An agent-based model of intra-day financial markets dynamics

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Dolfins project

Context

during recent years, the availability of advanced technology has been substantially reducing the latency required to operate on financial markets, fostering market activity at increasingly higher frequencies

Cont (2011) time to execution dropped 25-fold between 2000 and 2010

Carrion (2013) 68.3% of NASDAQ turnover attributable to HFT

Aldridge (2013) HFTs delivered positive returns in 2008, whereas 70% of LFTs lost money

Stylised facts

SF1 leptokurtosis

SF2 no linear autocorrelation

SF3 volatility clustering

SF4 leverage effect

SF5 # price changes per day

SF6 autocorrelation of durations

SF7 fat-tailed durations

SF8 order-flow clustering

SF9 volumes autocorrelation

SF10 volume/volatility correlation

SF11 U-shaped activity

Basic ingredients

- limit order book (price-time priority)
- single long-lived security
- no fundamental news
- no dividend paid
- fundamentalist vs. chartist traders
- no strategy switching

Novel ingredients

- endogenous participation
- automatic cancellation
- strict global schedule (Euronext)

Trader participation

- **uniform** at each time step exactly one trader is activated, randomly selected from the population
- **endogenous** at each time step a trader is active if last observed (absolute) return is above a random trader-specific threshold, otherwise fall back to **uniform** with probability ϕ

Automatic cancellation

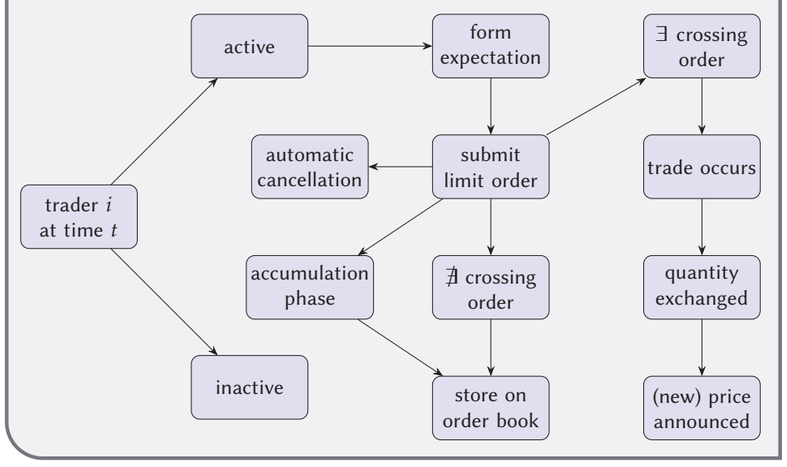
a limit order stored on the book is automatically cancelled from the book

- at its expiration time
- when a new order has different sign
- when it is deemed unfavourable
  - new buy order at lower price
  - new sell order at higher price

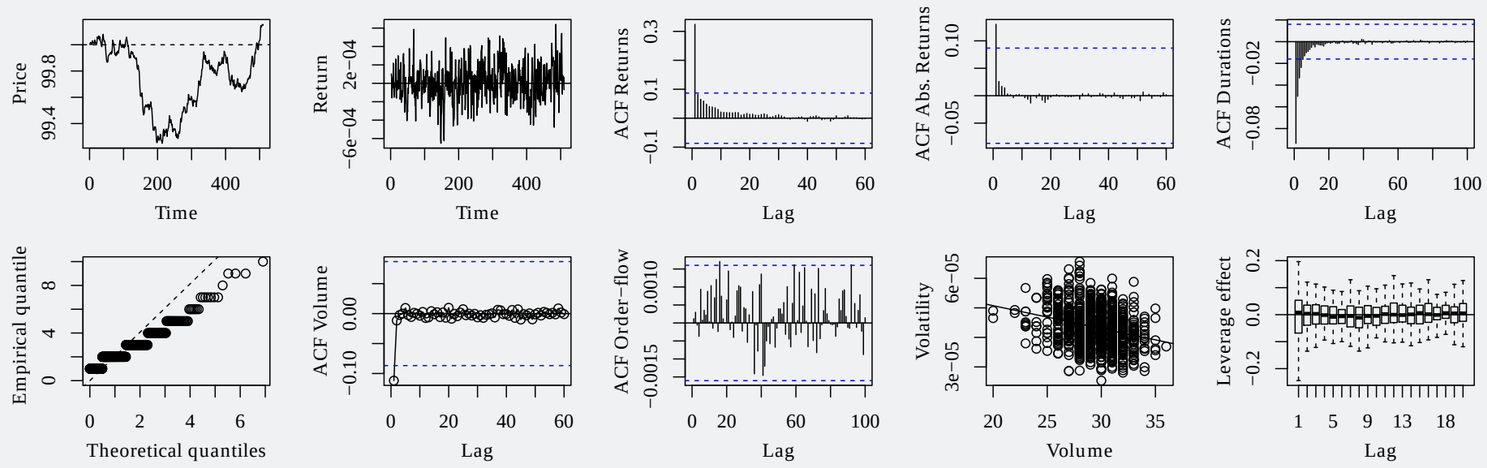
Timing (Euronext)

time	phase
7:15am – 9:00am	pre-opening
9:00am	opening auction
9:00am – 5:30pm	main trading session
5:30pm – 5:35pm	pre-closing
5:35pm	closing auction
10 hours, 20 minutes	37,200 sec.

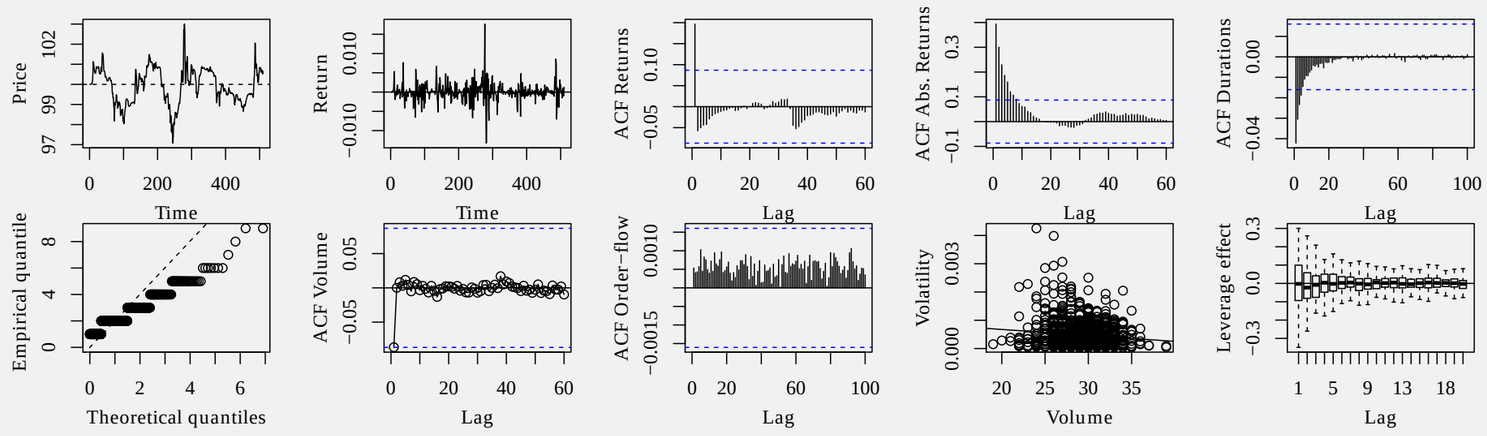
Workflow



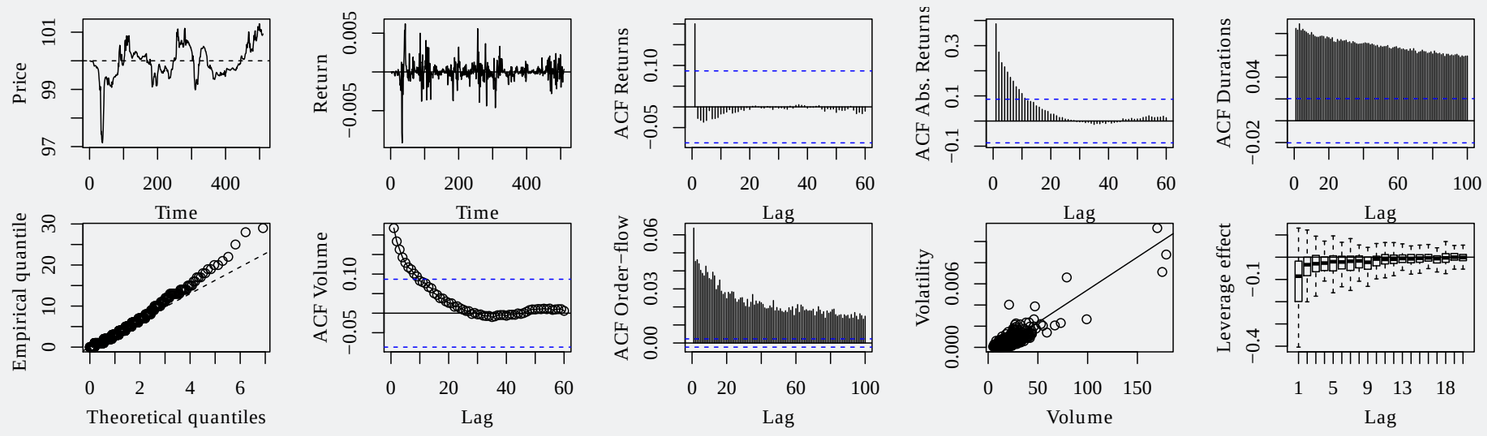
Noise Traders



Chartists – Fundamentalists



Endogenous Activation



Performance

SF	scenario NT	FC	EA
1	✗	✓	✓
2	✓	✓	✓
3	✗	✓	✓
4	✗	✗	✗
5	✓	✓	✓
6	✗	✗	✓
7	✗	✗	✓
8	✗	✗	✓
9	✗	✗	✓
10	✗	✗	✓
11	✗	✗	✗

Results

- a very parsimonious model is able to reproduce many of the established intraday stylised facts
- imposing a strict global schedule helps mapping simulation time into calendar time
- endogenous activation is necessary for reproducing the timing properties of actual financial markets

Extensions

- time feedback
- leverage requirements
- budget constraints
- model calibration

Contact

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