The Future Of Financial System

Richard Olsen

Today

- Outdated financial system
- Overextended global economy

Next 10 Years

Global Transformation:

- New financial system based on distributed ledger technology
- Predictive technologies using Big Data powered by relativity theory of economics
- WikiFinClimate

Outline

- Distributed ledger technology
- Digital coins for everything
- One global Internet market
- Liquidity for coin markets
- Relativity theory of economics
- Liquidity investment strategies
- WikiFinClimate

Global Issues Today

- Financial crisis of 2008 is ongoing.
- Global quantitative easing, overexposed central banks, zero interest rates
- Initial market shocks: oil price, RUB, CHF
- Rapidly changing political map
- Environment
- Social issues

How Can We Address Challenges?

- Introspection…we need to reflect.
- Subtlety of biology
- Inspiration from history of natural sciences
- Ingenious modern technology
- Financial markets are nervous system.
- Innovation….let me explain…

What Is Desirable?

- Direct ownership
- People can pay with asset of their choice.
- Liquidity for all types of assets
- Price stability, no market excesses
- Informed society: powerful economic, environmental and political forecasting system as public service
- Self-equilibrating and sustainable society

Financial System Architecture

Financial System Today

- Financial system architecture is a pile of spaghetti....
- Historically grown - step by step computerization of manual business processes.
- Delivery and settlement of trades is batch based at t+2 days from time of trade.
- Every bank relies on its own book keeping. Institutions are islands – verification of trades is cumbersome.
- High uncertainty, multiplication of risk, big transaction costs and lack of liquidity and transparency.

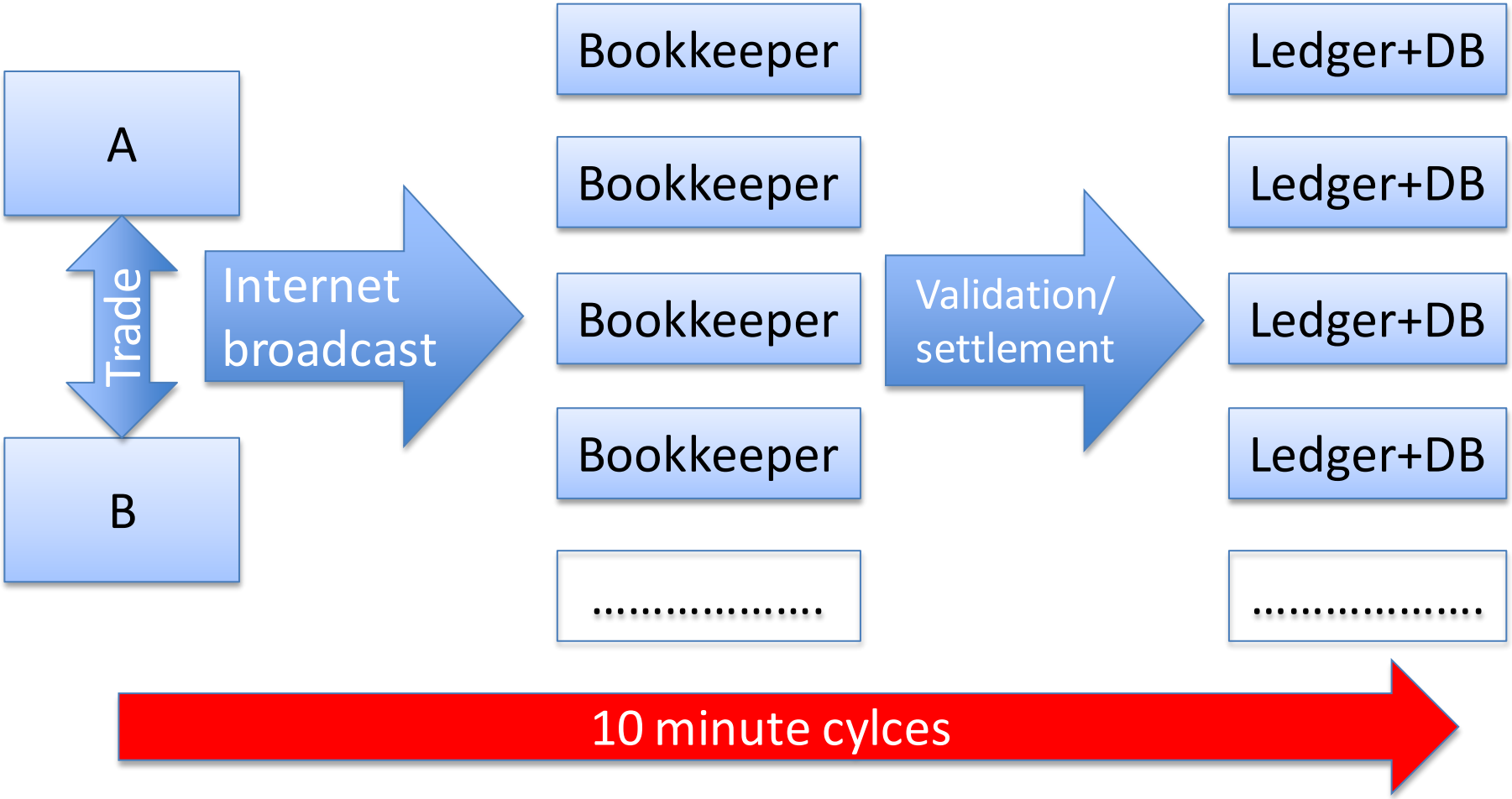
Distributed Ledger Technology

Bank of England Report Q3 2014:

Distribututed Ledger Technology (DLT) is biggest innovation since discovery of double bookkeeping.

Proof of concept:
Bitcoin (2009)
Variations (Litecoin, Ethereum, Ripple, etc).

Distributed Ledger Technology



DB stands for deposit box, where owner has private key.

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What Is Ledger?

- Record of transactions: digital coin with series number was sold by A to B , B now has a private key to digital coin and only B can initiate the next transaction.
- Ledger is like a long row of ‘deposit boxes’ (DB), each box with a private crypto key that can only be opened by person in possession of the private key.

Benefits of DLT

- Internet service
- No central authority
- Distributed bookkeeping
- N eyes are better than 2 eyes
- No double spending
- Direct ownership with private key
- Within 10 minutes fully settled
- Transparency, certainty and clarity

DLT: Digital Coins

Bitcoin (2009)

Colored Coins (2014)
Protocol to issue customized coins using DLT.
Bitcoin is used as ‚paper' to specify terms and conditions of coin.
Example: ECB issues EUR as colored coin, Fed issues USD as colored coin, or Citi issues USD, JPY or Apple shares.... as Citi_USD_coins, etc..

Colored Coins Are Certificates

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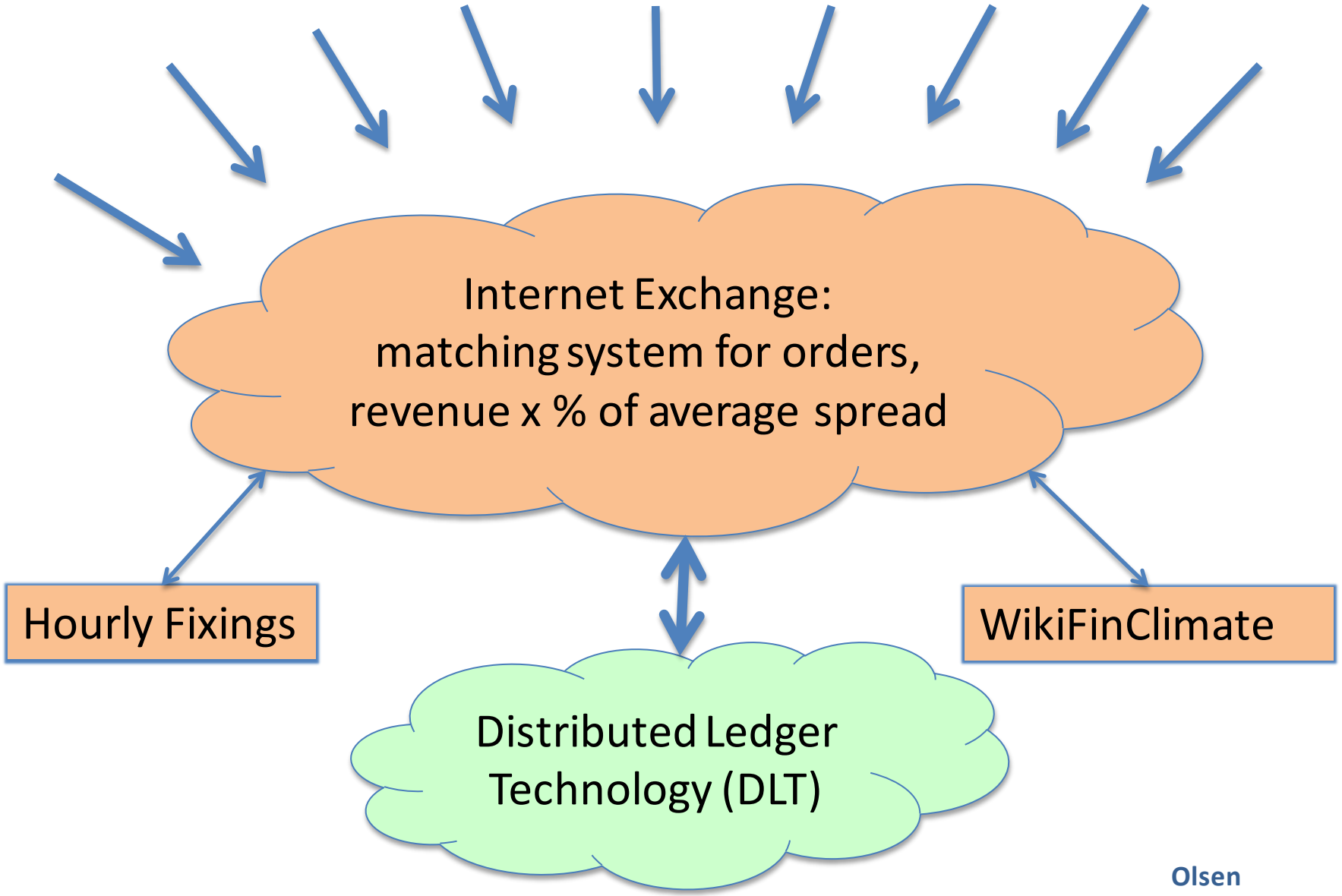
Internet Exchange



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Matching Engine

Objective: efficient price discovery

- Minimizing transaction costs
- Consolidation of liquidity
- Orderly queueing by all market participants
- Optimizing information flow

Price-Spread-Time Queueing

Spread is indicator for private information and powerful tool to shape expectations.

Matching engines need to reward market participants for revealing private information.

Effects Of Price-Spread-Time

- Not same as minimum lifetime of quotes
- Continuous reshuffling of queue, more stochastic
- Changes speed race
- Crossing of spread with one-sided prices
- Efficient price discovery low micro volatility

Benefits Of Internet Exchange

- 10 minute settlement
- Low transaction costs
- Any ticket size
- For any type of asset, claim or issuer
- Liquidity
- Efficient, fair, transparent
- Abitlity to exchange any asset into any other asset
- People can pay with any asset of their choice not just RUB, EUR, USD or BIT!

Financial Market Of Future

- One global Internet exchange
- Intraday interest rate yield curve
- Explosion of transaction volume
- Algorithmic and high frequency trading will account for 99.9% of volume: automation of decision making
- Direct ownership of assets
- Electronic exchange society
- Wave of innovation for retail and institutions

Predictive Technologies

Status Of Economics

- Economic models are used as a framework of discussion for debates, but not to hard wire decisions.
- How can we lower volatility of markets, so that they provide more added value to economy?
- Complexity and speed of markets require automated algorithm-based decision making.
- We need to come up with powerful models!

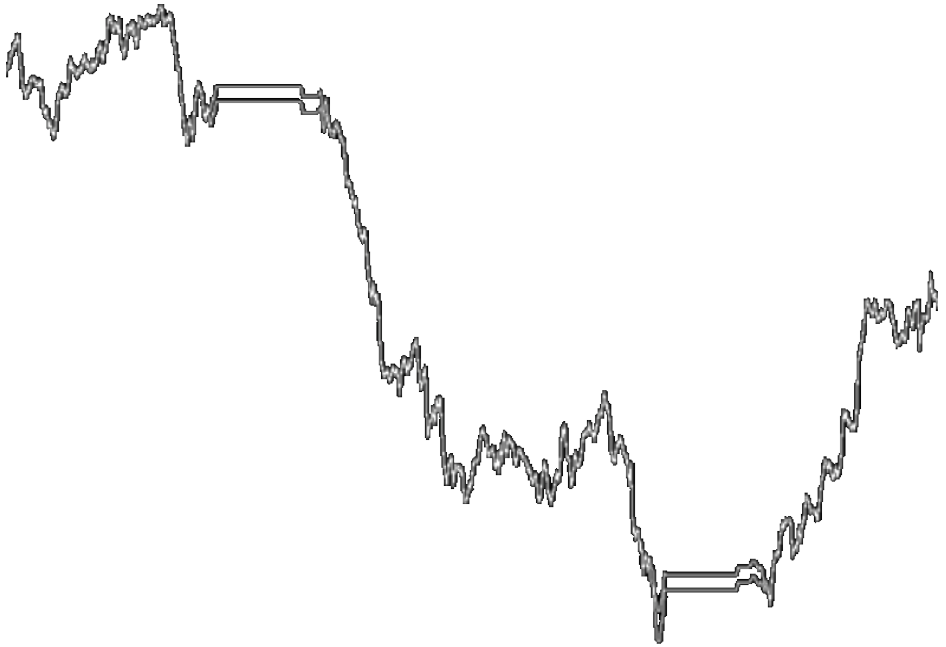
Fundamental Question

- Is economy ‚one' system in the sense of classical physics?
- Is economy a ‚multi-system problem' in analogy to relativity theory?
- Example of twin paradox

Necessity To Rethink Time:

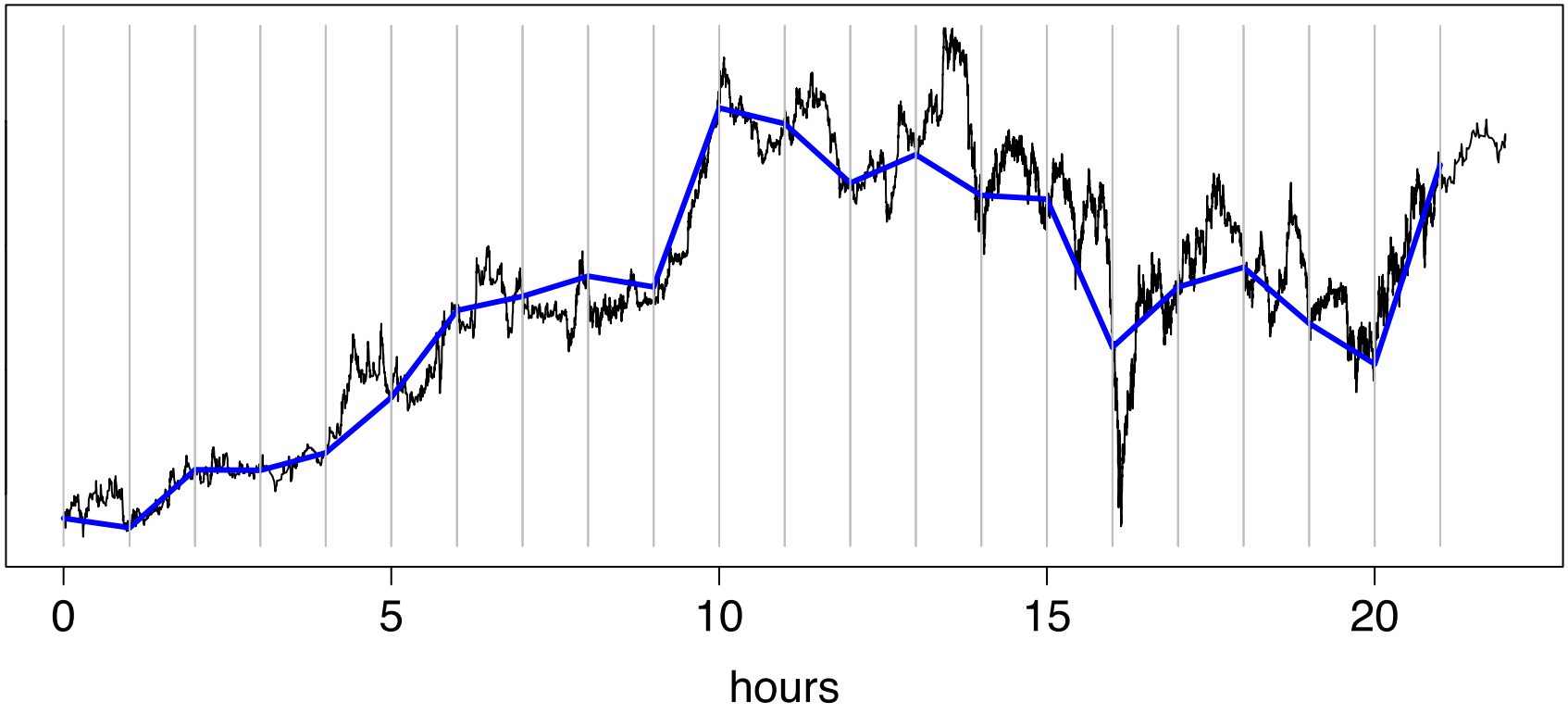
What is time?

How To Sample A Time Series?

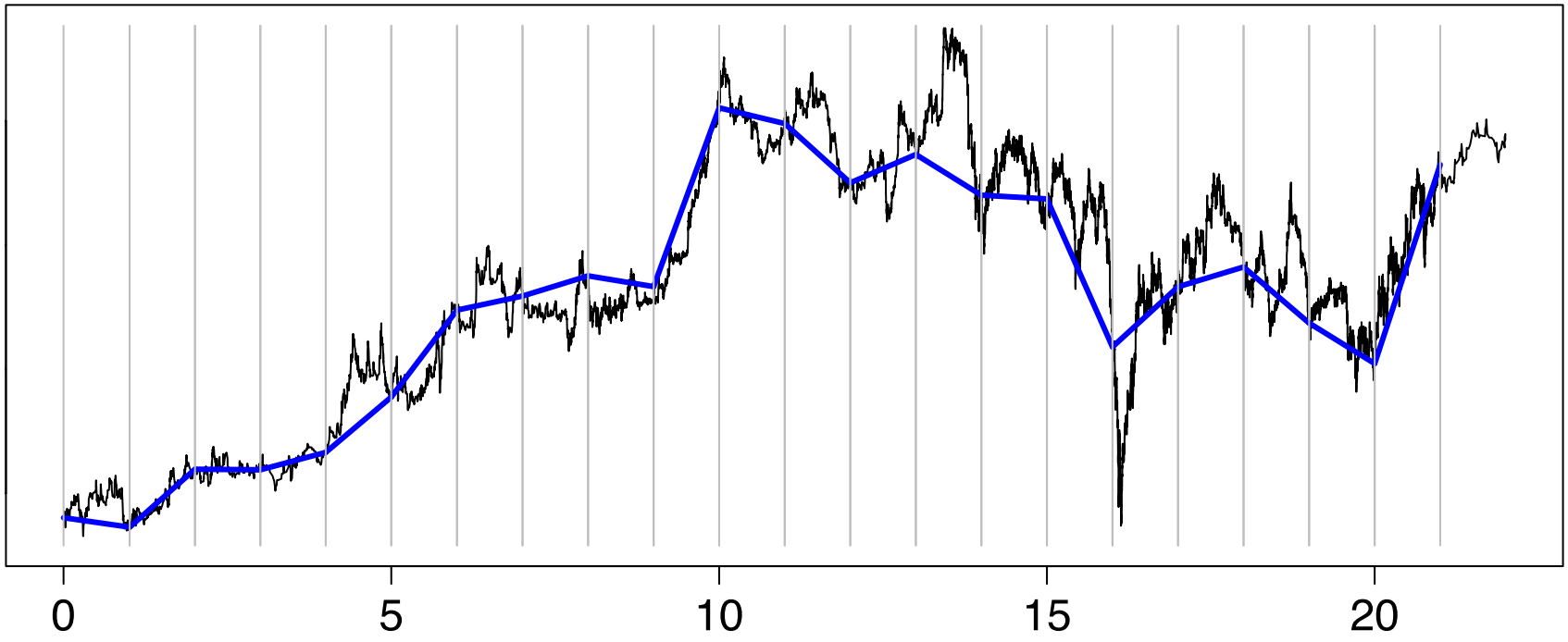


- Tick-by-tick?
- Every second?
- Every minute, hour, day, week, month…data?
- How to interpolate, if no data is available?

Data Mapping In Physical Time

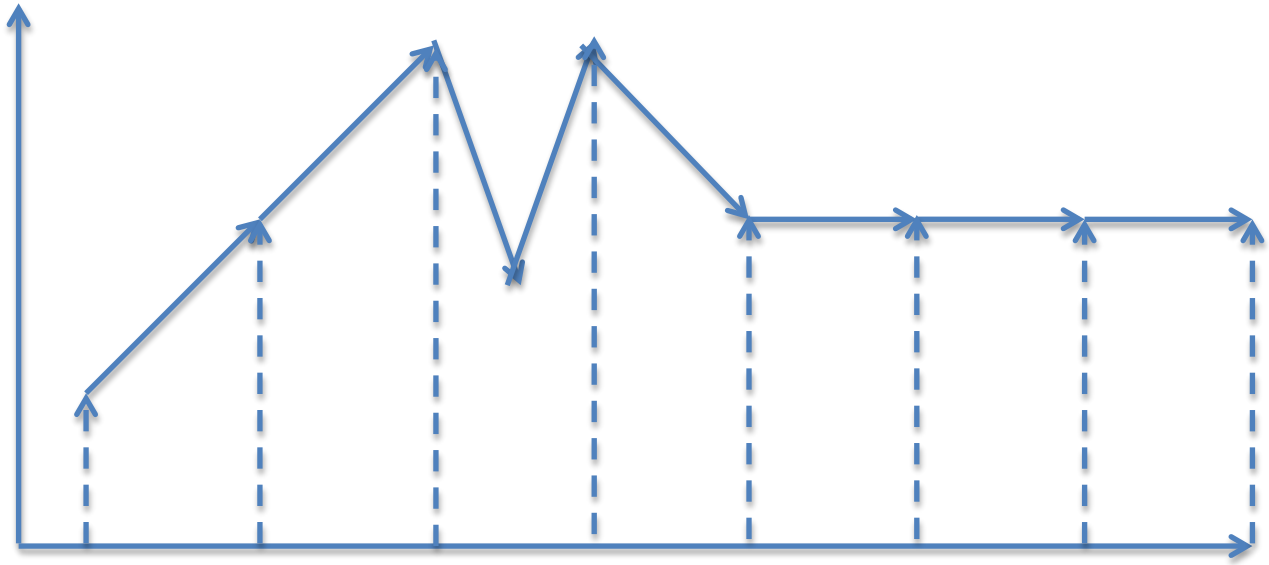


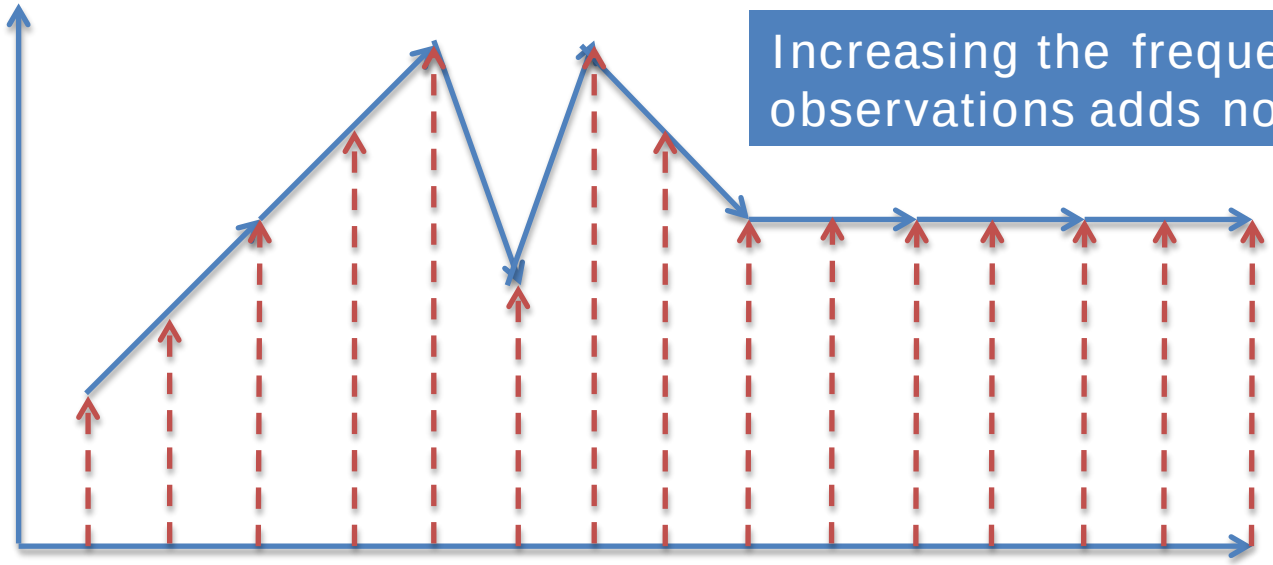
Physical Time Is Static



Mapping of data with physical time grid loses information about extremes.

Frequency Of Sampling





Increasing the frequency of observations adds noise.

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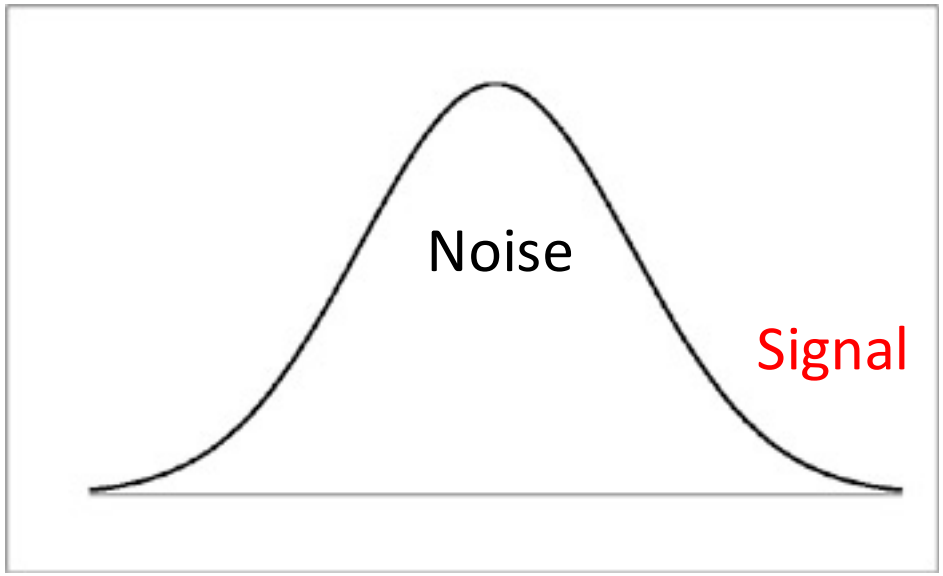
Increased Sampling Reduces Signal Quality



- Basic problem: information is in tails.
- Signal to noise ratio deteriorates with increased sampling.

Time Issues

- Sampling and testing in physical time
- Uniqueness of events
- Sampling frequency and length of coastline
- Consistent time aggregation for long and short-term
- Impact of seasonality and heatwave effects

Model quality is as good as definition of time.

10 reaserch papers or so discuss time...low citation number.

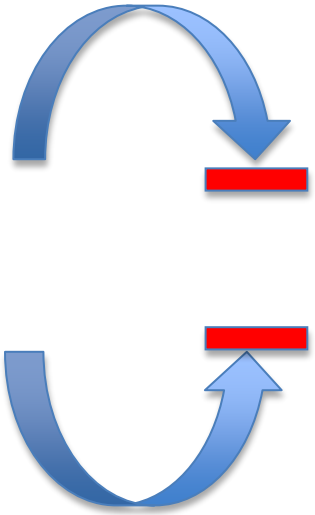
Physical Time

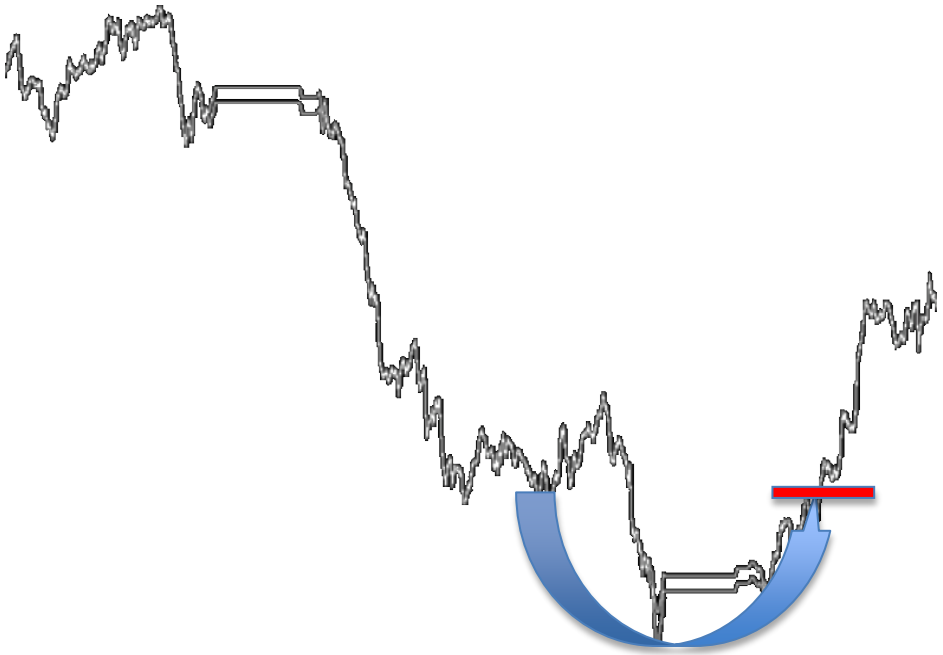
- Physical time maps the rotation of the earth.
- It is a uniform scale: X = (X_1, X_2, X_3 ….)
- Events have equal weights.
- There are fixed equidistant time intervals of 1 minutes, 1 hour, 1 day, 1 week.

New Definition Of Time

Event Time: Reversal From Extreme

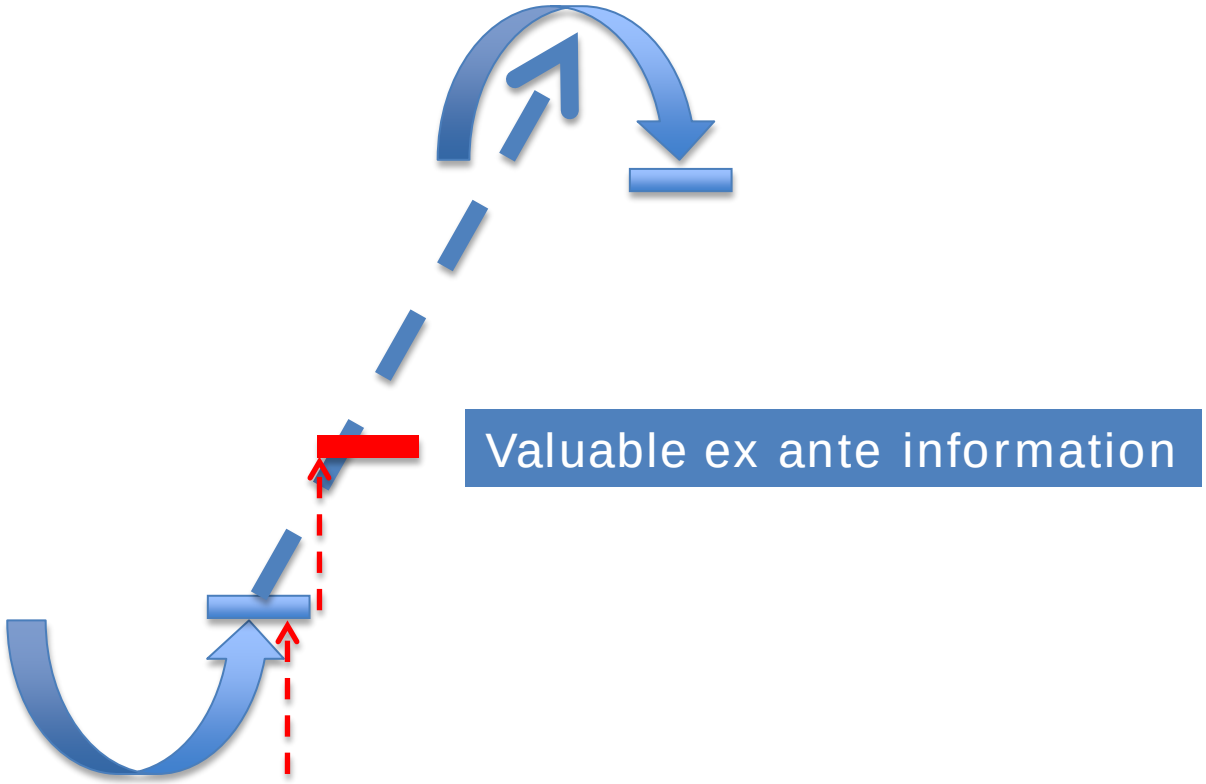
An event is defined as a price reversal from extreme by x %.





In our papers we call a price reversal a directional change.

Empirical Evidence



Overshoots are on average equal to threshold; this is true for all observed thresholds: scaling law.

Established Scaling Laws

Müller *et al.*, *J. Bank Finance*, 1990:

Mean absolute change of mid-price to time

$$\langle |\Delta x| \rangle_p = \left(\frac{\Delta t}{C_x(p)} \right)^{E_x(p)}$$

$$\text{where } \langle x \rangle_p = \left(1/n \sum_{j=1}^{n} x_j^p \right)^{1/p} \quad p = \{1; 2\}$$

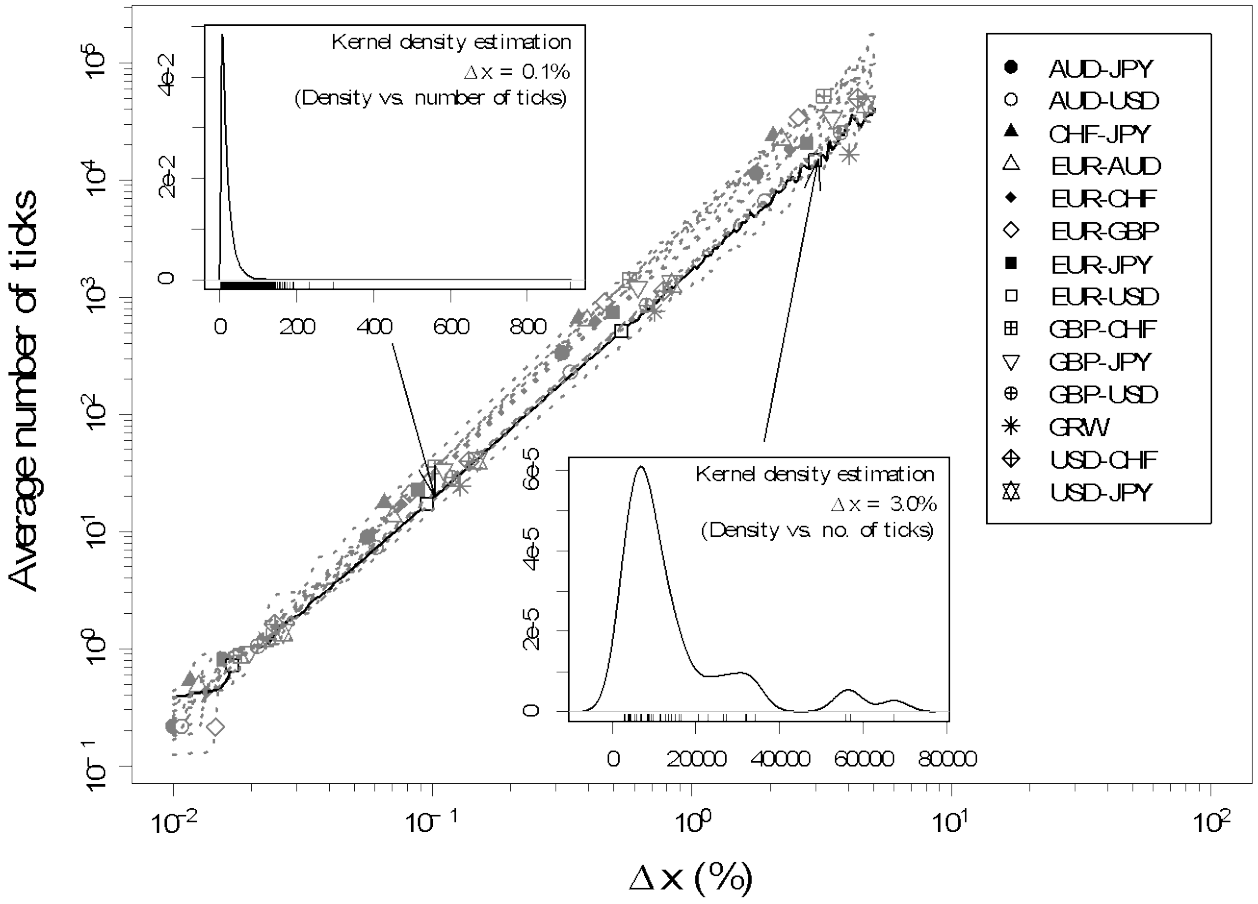
Guillaume *et al.*, *Finance Stoch.* 1997:

Number of directional changes to thresholds

$$\mathsf{N}(\Delta x_{dc}) = \left(\frac{\Delta x_{dc}}{C_{\mathsf{N},dc}} \right)^{E_{\mathsf{N},dc}}$$

New: Tick-Count Scaling Law

$$\langle \mathrm{N}(\Delta x_{tck}) \rangle = \left(\frac{\Delta x}{C_{\mathrm{N},tck}} \right)^{E_{\mathrm{N},tck}} \qquad \text{where } \Delta x_{tck} = 0.02\%$$



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Other New Scaling Laws

Decomposing total price move into directional-change and overshoot:

$$
\begin{aligned}
\langle|\Delta x^{tm}|\rangle &= \langle|\Delta x^{dc}|\rangle + \langle|\Delta x^{os}|\rangle, \\
\langle\Delta t^{tm}\rangle &= \langle\Delta t^{dc}\rangle + \langle\Delta t^{os}\rangle, \\
\langle \mathrm{N}(\Delta x^{tm}_{tck})\rangle &= \langle \mathrm{N}(\Delta x^{dc}_{tck})\rangle + \langle \mathrm{N}(\Delta x^{os}_{tck})\rangle
\end{aligned}
$$

Leads to 9 additional scaling laws:

$$
\begin{aligned}
\langle|\Delta x^{*}|\rangle &= \left(\frac{\Delta x_{dc}}{C_{x,*}}\right)^{E_{x,*}} \\
\langle\Delta t^{*}\rangle &= \left(\frac{\Delta x_{dc}}{C_{t,*}}\right)^{E_{t,*}} \\
\langle \mathrm{N}(\Delta x^{*}_{tck})\rangle &= \left(\frac{\Delta x_{dc}}{C_{\mathrm{N},*}}\right)^{E_{\mathrm{N},*}}
\end{aligned}
$$

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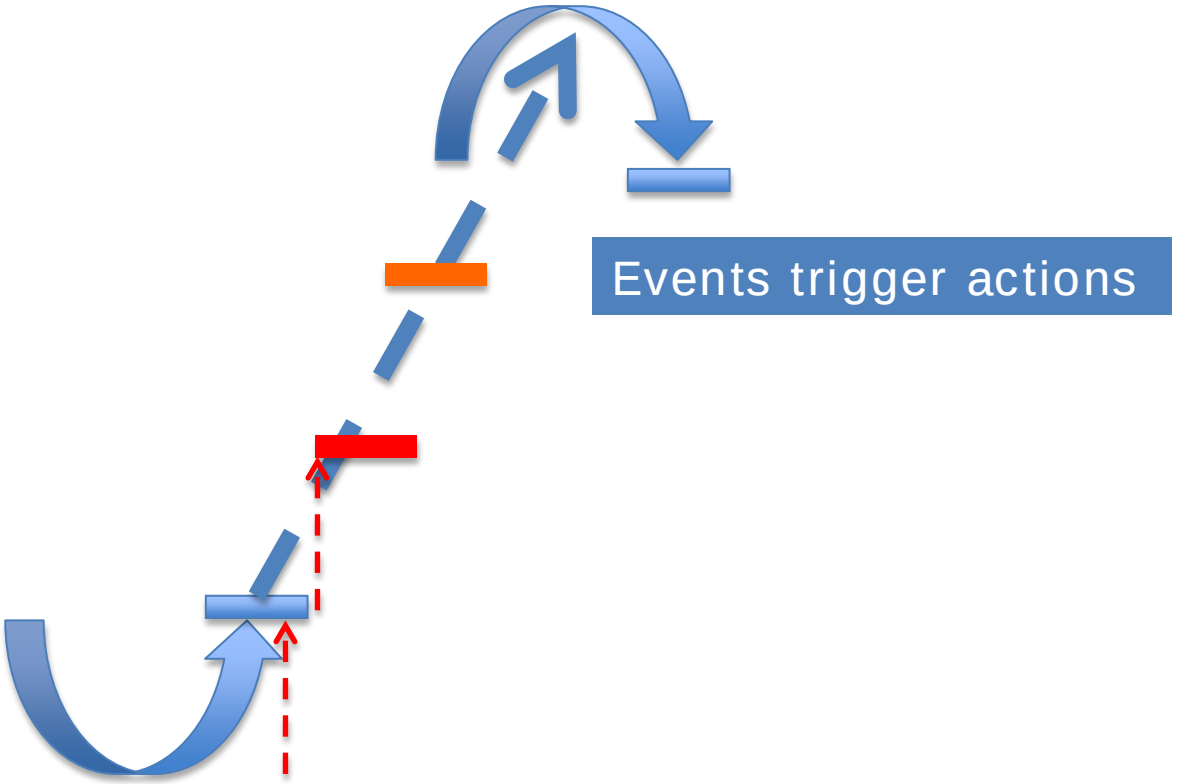
Why Do Scaling Laws Exist?

- Uncertainty principle between systems.
- Information transmission between systems.
- Relativity theory of interacting systems.

Why Are Scaling Laws Important?

- Scaling laws establish average relationships between variables.
- Grid of scaling laws is a dynamic frame of reference to relate different variables to each other.
- In the new model approach scaling laws are the equivalent of the fundamental value.
- Scaling laws are used to specify behavior of agents, for example to develop predictive models and implement investment strategies.

Event Language For Agent Models



We use threshold levels of overshoot as event trigger for behavior of agents.

Algorithms For Trading/Investing

- Development of agent based models for economics and finance
- How can investment strategies generate consistent profits? Strategies that provide 'liquidity' and stabilize market prices, add value to economic system as a whole. Profits are a reward for this activity.
- Applications: market making models, investment strategies, new investment products, forecasting services.
- Last but not least: central bank can launch dynamic market stabilization strategies.

WikiFinClimate

- We need global information system to link information.
- Build ‘Wikipedia’ for BigData:
  - Online Internet platform
  - Event programming language
  - Crowd based model development
  - Service public
  - Input to decentralized applications

What To Take Away?

We have answers to the present crisis: we are not helpless:

- Central banks can adopt stabilizing market strategies, instead of traditional 'buy and hold' – they 'buy and sell' to support liquidity and prevent excessive overshooting.
- Colored coins are efficient mechanism to reform financial system.
- BigData – WikiFinClimate
- ……

Outlook

Next 10 years – complete transformation of financial system with direct ownership of assets and recycling of financial market energy thanks to

- One global Internet exchange for digital colored coins
- Powerful predictive technologies
- WikiFinClimate

Let us make our dreams come true!