Statistical laws of JGB price and exogenous shock

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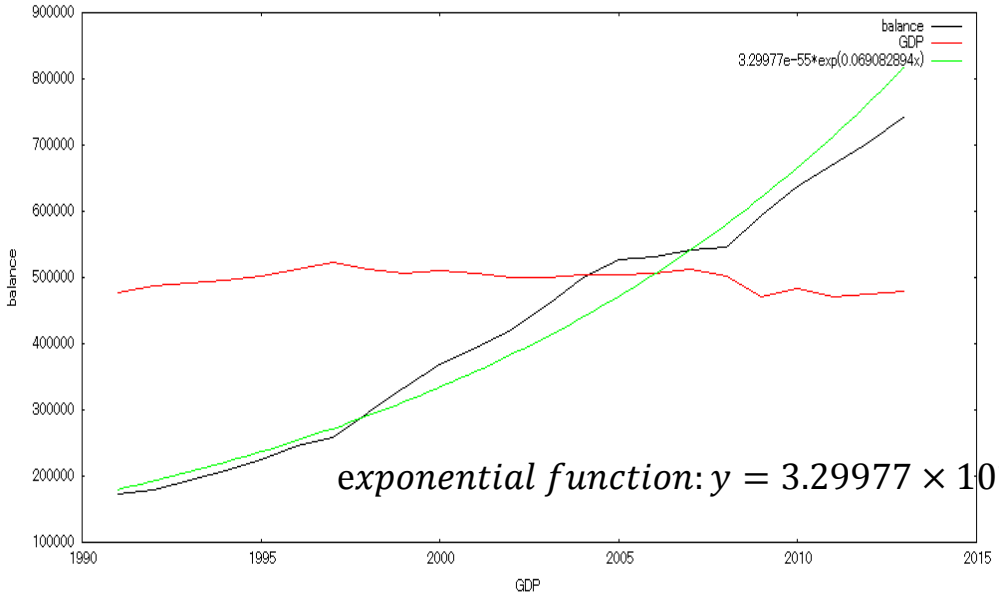
1. Motivation
2. Comparison of JGB futures and spot in daily
3. Statistical laws of JGB futures price
4. Correlation between JGB and news
5. Summary

1. Motivation



$$exponential\ function: y = 3.29977 \times 10^{-55} exp(0.069082894x)$$

Fig.1a Japanese government debt (black) GDP(**red**) (1991~2013)

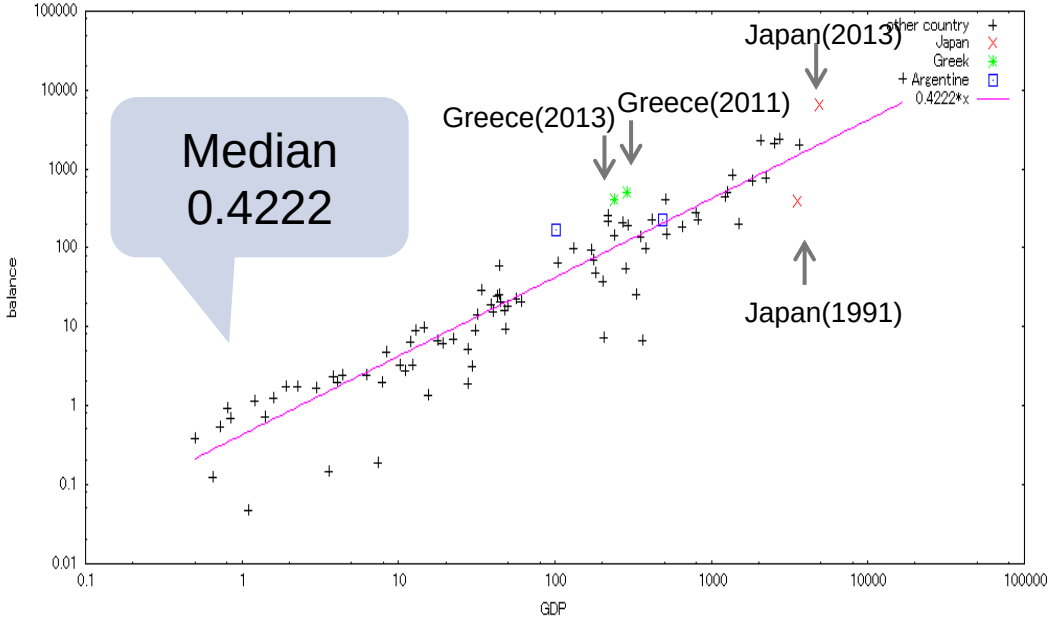


Fig.1b Government debt per GDP (2013)

2. Comparison of JGB futures and spot in daily

◎futures and spot

Spot : JGB spot is traded by several banks and insurance companies.

Futures : JGB futures is listed on the Tokyo Stock Exchange, so trading volume is larger than JGB spot.

I want to check that futures and spot move together.

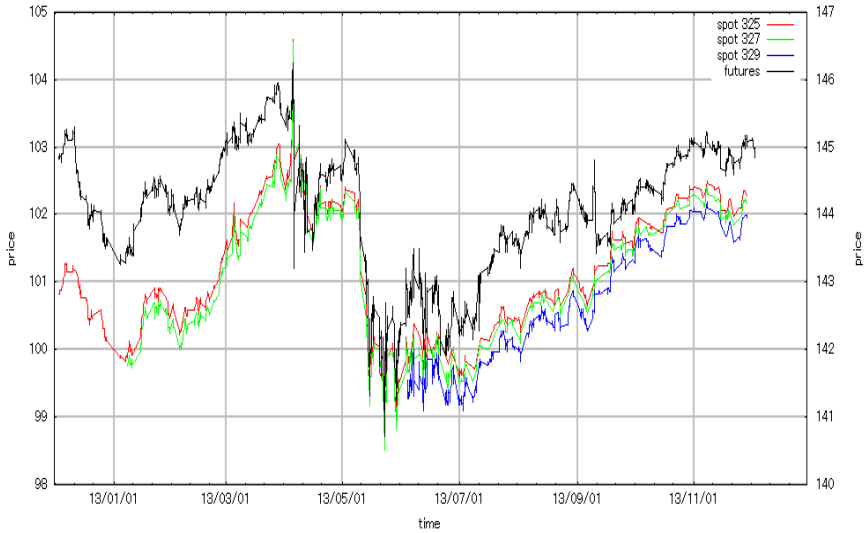


Fig.2a price of JGB futures(black) and spot 2012/12/03~2013/11/29 (every minute)

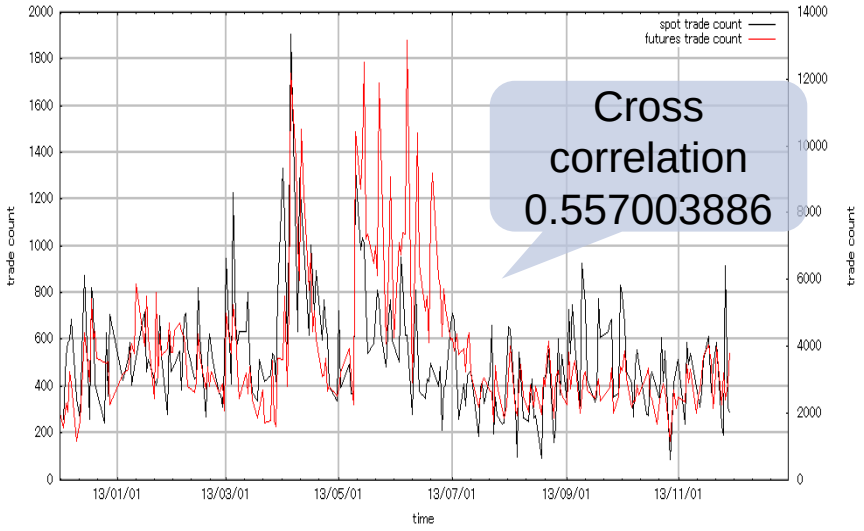


Fig.2b trading count of JGB futures(red) and spot(black) 2012/12/03~2013/11/29 (daily)

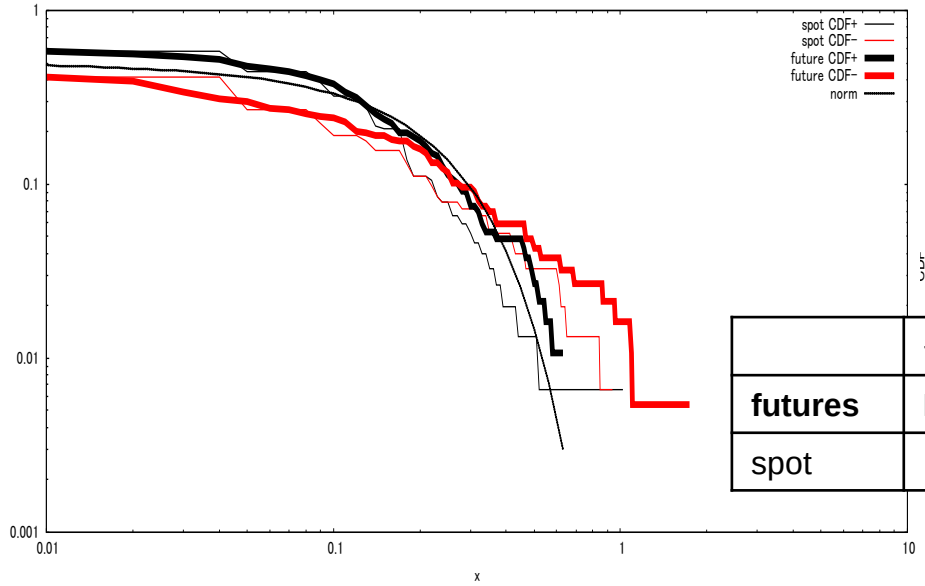


Fig.2c price change CDF (every 1 day)

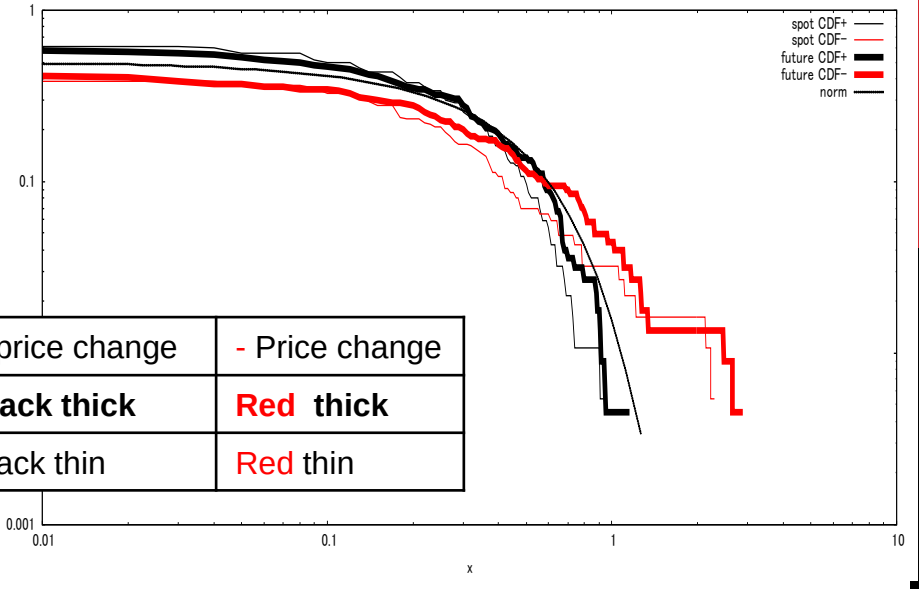


Fig.2d price change CDF (every 7 days)

	+ price change	- Price change
futures	**Black thick**	**Red thick**
spot	Black thin	Red thin

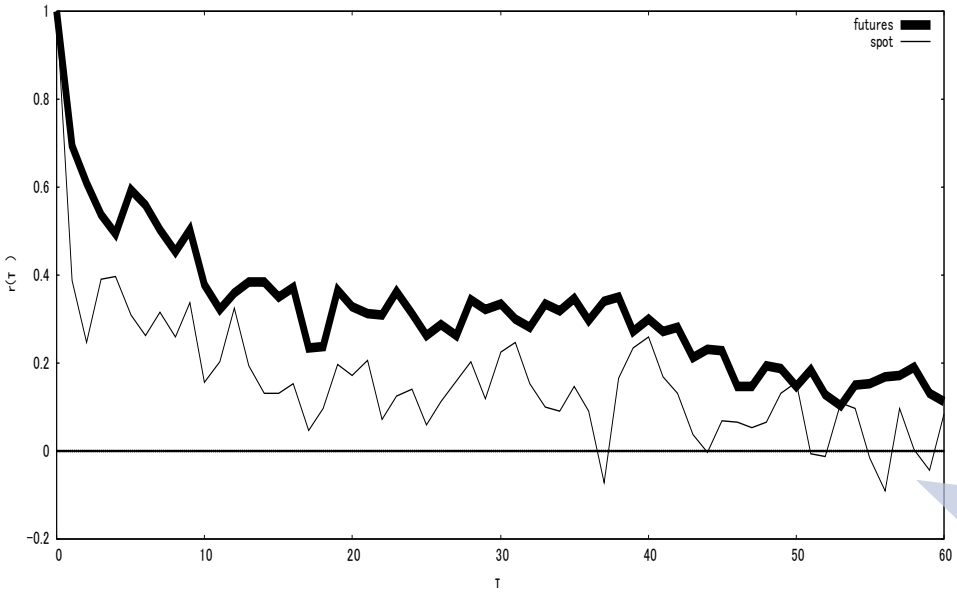


Fig.2e autocorrelation of trade count time series (0 ~ 60 days)

$$P(\geq x) \equiv n(\geq x)/N$$

x: price change

$n(\geq x)$: frequency above x

N: amount

$$r(\tau) \equiv \frac{\langle C(t) \times C(t+\tau)\rangle - \langle C(t)\rangle\langle C(t+\tau)\rangle}{\sigma(C(t)) \times \sigma(C(t+\tau))}$$

C(t):trade count

τ: time difference (day) $\quad \tau \in \{0,1,2,\cdots,60\}$

$\sigma(C(t))$:standard deviation

3. Statistical laws of JGB futures price

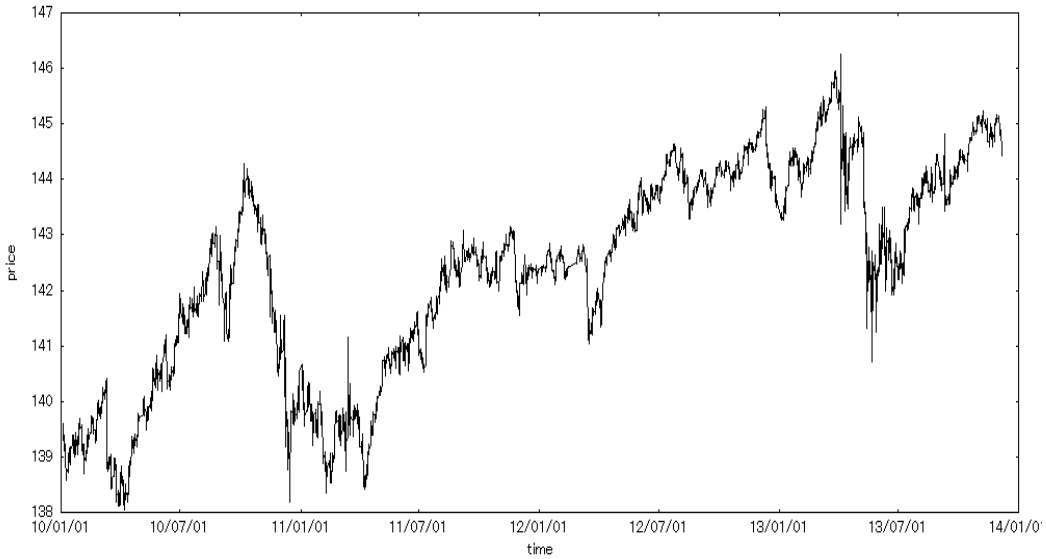
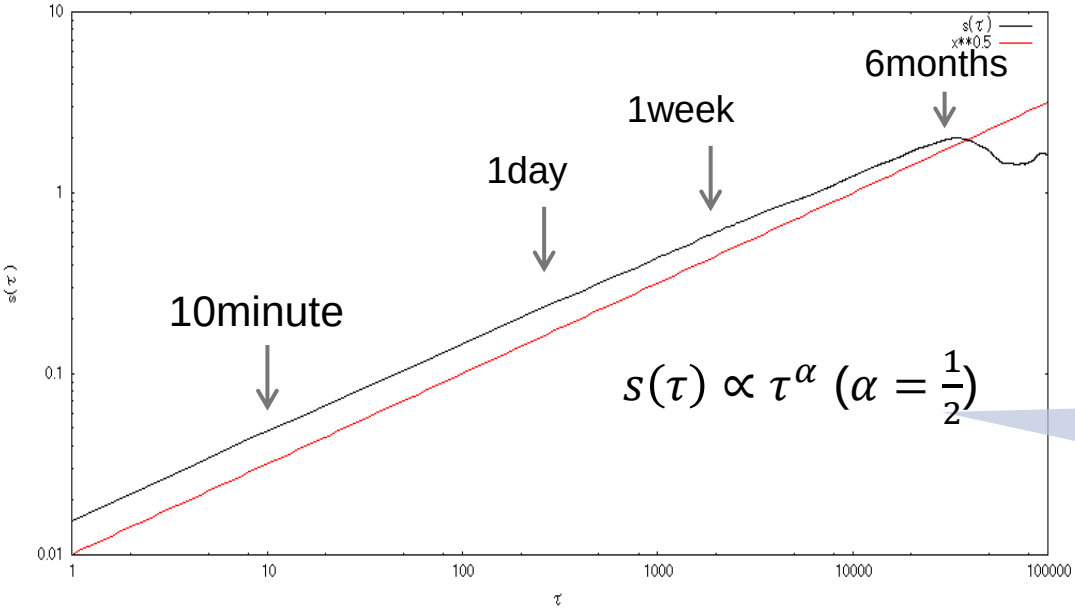


Fig.3a JGB futures price time series every 1 minute (2010/01/01~2013/11/29)



$$s(\tau) \equiv \sigma(p(t+\tau) - p(t))$$

$t: time(minute)$

$p(t): price$

$\tau: time\ change(minute)$

Equal to stock price Hurst exponent

※Trade time in a day is 270 minute

※Trade day in a week is 5 days

Fig.3b standard deviation of JGB price change

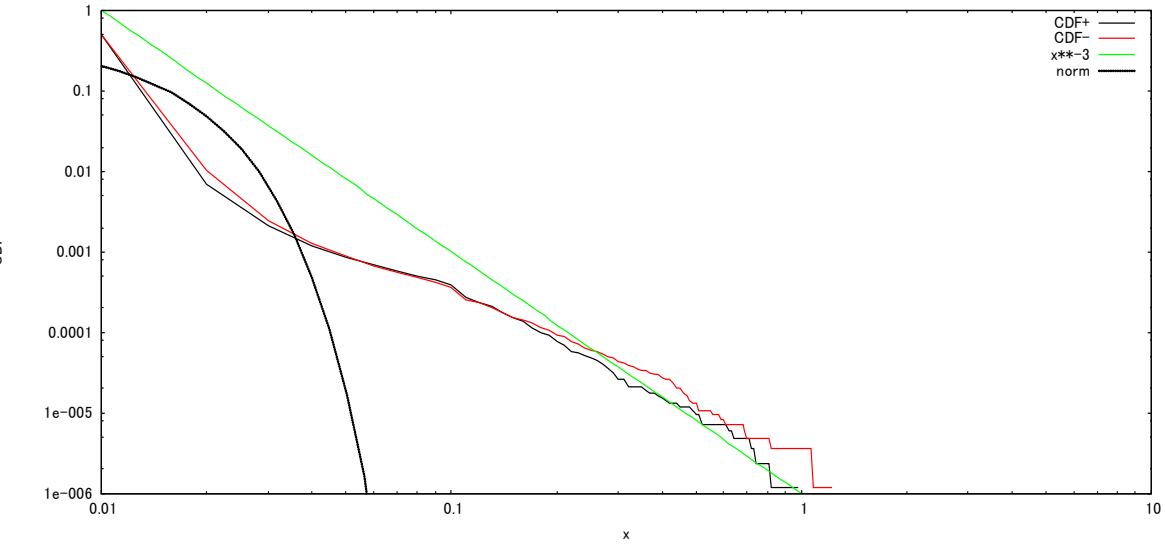


Fig.3c CDF of JGB price change (every tick)

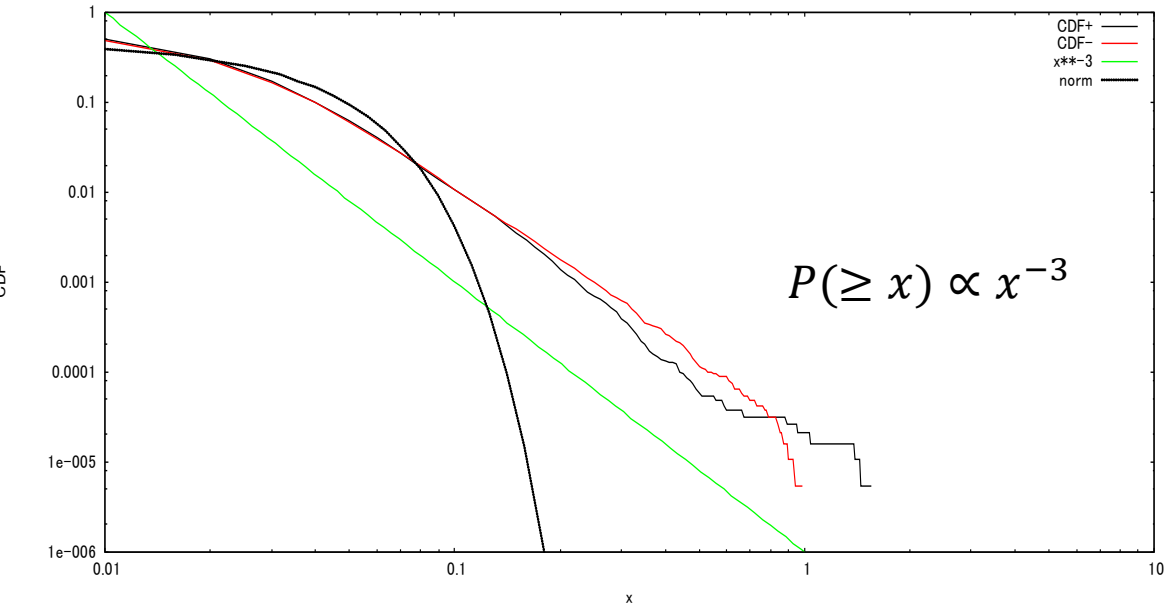


Fig.3d CDF of JGB price change (every 10minutes)

$$P(\geq x) \equiv n(\geq x)/N$$

$n(\geq x)$: $frequency\ above\ x$

N: $amount$

4. Correlation between JGB and news

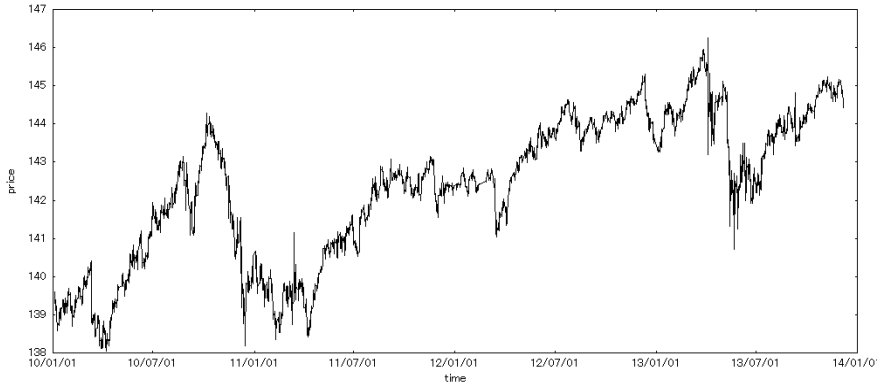


Fig.4a JGB futures price time series every 1 minute (2010~2013)

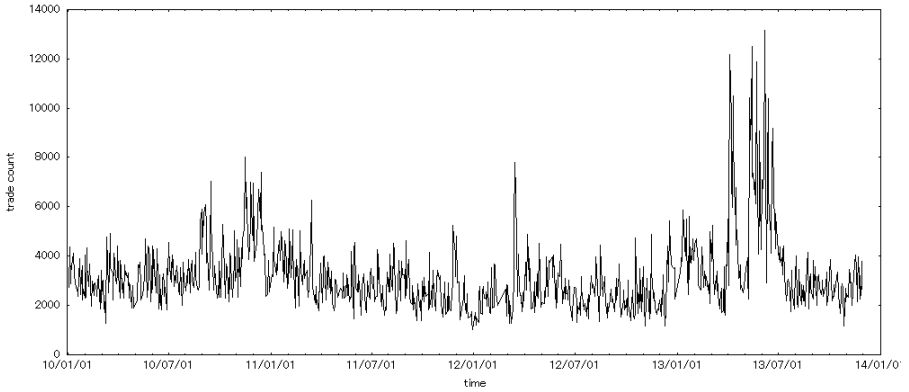


Fig.4b JGB trade count time series every 1day (2010~2013)

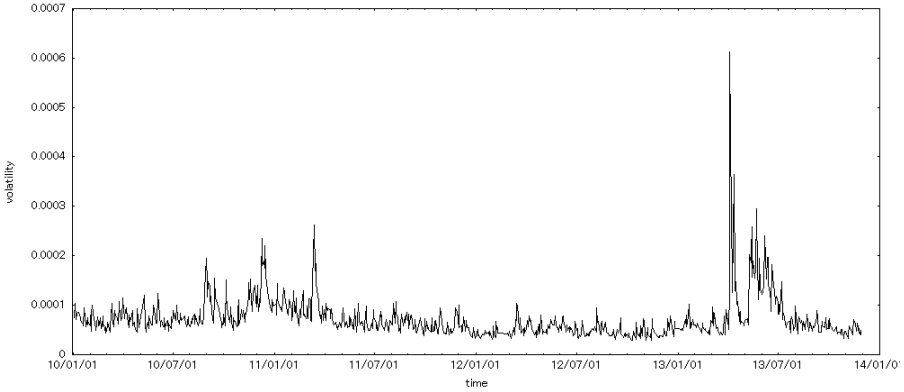


Fig.4c JGB price volatility time series every 1day (2010~2013)

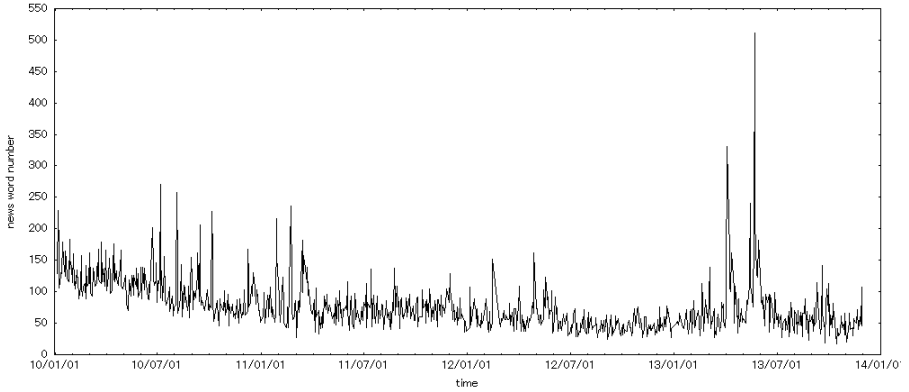
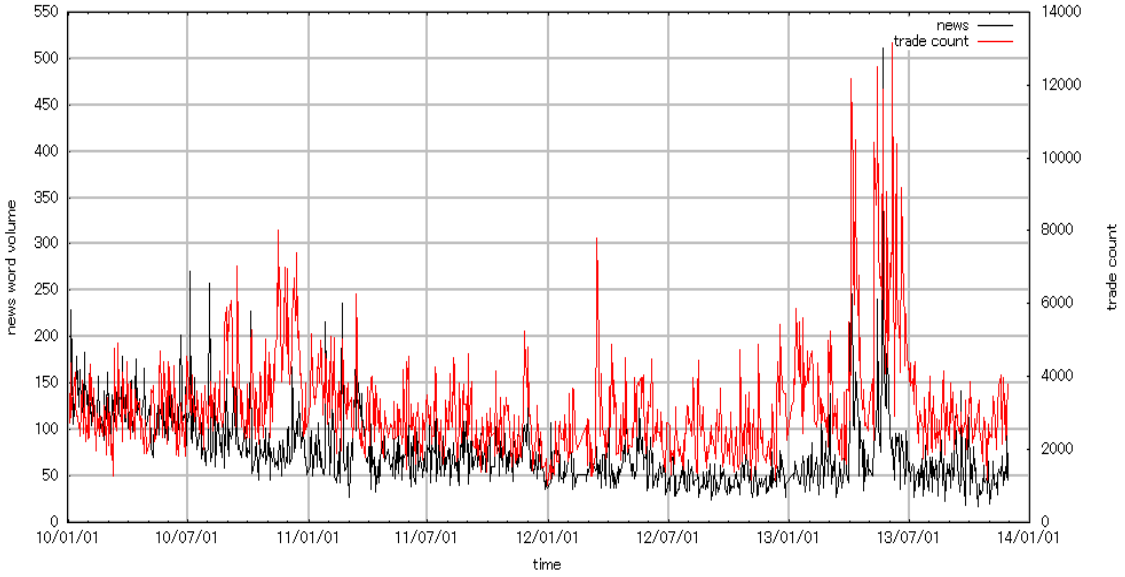


Fig.4d News time series every 1day (2010~2013)

$$u_j = \log \frac{p_j}{p_{j-1}} \quad p_j : price$$

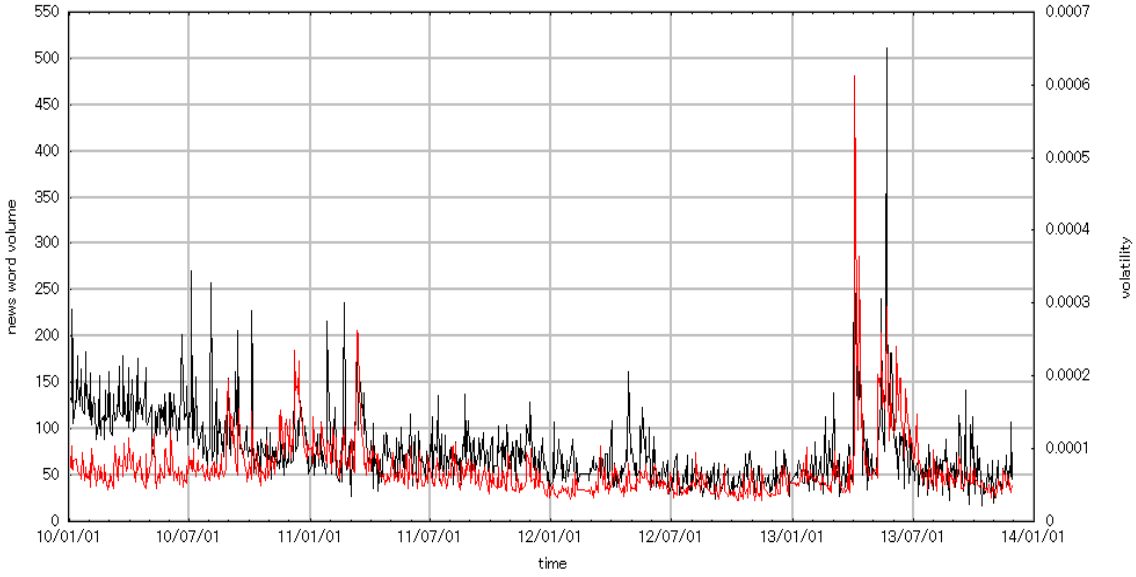
$$V_i = \sqrt{\langle u^2 \rangle - \langle u \rangle^2}, \; V_i : volatility$$

frequency of words “Japanese government bond”, “jgb” and “jgbs”



Cross correlation 0.36945513

Fig.4e News(black) and trade count(**red**)



Cross correlation 0.48656395

Fig.4f News(black) and volatility(**red**)

5. summary

- Statistical laws of JGB price is similar to stock price
- JGB react to exogenous shock (News)