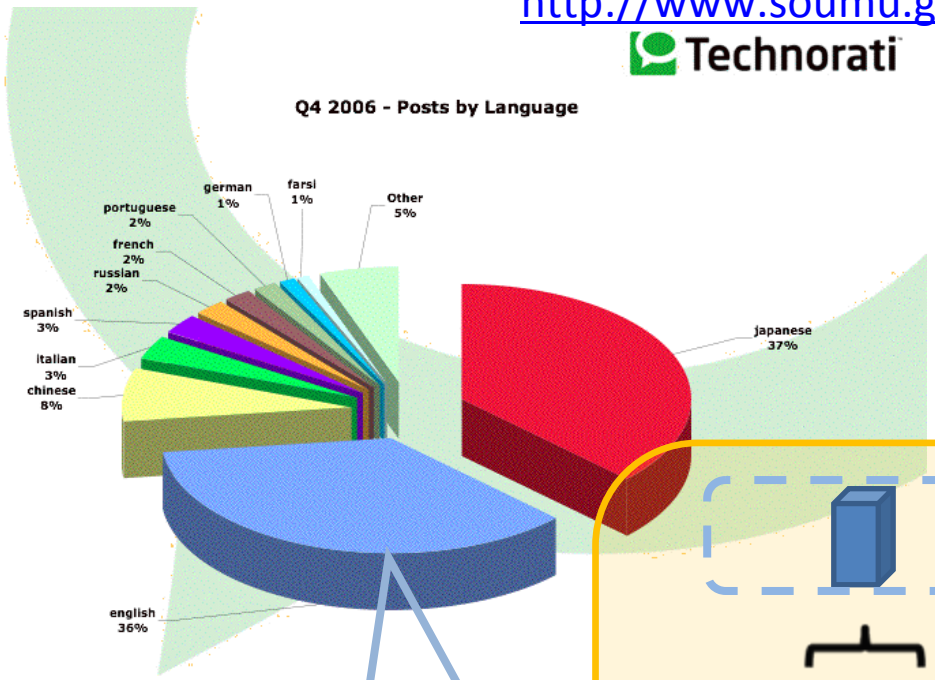
- ✔ Statistical properties of markets change with time by internal instability and external news
  市場の統計性は内的なゆらぎや外的なニュースなどの影響で変化する

- ✔ Large price changes are caused by trend-follow effect of dealers
  ディーラーのトレンドフォローの効果によって頻繁に価格の大変動が発生する

- ✔ Trend-follow effects can be described by market potentials
  トレンドフォローの効果は市場のポテンシャルで記述することができる

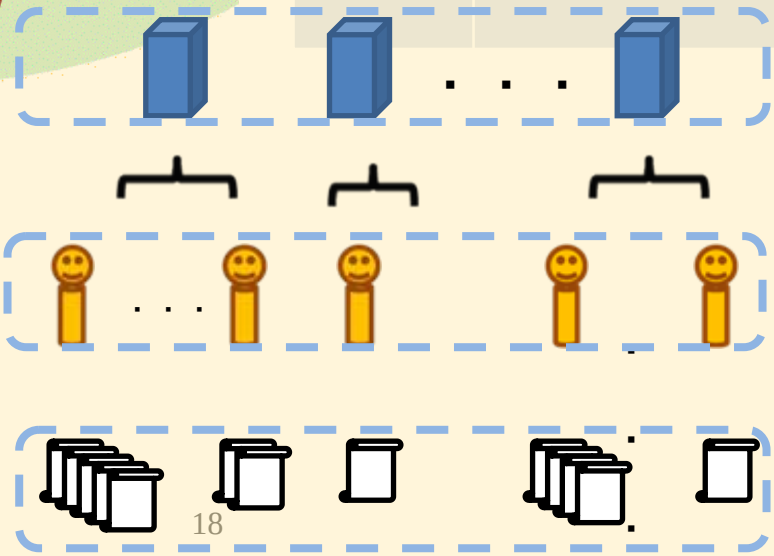
Word-of-mouth in the Cyber space
インターネットの口コミ

http://www.soumu.go.jp/iicp/chousakenkyu/seika/houkoku.html



Rank	Language	
1	Japanese	37%
2	English	36%
3	Chinese	8%

Japanese blog entries are largest in the world.

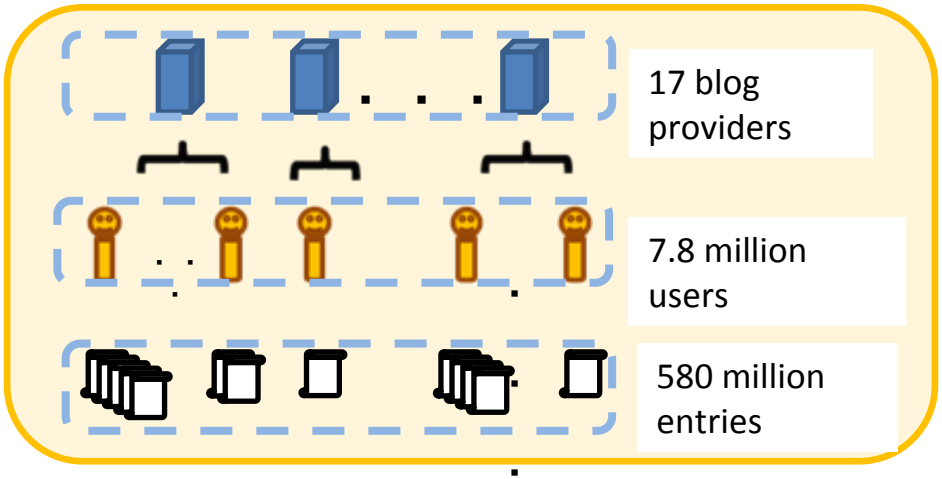


17 blog providers

7.8 million users

460 million entries/0.5y

Observation



Collaborating with Dentsu Inc and Hotto Link.

Physicists' view of economic phenomena

Huge amount of data 巨大なデータ

1st

Data analysis: Find empirical laws & Universal Phenomena

Discovery of empirical laws 法則性の発見

Why and how なぜ、どのように、を解明

2nd

Make models satisfying observation results

3rd

Use the model for prediction of the risk. Application to the real economy.

Prediction and control 予測と制御

Frontier of Econophysics

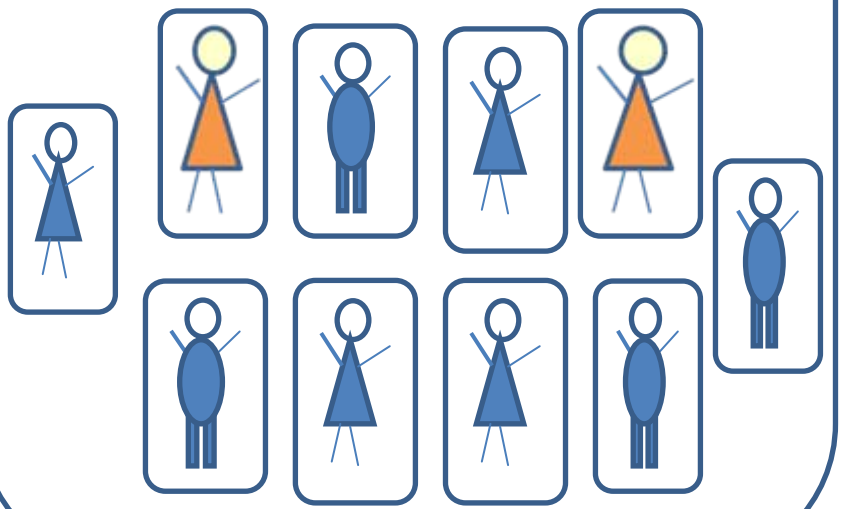
Key words

- random walk
- nonlinear dynamics
- fractals, power laws
- phase transition
- many-body interaction
- long-tail correlation
- network structures
- chain reaction
- collective human behaviors
- mass-psychology

Human ≠ molecule

Alone,
Act with individual decision, purpose.
Heterogeneous

Mass of independent individual
Random



Mass of strongly dependent individual (Mass psychology, collective human behavior, herding, etc.) **Laws**