Données haute fréquence

Analyse et modélisation statistique multi-échelle de séries chronologiques financières

Cours de Master - Paris 6

Transparents de la Partie IV :

Séries financières hautes fréquences

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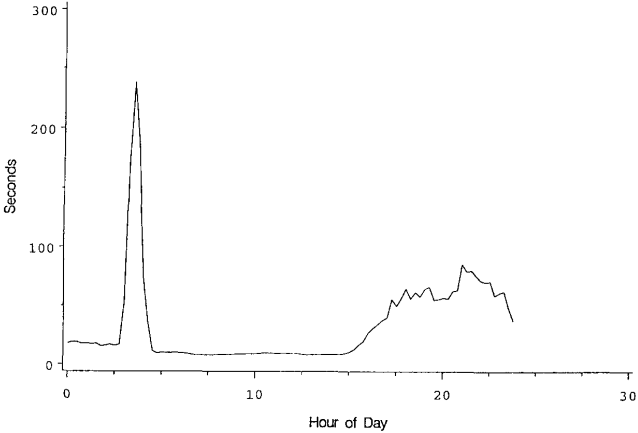

Fig. 1. Expected quote duration conditioned on time of day.

Robert F. Engle, Jeffrey R. Russell
Forecasting the frequency of changes in quoted foreign exchange prices with the autoregressive conditional duration model, Journal of Empirical Finance 4 (1997) 187-212.

	acf
lag 1	0.083
lag 2	0.076
lag 3	0.064
lag 4	0.053
lag 5	0.059
lag 6	0.048
lag 7	0.050
lag 8	0.038
lag 9	0.048
lag 10	0.040
lag 11	0.049
lag 12	0.043
lag 13	0.039
lag 14	0.040
lag 15	0.042

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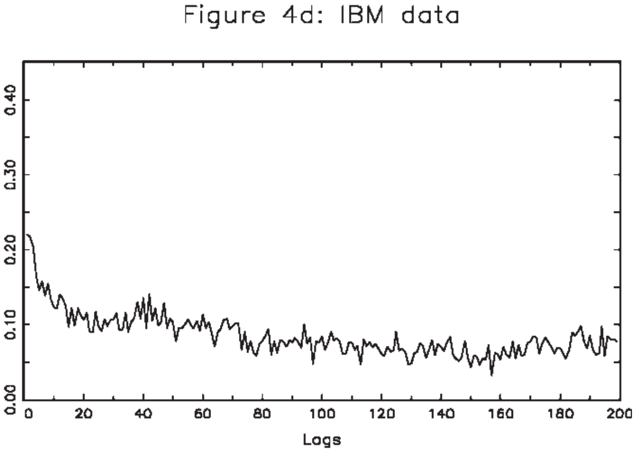

L. Bauwens,P. Giot
The Logarithmic ACDModel : An Application to the Bid-Ask Quote Process of Three NYSEStocks
Annales d'économie et de statistique 60 (2000)

Key issue : (historical) variance/covariance estimation

- diffusion processes : better estimates at fine scales
  $\Rightarrow$ one should use high frequency data (tick data)
- **However** : microstructure noise
  - Price processes are point processes
  - Prices "live" on a *tick grid*
  - **Strong mean reversion at very small scales**
  - Some references

    In economics : Roll (1984) [Roll model], Glosten (1987), Glosten et Harris (1988), Harris (1990)
    In statistics and econometrics : Gloter and Jacod (2001), Ait-Sahalia, Myland et Zhang (2002-2006)

Microstructure (and (co)variance estimation)

Key issue : (historical) variance/covariance estimation

- diffusion processes : better estimates at fine scales
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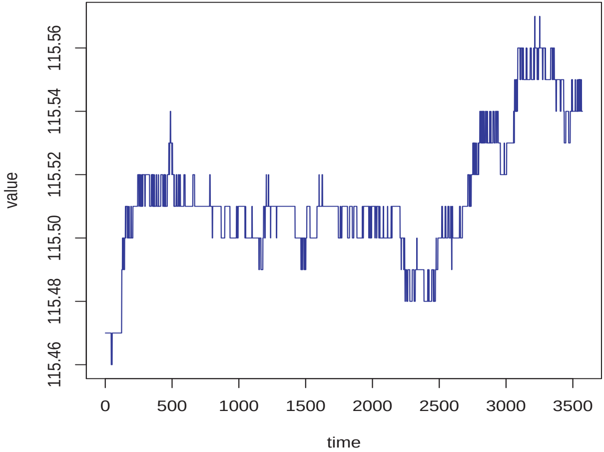


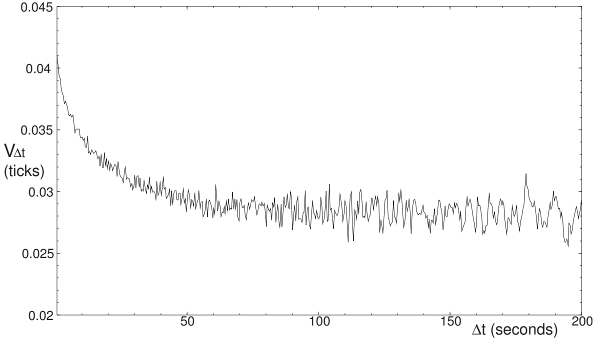
FIGURE: Bund 10Y, 6 Feb 2007, 09 :00–10 :00 (UTC) 1 data per second.

Stylized facts of microstructure noise

Two *stylized facts* of microstructure noise

- **signature plot**
  $\rightarrow$ variance estimators increase when going to high frequency
- **Epps effect** (Epps, 1979)
  $\rightarrow$ correlation estimators go to 0 when going to high frequency

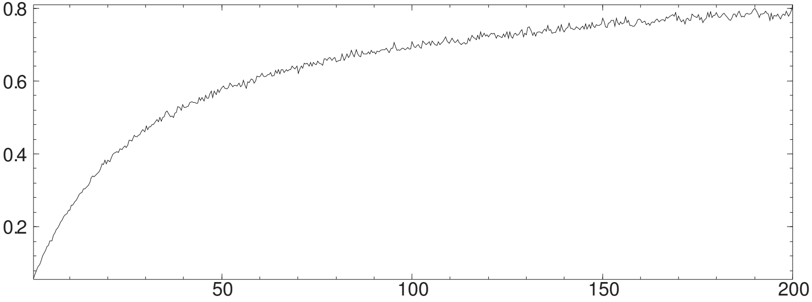
Signature Plot



$$V_{\Delta t} = \sum_{n=0}^{1day/\Delta t} |X((n+1)\Delta t) - X(n\Delta t)|^2$$

Bund 10Y, 21 jours (9-11 am), Last traded price
Données fournies par QuantHouse

Epps effect



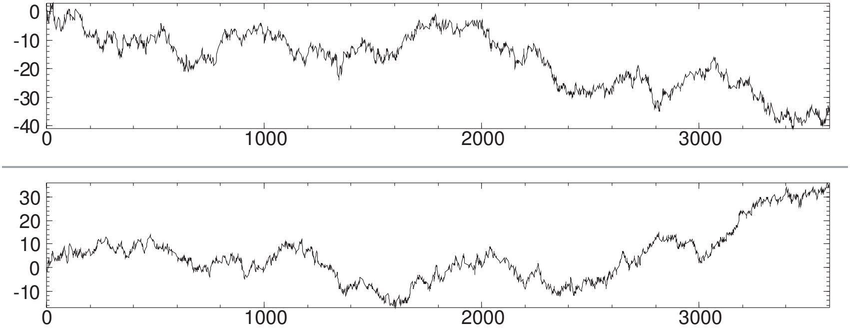
Corrélation : $C_{\Delta t} = \tilde{C}_{\Delta t}/\tilde{C}_0$, avec

$$\tilde{C}_{\Delta t} = \sum_{n=0}^{1day/\Delta t} (X((n+1)\Delta t) - X(n\Delta t))(Y((n+1)\Delta t) - Y(n\Delta t))$$

Bund 10Y - Bobl 5Y - 40 jours - 9-11 am

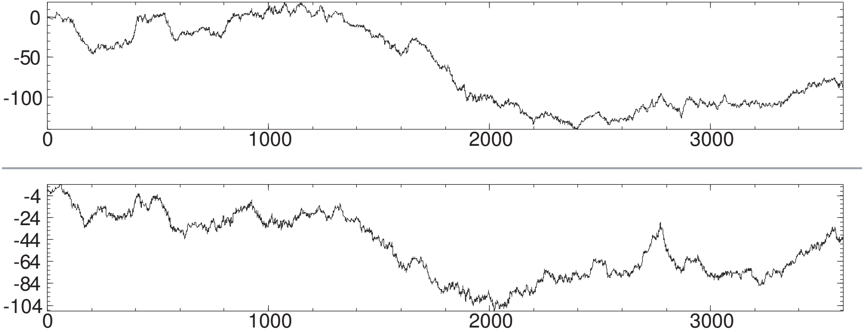
Donnée fournies par QuantHouse

2d MEP Model Simulation (correlation = 10%)



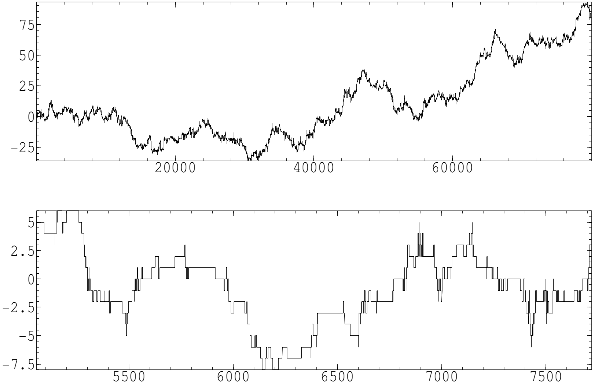
E.Bacry, S.Delattre, M.Hoffmann, J.F.Muzy (2010,2012)

2d MEP Model Simulation (correlation = 80%)



E.Bacry, S.Delattre, M.Hoffmann, J.F.Muzy (2012)

1d MEP Model Simulation over 10 hours + Zoom on 1h

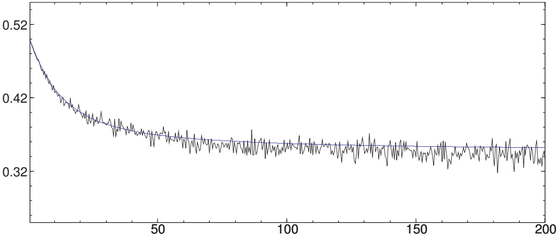


Microstructure "Stylized facts"

⟶ Point processes (Hawkes) diffusing at large scales

⟶ Prices "live" on a *tick grid*

⟶ Strong mean reversion at very small scales

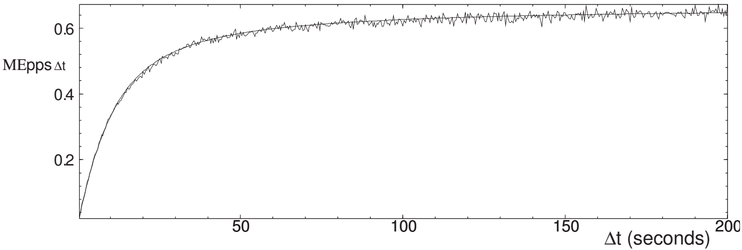


Signature plot pour le modèle MEP (Bacry, Delattre, Hoffmann, Muzy, 2010, 2012) :

$$E(V_{\Delta t}) = \Lambda \left[\nu^2 + (1-\nu^2) \frac{1-e^{-\gamma \Delta t}}{\gamma \Delta t} \right], \qquad (1)$$

où $\Lambda = \frac{\mu}{1-||\phi||_1}$, $\nu = \frac{1}{1+||\phi||_1}$ and $\gamma = \alpha + \beta$

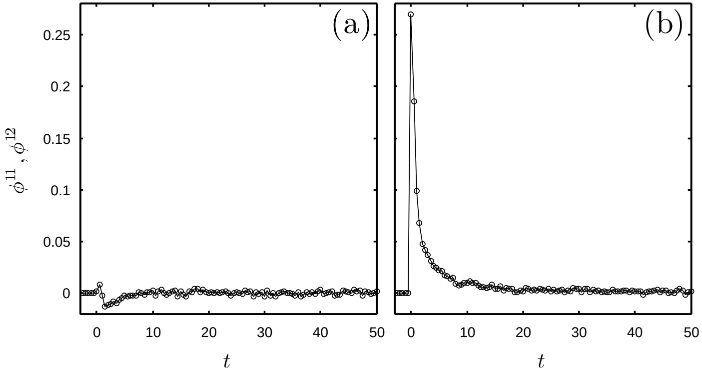
- $E(V_{\Delta t=0}) = \Lambda = 2E(\lambda^{\pm}) =$ "microstructural" variance
- $E(V_{\Delta t=+\infty}) = \Lambda \nu^2 =$ "diffusive" variance



Epps effect pour le modèle MEP (Bacry, Delattre, Hoffmann, Muzy, 2010, 2012) :

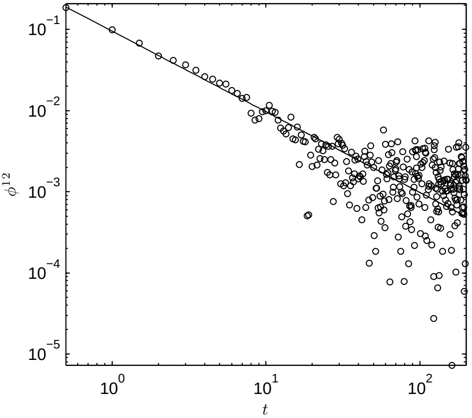
Non parametric kernel estimation in MEP model on Bund Futures
Al Dairy, Bacry,Muzy, 2011

$\simeq$ 375000 jumps



(a) : Self exciting kernel $\phi^{N,s}$ estimation
(b) : Cross exciting kernel $\phi^{N,c}$ estimation

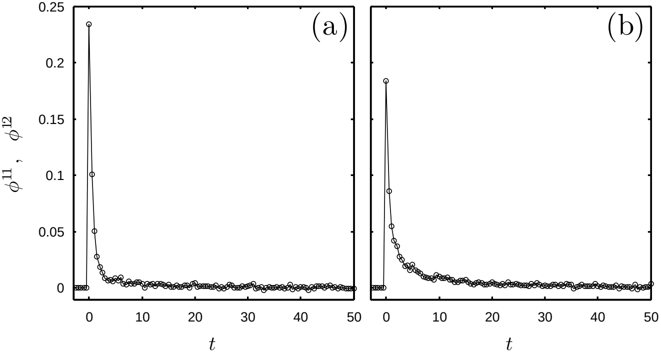
Log-log plot of the cross exciting kernel $\phi^{N,c}$ estimation
Al Dairy, Bacry,Muzy, 2011



Power-law fit $\phi^{N,c}(t) \sim t^{-\beta}$ with $\beta \simeq 1$

Non parametric kernel estimation in MEP model on Bund Futures
Al Dairy, Bacry,Muzy, 2011

$\simeq$ 624000 jumps



(a) : Self exciting kernel $\phi^{N,c}$ estimation
(b) : Cross exciting kernel $\phi^{N,c}$ estimation

Accounting for market impact of a labeled agent

- Agent at time t : $dA^+(t)$ buy orders $dA^-(t)$ sell orders

$$dA(t) = \begin{pmatrix} dA^+(t) \\ dA^-(t) \end{pmatrix}$$

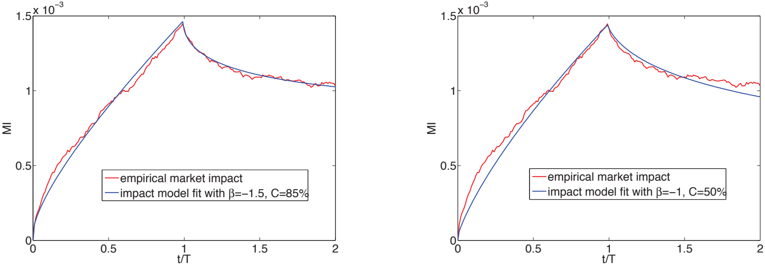
- **Impacts will be modeled by additive terms on λ^{N^+}, λ^{N^-}**
- **Single buy order** at time t_0 : $dA^+(t) = \delta(t - t_0)$, $dA^- = 0$
  - Impact on upward jumps : $\lambda_t^{N^+} \to \lambda_t^{N^+} + \varphi^{I,s}(t - t_0)$
    $\longrightarrow$ "Instantaneous" impact of the trade itself
    $\longrightarrow$ delayed upward moves (e.g., cancel orders)
  - Impact on donward jumps : $\lambda_t^{N^-} \to \lambda_t^{N^-} + \varphi^{I,c}(t - t_0)$
    $\longrightarrow$ delayed downward moves
- **Meta order** starting at time t_0

$$\lambda_t^N = \mu.u + \Phi^N \star dN_t + \Phi^I \star dA(t),$$

where $\Phi^I(t) = \begin{pmatrix} \varphi^{I,s} & \varphi^{I,c} \\ \varphi^{I,c} & \varphi^{I,s} \end{pmatrix}$ is the impact kernel

E.B, M.Hoffmann, A.Iuga, M.Lasnier, C.A.Lehalle
(working paper + Poster)

$$MI(t) = E(X_t - X_{t_0=0}) \quad \text{with} \quad X_t = N_t^+ - N_t^-$$



- Concave impact while trading
- Relaxation after trading
- Is able to reproduce both permanent/non permanent impact

What if all available market orders are anonymous ?

Markets generally do not provide labeled data

- Flow of anonymous marker orders $T_t = \begin{pmatrix} T_t^+ \\ T_t^- \end{pmatrix}$

  T^+ (resp. T^-) : trade arrivals at the best ask (resp.bid)

- No more access to market impact profile !

- Only access to the Response function : $R(t - t_0)$:
  Expectation of the price at time t knowing there was a buying market order at time t_0, i.e.,

$$R(t - t_0) = E(N_t^+ - N_t^- \, | dT_{t_0}^+ = \delta(t - t_0))$$

Towards a model for market impact of anonymous market orders ?

Model for market impact of a labeled agent

E.B., M.Hoffmann, A.Iuga, M.Lasnier, C.A.Lehalle (2013,Working paper)

- **The market orders of the labeled agent**

  $\mathbf{A}(\mathbf{t}) = \begin{pmatrix} A^+(t) \\ A^-(t) \end{pmatrix}$

  A^+ (resp. A^-) : trade arrivals at the best ask (resp.bid)

- **The Price model**

  $$X_t = N_t^+ - N_t^-$$

  N^+ (resp. N^-) : upward (resp. downward) jumps

$$\lambda^N{}_t = \mu.u + \Phi^N \star dN_t + \Phi^I \star \mathbf{dA}(\mathbf{t})$$

E.B, J.F.Muzy (2013, Preprint)

- **The anonymous market orders flow $\mathbf{T_t} = \begin{pmatrix} T_t^+ \\ T_t^- \end{pmatrix}$**

  T^+ (resp. T^-) : trade arrivals at the best ask (resp.bid)

- **The Price model**

$$X_t = N_t^+ - N_t^-$$

  N^+ (resp. N^-) : upward (resp. downward) jumps

$$\lambda^N{}_t = \mu.u + \Phi^N \star dN_t + \Phi^I \star \mathbf{dT_t}$$

E.B, J.F.Muzy (2013, Preprint)

- **The anonymous market orders flow** $\mathbf{T_t} = \begin{pmatrix} T_t^+ \\ T_t^- \end{pmatrix}$

  T^+ (resp. T^-) : trade arrivals at the best ask (resp.bid)

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  N^+ (resp. N^-) : upward (resp. downward) jumps

$$\lambda^N{}_t = \Phi^N \star dN_t + \Phi^I \star \mathbf{dT(t)}$$

E.B, J.F.Muzy (2013, Preprint)

- **The anonymous market orders flow** $\mathbf{T_t} = \begin{pmatrix} T_t^+ \\ T_t^- \end{pmatrix}$

  T^+ (resp. T^-) : trade arrivals at the best ask (resp.bid)

- **The Price model**

$$X_t = N_t^+ - N_t^-$$

  N^+ (resp. N^-) : upward (resp. downward) jumps

$$\lambda^N{}_t = \Phi^N \star dN_t + \Phi^I \star \mathbf{dT(t)}$$

$\longrightarrow$ Φ^I : "Instantaneous" impact + influence on price moves
$\longrightarrow$ Φ^N : Influence of past price moves on future price moves

E.B, J.F.Muzy (2013, Preprint)

The anonymous trade arrivals model $\longrightarrow$ A 2d Hawkes process

$$T_t = \begin{pmatrix} T_t^+ \\ T_t^- \end{pmatrix}$$

T^+ (resp. T^-) : trade arrivals at the best ask (resp.bid)

$$\lambda_t^T = \mu . u + \Phi^T \star dT_t + \Phi^R \star dN_t$$

where

$$u = \begin{pmatrix} 1 \\ 1 \end{pmatrix}, \ \Phi^T = \begin{pmatrix} \varphi^{T,s} & \varphi^{T,c} \\ \varphi^{T,c} & \varphi^{T,s} \end{pmatrix} \text{ and } \Phi^R = \begin{pmatrix} \varphi^{R,s} & \varphi^{R,c} \\ \varphi^{R,c} & \varphi^{R,s} \end{pmatrix}$$

$\longrightarrow$ μ : Anonymous trade intensity
$\longrightarrow$ Φ^T : Auto-correlation of trades
$\longrightarrow$ Φ^R : Retro-influence of price moves on trades

The overall model is a 4 dimensional Hawkes process P

E.B, J.F.Muzy (2013, Preprint)

$P_t = \begin{pmatrix} T_t \\ N_t \end{pmatrix}$ whose intensity $\lambda_t = \begin{pmatrix} {\lambda^T}_t \\ {\lambda^N}_t \end{pmatrix}$ is given by

$$\lambda_t = M + \Phi \star dP_t,$$

where

$$M = \begin{pmatrix} \mu.u \\ 0 \end{pmatrix}, \quad \Phi(t) = \begin{pmatrix} \Phi^T(t) & \Phi^R(t) \\ \Phi^I(t) & \Phi^N(t) \end{pmatrix}$$

- μ : Anonymous trade intensity
- $\Phi^T(t)$: Auto-correlation of anonymous trades
- $\Phi^I(t)$: "Instantaneous" impact + influence on price moves
- $\Phi^N(t)$: Influence of past price moves on future price moves
- $\Phi^R(t)$: Retro-influence of price moves on anonymous trades

Non parametric estimation

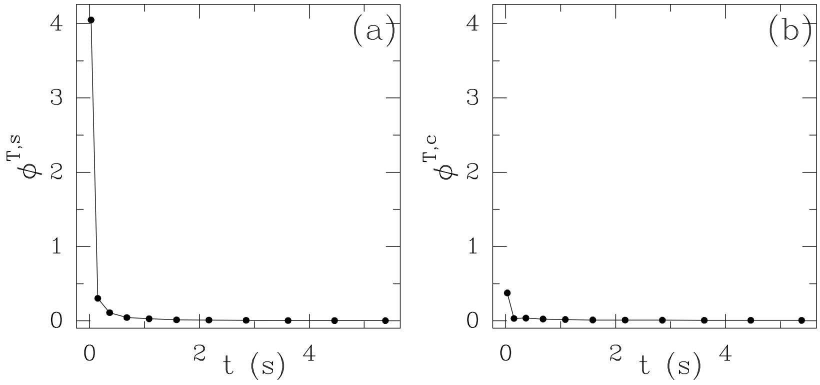
$$\lambda_t = M(t) + \Phi \star dP_t,$$

where

$$M(t) = \begin{pmatrix} \mu.u \\ 0 \end{pmatrix}, \quad \Phi(t) = \begin{pmatrix} \Phi^T(t) & \Phi^R(t) \\ \Phi^I(t) & \Phi^N(t) \end{pmatrix}$$

- **Non parametric estimation of** μ **and all the kernels** : Φ^T, Φ^R, Φ^N, Φ^I, **from anonymous market data**.

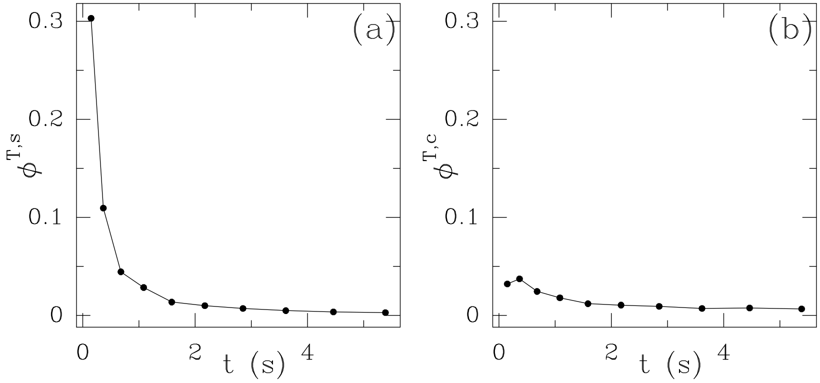
Non parametric estimation of Φ^T for Eurostoxx Futures 10h-12h, 2009-2012 (800 days)



Trade auto-correlation

Non parametric estimation of Φ^T for Eurostoxx Futures 10h-12h, 2009-2012 (800 days)

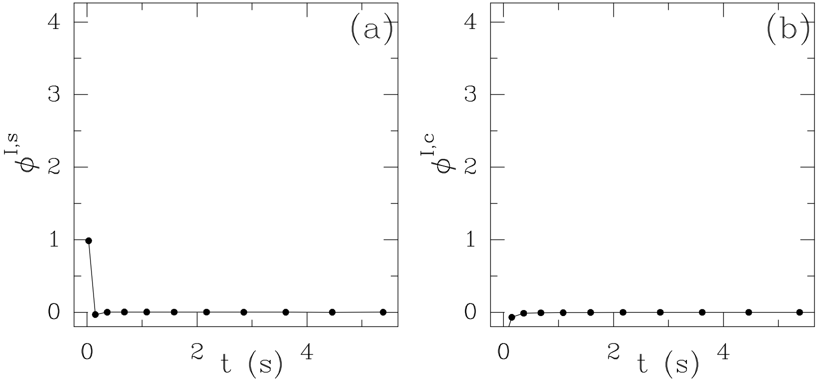
Zooming ...



Trade auto-correlation :

$\longrightarrow$ Mainly "positive" correlation : Splitting and Herding

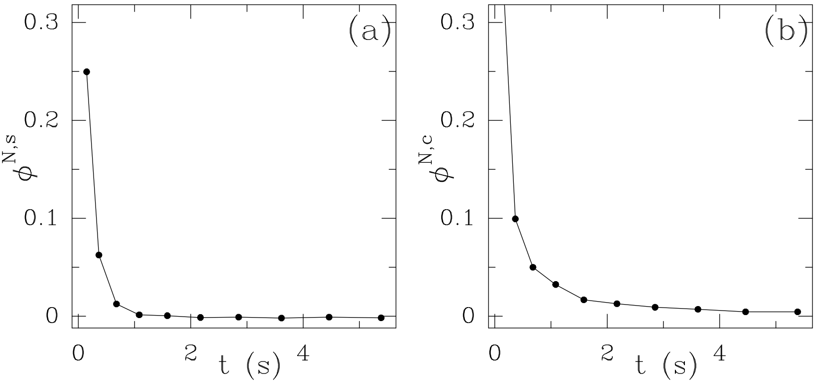
Non parametric estimation of Φ^I for Eurostoxx Futures 10h-12h, 2009-2012 (800 days)



Trade "instantaneous" impact + influence on delayed price moves
$\longrightarrow$ Mainly instantaneous impact :

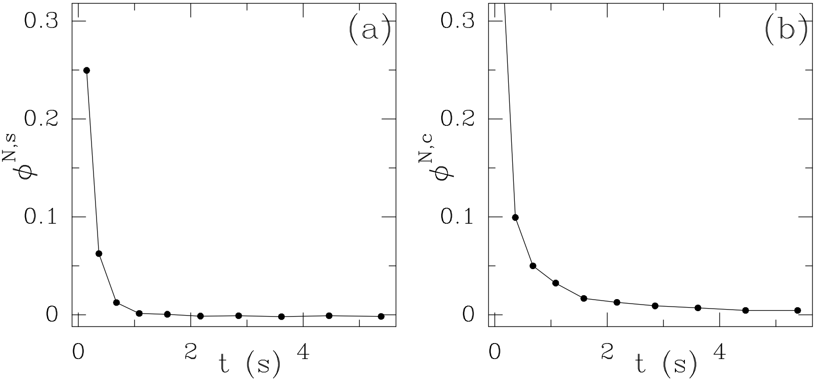
$\phi^{I,s}(t) \simeq C\delta(t)$ **and** $\phi^{I,c} \simeq 0$.

Non parametric estimation of Φ^N for Eurostoxx Futures 10h-12h, 2009-2012 (800 days)



Influence of past price moves on future price moves

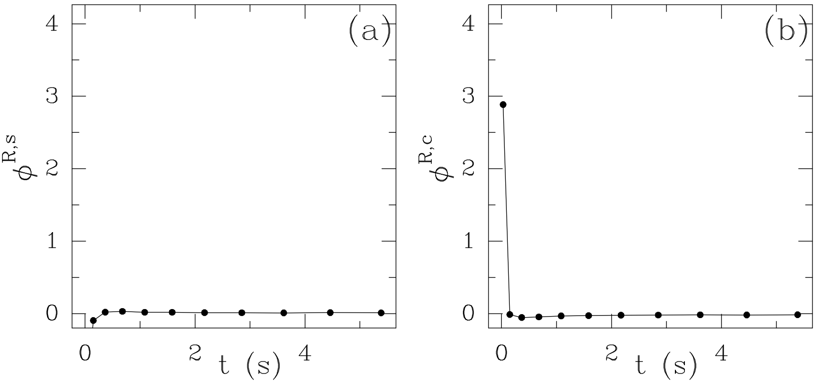
Non parametric estimation of Φ^N for Eurostoxx Futures 10h-12h, 2009-2012 (800 days)



Influence of past price moves on future price moves

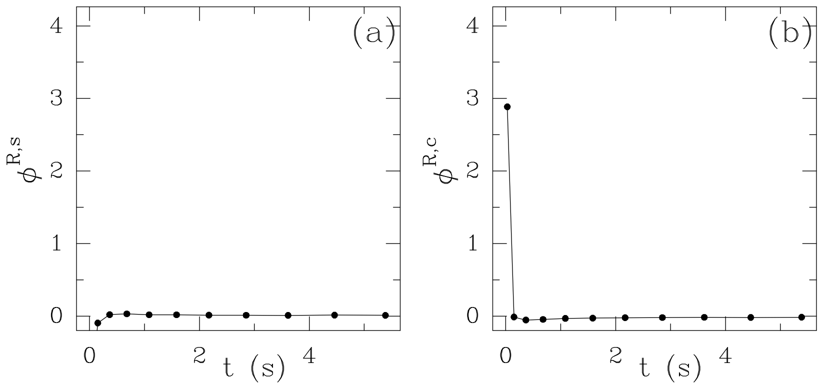
$\longrightarrow$ Mostly mean reverting

Non parametric estimation of Φ^R for Eurostoxx Futures 10h-12h, 2009-2012 (800 days)



Retro-influence of price moves on anonymous trades :

Non parametric estimation of Φ^R for Eurostoxx Futures 10h-12h, 2009-2012 (800 days)



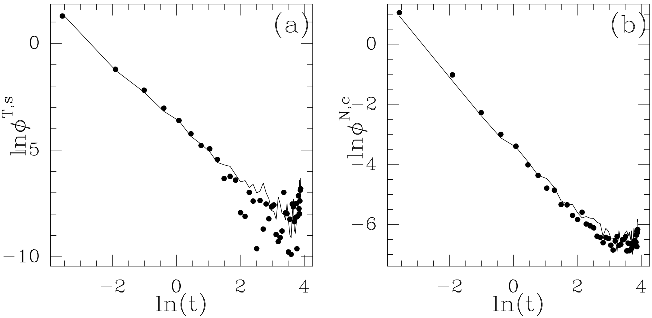
Retro-influence of price moves on anonymous trades :

$\longrightarrow \phi^{R,cross}$ large and $\phi^{R,self} \simeq 0$!

Price goes up $\Longrightarrow$ more sell market orders

Non parametric estimation for Eurostoxx Futures 10h-12h, 2009-2012 (800 days)

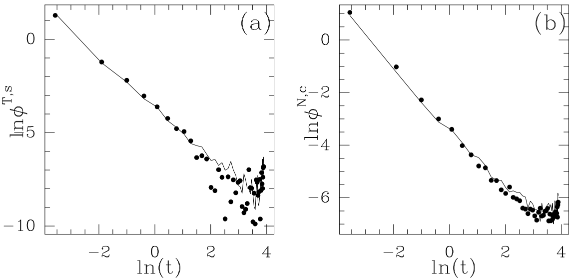
- **Most kernels are power-law** (when non 0) : $\frac{\alpha}{(\delta+x)^\beta}$
- **With** $\beta \simeq 1$: unstablity limit !
  (K.Al Dayri, E.B, J.F.Muzy, EPJB 2012).



- Except $\varphi^{I,s} \simeq C\delta$ ($C << 1$) and $\varphi^{R,c}$

Non parametric estimation for Eurostoxx and Bund Futures 10h-12h, 2009-2012 (800 days)

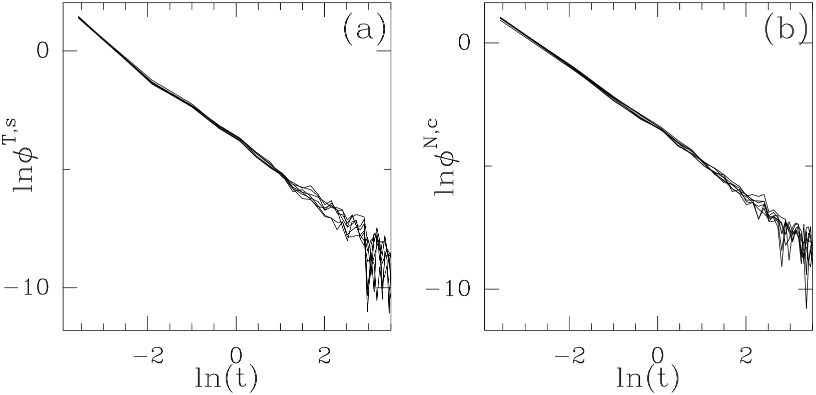
- **Kernels can be amazingly stable when asset changes**



plain line : Eurostoxx Futures, • : Bund

- **No adjustment (no prefactors)** !

Log-Log plots of $\varphi^{T,s}$ and $\varphi^{N,c}$ for different intraday slices :
9h-11h, 10h-12h, 11h-13h, 12h-14h, 13h-15h, 14h-16h, 15h-17h



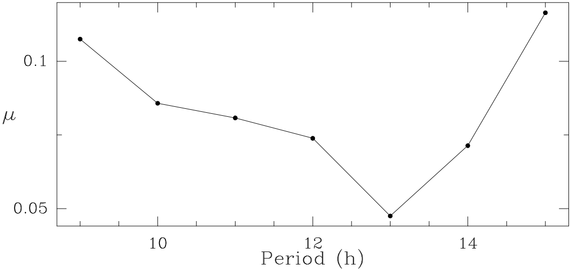
The kernel estimations do not depend on the intraday period

The intraday seasonality is only carried by μ (U-shape)

Model with intraday seasonality

$$\lambda_t = M(t) + \Phi \star dP_t,$$

where $M(t) = \begin{pmatrix} \mu_{\text{seasonal(t)}} \cdot u \\ 0 \end{pmatrix}, \quad \Phi(t) = \begin{pmatrix} \Phi^T(t) & \Phi^R(t) \\ \Phi^I(t) & \Phi^N(t) \end{pmatrix}$



Closed analytical formula for ....

Closed analytical formula for many quantities of interest

- Response function
- Diffusive variance of the price
- Auto-correlation function of
  - the trade signs (in practice heavy correlation)
  - the increments of the price (in practice very small correlations)
- Market impact
- ...

Analytical formula for the Market Impact of a meta-order

A particular case :

- An **"impulsive" Impact kernel** : $\varphi^{I,s}(t) = C\delta(t)$, $\varphi^{I,c}(t) = 0$
- A **single buy order** : $dA^+(t) = \delta(t), dA^-(t) = 0$

$\Longrightarrow$ the Market impact is

$$MI(t) = E(X_t - X_0) = 1_{[0,+\infty]}(t) - \int_0^t \Delta\xi(u)du,$$

where the Laplace transform of $\Delta\xi(t)$ is given by

$$\widehat{\Delta\xi} = 1 - \frac{(1 - \Delta\widehat{\phi}^T)}{(1 - \Delta\widehat{\phi}^T)(1 - \Delta\widehat{\phi}^N) - \Delta\widehat{\phi}^R}$$

where $\Delta\varphi^? = \varphi^{?,s} - \varphi^{?,c}$ measures the "kernel's imbalance"

Permanent versus non-permanent market impact

Analytical formula for the asymptotic market impact $MI(+\infty)$

In the case of a "cross-only" Retro-kernel : $\varphi^{R,s}(t) = 0$

$\Longrightarrow$ The asymptotic market impact is

$$MI(+\infty) = \frac{1}{(1 - \Delta||\varphi^N||_1) + ||\varphi^{R,c}||_1/(1 - \Delta||\varphi^T||_1)},$$

where

$$\Delta||\varphi^T||_1 = ||\varphi^{T,s}||_1 - ||\varphi^{T,c}||_1 \ (\in]-1,1[\text{ implied by stability})$$
$$\Delta||\varphi^N||_1 = ||\varphi^{N,s}||_1 - ||\varphi^{N,c}||_1 \ (\in]-1,1[\text{ implied by stability})$$

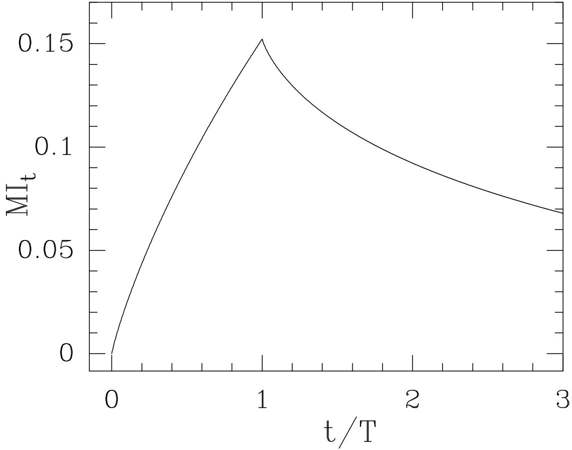
$MI(+\infty)$ **decreases when mean reversion increases, i.e. :**

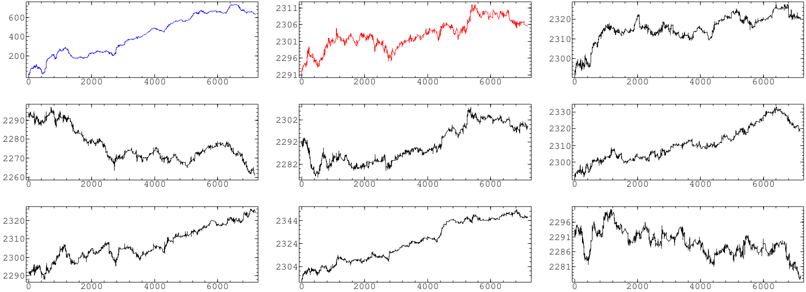
- **when $\Delta||\varphi^N||_1$ goes to -1**
- **when $||\varphi^{R,c}||_1$ increases**
- **when $\Delta||\varphi^T||_1$ goes to 1**

Market impact profile estimation from anonymous data on Eurostoxx Futures

- Non parametric estimation of **all the kernels** : Φ^T, Φ^R, Φ^N, Φ^I
- Setting $\varphi^{T,c} = 0$, $\varphi^{I,c} = 0$ and $\varphi^{R,s} = 0$
- Fitting exponential kernels on $\varphi^{I,s}$ and $\varphi^{R,c}$
- Fitting Power-law kernels on $\varphi^{T,s}$, $\varphi^{N,c}$ and $\varphi^{N,s}$
- Computing the market impact profile from analytical formula

Market impact profile estimation from anonymous data on Eurostoxx Futures





$T_t^+ - T_t^-$: True cum. Trades on 3/08/2008 - [10am-12am]
$N_t^+ - N_t^-$: True mid-price on 3/08/2008 between 10am and 12am
Simulation of the mid-price process N given the real trades

CU_200709.SSV

20070806	CU	200709	1.38190000	1.38600000	1.37960000	1.38180000	177660	222003	178569	224742
20070807	CU	200709	1.38140000	1.38350000	1.37540000	1.37790000	159381	224424	160164	227532
20070808	CU	200709	1.37600000	1.38450000	1.37390000	1.38160000	170989	226836	171746	229851
20070809	CU	200709	1.38130000	1.38350000	1.36720000	1.37030000	278443	222602	279726	225978
20070810	CU	200709	1.36980000	1.37260000	1.36610000	1.37160000	179836	218411	180729	222092
20070813	CU	200709	1.37110000	1.37280000	1.36220000	1.36380000	154249	216533	155261	220666
20070814	CU	200709	1.36260000	1.36440000	1.35460000	1.35580000	178334	214017	179335	218546
20070815	CU	200709	1.35510000	1.35530000	1.34510000	1.34780000	213781	211204	214926	215818
20070816	CU	200709	1.34390000	1.34610000	1.33700000	1.34190000	260416	213628	261292	218399
20070817	CU	200709	1.34380000	1.35590000	1.33830000	1.34880000	302914	211972	304251	217321
20070820	CU	200709	1.35040000	1.35220000	1.34720000	1.34940000	124404	207485	125460	213269
20070821	CU	200709	1.34880000	1.35330000	1.34690000	1.34800000	144729	209941	145440	216026
20070822	CU	200709	1.34750000	1.35630000	1.34620000	1.35440000	151463	213730	152286	219927
20070823	CU	200709	1.35590000	1.35990000	1.35460000	1.35680000	128232	211470	128848	217839
20070824	CU	200709	1.35770000	1.36940000	1.35630000	1.36820000	148872	214518	149887	220687
20070827	CU	200709	1.36850000	1.36950000	1.36440000	1.36620000	83428	214195	84282	220551
20070828	CU	200709	1.36530000	1.36910000	1.36100000	1.36420000	129318	214903	130452	221098
20070829	CU	200709	1.36130000	1.36920000	1.35720000	1.36700000	168740	220237	169668	226480
20070830	CU	200709	1.36860000	1.36860000	1.36020000	1.36470000	169905	223758	176365	229894
20070831	CU	200709	1.36410000	1.37300000	1.36300000	1.36470000	189816	218166	193957	224292
20070904	CU	200709	1.36410000	1.36640000	1.35570000	1.36190000	192186	213184	198469	221662
20070905	CU	200709	1.36140000	1.36800000	1.35760000	1.36600000	168246	207122	186018	223632
20070906	CU	200709	1.36550000	1.37160000	1.36400000	1.36910000	154470	198770	171616	223623
20070907	CU	200709	1.36960000	1.38040000	1.36680000	1.37730000	192392	193361	212091	227851
20070910	CU	200709	1.37800000	1.38200000	1.37710000	1.38090000	107238	181410	136791	226495
20070911	CU	200709	1.38080000	1.38520000	1.37820000	1.38360000	125226	172423	166524	235169
20070912	CU	200709	1.38410000	1.39180000	1.38270000	1.39110000	141825	148920	264072	249373
20070913	CU	200709	1.39080000	1.39280000	1.38630000	1.38860000	97454	111214	289727	270858
20070914	CU	200709	1.38720000	1.38960000	1.38440000	1.38750000	60237	92657	240168	280650
20070917	CU	200709	1.38720000	1.38890000	1.38550000	1.38750000	5741	89381	117587	281805

CU_200712.SSV

20070806	CU	200712	1.38550000	1.38850000	1.38290000	1.38470000	88
20070807	CU	200712	1.38580000	1.38600000	1.37860000	1.38090000	77
20070808	CU	200712	1.38030000	1.38740000	1.37710000	1.38460000	75
20070809	CU	200712	1.38530000	1.38640000	1.37040000	1.37330000	127
20070810	CU	200712	1.37200000	1.37530000	1.36920000	1.37460000	89
20070813	CU	200712	1.37330000	1.37660000	1.36540000	1.36680000	106
20070814	CU	200712	1.36560000	1.36720000	1.35780000	1.35880000	96
20070815	CU	200712	1.35800000	1.35820000	1.34750000	1.35060000	109
20070816	CU	200712	1.34590000	1.34890000	1.33990000	1.34460000	85
20070817	CU	200712	1.34680000	1.35820000	1.34120000	1.35130000	131
20070820	CU	200712	1.35190000	1.35450000	1.34980000	1.35170000	105
20070821	CU	200712	1.35170000	1.35560000	1.34950000	1.35030000	67
20070822	CU	200712	1.34920000	1.35850000	1.34860000	1.35670000	80
20070823	CU	200712	1.35800000	1.36200000	1.35700000	1.35910000	61
20070824	CU	200712	1.35910000	1.37170000	1.35860000	1.37070000	99
20070827	CU	200712	1.37200000	1.37200000	1.36690000	1.36870000	84
20070828	CU	200712	1.36710000	1.37140000	1.36370000	1.36670000	112
20070829	CU	200712	1.36380000	1.37170000	1.35990000	1.36960000	92
20070830	CU	200712	1.37040000	1.37100000	1.36300000	1.36770000	643
20070831	CU	200712	1.36710000	1.37620000	1.36640000	1.36840000	413
20070904	CU	200712	1.36780000	1.37010000	1.35980000	1.36560000	623
20070905	CU	200712	1.36550000	1.37150000	1.36140000	1.36960000	1774
20070906	CU	200712	1.36890000	1.37510000	1.36770000	1.37270000	1714
20070907	CU	200712	1.37330000	1.38350000	1.37050000	1.38050000	1968
20070910	CU	200712	1.38140000	1.38530000	1.38030000	1.38420000	2953
20070911	CU	200712	1.38410000	1.38850000	1.38150000	1.38700000	4106
20070912	CU	200712	1.38780000	1.39540000	1.38620000	1.39470000	12222
20070913	CU	200712	1.39440000	1.39640000	1.38980000	1.39190000	19187
20070914	CU	200712	1.39050000	1.39300000	1.38750000	1.39070000	17966
20070917	CU	200712	1.39070000	1.39210000	1.38810000	1.38990000	11167
20070918	CU	200712	1.38940000	1.40130000	1.38590000	1.39980000	16405
20070919	CU	200712	1.40090000	1.40110000	1.39570000	1.39820000	14116
20070920	CU	200712	1.39850000	1.41200000	1.39830000	1.40970000	19332

Données fournies par SAPIANCE CAPITAL, Londres