Computer Based Statistics: Introduction in SAS

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Market Microstructure

Definition

Hasbrouck (2000):

*Market Microstructure is the study of the trading mechanism used for financial securities*
Market Structure

- Limit Order Markets
- Floor Markets
- Dealer Markets
- Auctions and Clearing Mechanisms
Basic concepts of (empirical) financial market microstructure

Ask/bid prices and depths provided by liquidity suppliers
- market makers (NYSE: specialist, NASDAQ: dealer)
- limit order traders (Xetra)
  limit buy order: buy order with upper price limit and given buy volume
  limit sell order: sell order with lower price limit and given sell volume
Non-executable limit orders (LO) constitute the limit order book
market order (MO): no price limit (but buy and sell volume)
Basic concepts of (empirical) financial market microstructure

(best) ask price (or offer price)  depth at best ask price
(best) bid price  depth at best bid price

→ best quotes

Inside spread or quoted spread: ask price - bid price

Spread: natural measure of liquidity and market quality and (implicit) transaction costs (cost of round trip)
Basic concepts of (empirical) financial market microstructure

midprice or midquote or midpoint \((\text{askprice} + \text{bidprice})/2\)

relative (quoted) spread:

\[
\left( \frac{\text{quoted spread}}{\text{midquote}} \right) \cdot (100\%)
\]
Basic concepts of (empirical) financial market microstructure

Trades occur at the ask or bid $\rightarrow$ transaction price $=$ bid price or ask price

or inside the quoted spread

or outside the quoted spread (if trading volume exceeds depth)
Three components which influence the spread

1. order processing costs (also opportunity costs of market making
2. inventory holding costs (of liquidity supply market maker holds suboptimal portfolio, risk aversion)
3. adverse selection costs or asymmetric information costs (when some traders are better informed about true asset price than market maker)

→ 3 types of costs incurred by market maker (liquidity supplier)
→ spread has to compensate for them

Competition among liquidity suppliers reduces gains of liquidity supply in excess of these costs
## Measures of market quality (execution quality)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quoted spread</td>
<td>ask price - bid price</td>
</tr>
<tr>
<td>Effective spread</td>
<td>$2 \cdot (\text{execution price} - \text{midquote})$ for buy order</td>
</tr>
<tr>
<td></td>
<td>$2 \cdot (\text{midquote} - \text{execution price})$ for sell order</td>
</tr>
<tr>
<td>Realized spread</td>
<td>$2 \cdot (\text{execution price (t)} - \text{midquote (t + x)})$ for buy order</td>
</tr>
<tr>
<td></td>
<td>$2 \cdot (\text{midquote (t + x)} - \text{execution price (t)})$ for sell order</td>
</tr>
<tr>
<td>Price impact</td>
<td>$(\text{effective spread} - \text{realized spread})/2$</td>
</tr>
<tr>
<td></td>
<td>$\text{midquote (t + x)} - \text{midquote (t)}$ for buy order</td>
</tr>
<tr>
<td></td>
<td>$\text{midquote (t)} - \text{midquote (t + x)}$ for sell order</td>
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</table>
Very simple example of an order book

**Time t**

<table>
<thead>
<tr>
<th>Bid</th>
<th>Bid volume</th>
<th>Ask</th>
<th>Ask volume</th>
</tr>
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<tbody>
<tr>
<td>10.90</td>
<td>100</td>
<td>11.00</td>
<td>50</td>
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<tr>
<td>10.85</td>
<td>50</td>
<td>11.02</td>
<td>150</td>
</tr>
<tr>
<td>10.83</td>
<td>100</td>
<td>11.05</td>
<td>50</td>
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<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
Very simple example of an order book

New limit buy order of 100 shares for at most 11.03.

What is the transaction price?

What does the order book look like now?
### Time \( t + \Delta \)

<table>
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</tr>
<tr>
<td>10.83</td>
<td>100</td>
<td>11.06</td>
<td>50</td>
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<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
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</table>
### Market Microstructure

#### Time t+5

<table>
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<tr>
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<th>Ask</th>
<th>Ask volume</th>
</tr>
</thead>
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<td>:</td>
<td>:</td>
<td>:</td>
<td>:</td>
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</tbody>
</table>
Example

Calculate the quoted spread, the effective spread, the realized spread and the price impact.

\[
ES = \begin{cases} 
2 \cdot (price - midpoint) & \text{if buy} \\
2 \cdot (midpoint - price) & \text{if sell} 
\end{cases}
\]

\[
RS = \begin{cases} 
2 \cdot (price - midpoint5) & \text{if buy} \\
2 \cdot (midpoint5 - price) & \text{if sell} 
\end{cases}
\]

\[
PI = (ES - RS)/2
\]
Trade Classification

- compare transaction prices to midquotes

- compare transaction price to lagged transaction price