The Information Contained in the Duration of Prices

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Introduction

Background

- Information based models in market microstructure suggest that informed traders disclose their private information through trade and such information is progressively incorporated into prices.
- In addition to price and volume, the timing of trade also conveys information (Easley and O'Hara 1992). Informed traders only trade when new information enters in the market. So short durations are associated with large volumes and the presence of new information.

Motivation

- Limited understanding of factors influencing price durations. Most of previous research performed for highly traded stocks trading in NYSE.
  - Less frequently traded stocks may exhibit different dynamics (Manganelli 2005, Zhang et al. 2001).
  - Differences between equities and futures markets (Holder et al. 2004).
- Previous studies use transaction level data only. Cao et al. (2009) and Arzandeh and Frank (2017) show that the limit order book (LOB) contains information that contributes to price discovery.

Objective

- Estimate the relationship between price duration and its determinants in livestock markets.
  - Take into account irregularly spaced data and duration stylized facts.
  - Use the state of the LOB to explain price durations.

Data

- *Market Depth* data from CME Group
  - Lean hogs (HE) and Live cattle (LE)
  - Nov. 23, 2015 – March 31, 2016
  - Reconstruct 5 step deep LOB (both outright and implied) using every incremental book update.
- Thinning data
  - Drop 15 min. after opening and before closing
  - Use price changes only
  - Drop zero price durations

	Lean Hogs	Live cattle
Observations	81,312	125,366
Duration (seconds)	13.419	8.234
st. dev.	(21.778)	(23.003)
min	0.001	0.001
max	386.079	1772.062
Volume (# contracts)	2.40	2.36
st. dev.	(3.69)	(3.27)
min-max	1-200	1-155
BAS (cents)	0.04313	0.04831
st. dev.	(18.06)	(21.00)
median	0.050 (2 ticks)	0.050 (2 ticks)
min-max	1-27 ticks	1-22 ticks

Methods

- Price duration: time interval between a price change
  - Duration clustering: presence of either informed traders or liquidity traders.
  - Right-skewed shape: use generalized gamma family of distributions.
  - Intraday seasonalities: most studies report inverted U shape.
    Deseasonalized durations: $x_i^* = x_i/\phi(t_i - 1)$
    where $\phi(t_i - 1)$ is a smoothed estimate of the daily deterministic component.

Model

- Autoregressive Conditional Duration (ACD) model:

$$x_i^* = \psi_i \varepsilon_i$$

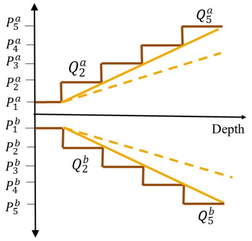
$$\psi_i = \omega + \sum_{j=0}^{p} \alpha_j x_{i-j} + \sum_{j=0}^{q} \beta_j \psi_{i-j} \qquad \omega > 0, \alpha_j, \beta_j \geq 0, \sum_{j=0}^{p} \alpha_j + \sum_{j=0}^{q} \beta_j < 1$$

where ψ_i is the conditional expected duration, $\mathrm{E}(x_i|F_{t-1})$, $\varepsilon_i \sim iid\ \mathcal{D}(\theta)$, $\mathcal{D}$ is a general distribution over $(0, \infty)$ with mean equal to one and parameter vector θ

- Exogenous variables (all three carry information about the presence of private information):
  - **Volume**: Short durations associated with high volumes.
  - **Bid-Ask spread** (BAS): Short durations associated with wider spreads.
  - **Limit order Book** (LOB): If the LOB contains information changes in the "slope" should explain price durations.

$$LOB = \sum_{j=2}^{n} \frac{Q_j^a}{P_j^a - P_{j-1}^a} + \frac{Q_j^b}{P_{j-1}^b - P_j^b}$$

where Q_j is the aggregate number of contracts across all orders at price P_j, a and b represent the ask and bid sides respectively, and $P_j - P_{j-1}$ is the price difference between two consecutive levels of the LOB.



Results

- Estimated coefficients reveal high persistence (summation close to 1).
- Higher volume and BAS indicate informed based trading which translates into shorter durations.
  - Each extra contract traded reduces duration by 3 milisec. in HE and by almost 8 milisec.s in LE.
  - A tick increase of the BAS shortens duration by 3 milisec. in HE and by almost 14 milisec. in LE.
- An increase in the "slope" of the LOB is associated with shorter durations, suggesting informed traders not only place market orders when new information arrives, but may also place limit orders as part of their trading strategies (consistent with Arzandeh and Frank 2017).
- Results consistent for both commodities, with higher coefficients for live cattle.

Lean Hogs

	Coeff.	SE	P-value
ω	0.0166	0.000157	<0.00
x_{t-1}	0.1189	0.001827	<0.00
ψ_{i-1}	0.8781	0.001445	<0.00
Volume	-0.0034	0.000074	<0.00
BAS	-0.0033	0.000031	<0.00
LOB	-0.0015	0.000181	<0.00

Live Cattle

	Coeff.	SE	P-value
ω	0.03323	0.00123	<0.00
x_{t-1}	0.0917	0.00153	<0.00
ψ_{i-1}	0.8984	0.00172	<0.00
Volume	-0.0080	0.00035	<0.00
BAS	-0.0140	0.00082	<0.00
LOB	-0.0018	0.00044	<0.00

Conclusions

- Price durations convey information as they respond to news entering the market.
- The dynamic relationships in livestock futures is qualitatively similar to findings in frequently traded stock markets. In both cases the results support the Easley and O'Hara (1992) model.
- The LOB captures new information in the market and should be included in microstructure studies of price behavior.
- The information contained in price durations could be used by algorithmic traders in the development of their trading strategies.

Acknowledgements

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