Brokerage America tries to show that Americans would not tolerate “middlemen” in transactions like ordering dinner at a restaurant.
middlemen in limit order markets

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one broker’s net position ining on Jan 30, 2008

Middleman’s inventory aggregated across markets

Net inventory at end of trading day is: 0 shares
main findings

- Middlemen quickly process public news which in theory
  - solves ‘no-trade’ deadlock between uninformed early investor and informed late investor who trade through take-it-or-leave-it (limit) orders (+)
  - creates adverse selection if both investors are uninformed (-)

- Empirically 07-08 sample Belgian and Dutch stocks shows
  - adverse selection is largest part of passive order markup
  - In-sample, chi-x (a venue friendly to middlemen) is introduced for Dutch stocks; coincidentally a highly active new middleman shows up who
    - participates more when public news is ‘important’
    - trades primarily passive (~80%)
  - A diff-in-diff analysis shows that the chi-x introduction
    - raised overall liquidity supply
    - lowered volume
literature

a lot
sketch of the static model

- one indivisible security
- investors $x$ and $y$ draw private value from $u \sim [0, 1]$
- they arrive nonsynchronously
- wlog investor $x$ owns the security, arrives first, and posts a take-it-or-leave-it limit sell order
- common value is changed by $z \sim g(z)$ in between investor arrivals
- competitive middlemen (when present) observe $z$, post a limit buy for the security and, if executed, post a limit sell to $y$
first best and no-trade

![Graph showing first best and no-trade scenarios]

- First best: Line at 0.65
- No trade: Line at 0.5

Variables: standard deviation, common value, innovation

Welfare axis ranges from 0.45 to 0.7.
investors uninformed on common value innovation

- first best
- uninformed investors, no middleman
- no trade

welfare vs. standard deviation common value innovation
late investor informed on common value innovation

- First best
- Uninformed investors, no middleman
- Only late investor informed, no middlemen
- No trade

Graph shows the relationship between welfare and the standard deviation of common value innovation.
competitive middlemen introduced

- First best: no trade
- Uninformed investors, no middleman
- Only late investor informed, no middlemen
- Trade via middlemen only
- No trade

Graph shows welfare versus standard deviation, common value, and innovation.
summary of model findings

- without middlemen and late investor uninformed on z one achieves 78% of welfare gap between first-best and autarky.
- without middleman and late investor informed on z one achieves anywhere between 0% and 78% of welfare gap.
- middleman and late investor informed on z one achieves anywhere between 30% and 78% of welfare gap.
data sample

- chi-x limit order market introduced in March 2007 for European stocks
- Its distinguishing features are
  - Fast-execution
  - Low fees, passive orders subsidized
- Chi-x thus friendly to high-frequency traders
- Empirical analysis studies the first 77 trading days in 2007 and 2008 for
  - Dutch index stocks that were ‘treated’ with chi-x introduction
  - Belgian index stocks that serve as the ‘untreated’ sample (chi-x introduced later)
- Main market for both sets of stocks was Euronext
- Trade files for Dutch stocks have anonymized broker ID
open one box of data first

pre chi-x

post chi-x

dutch stocks ‘treated’

belgian stocks ‘treated’
### Summary Statistics

<table>
<thead>
<tr>
<th>Variable (Units)</th>
<th>Large</th>
<th>Small</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euronext Volume (€1000/min)</td>
<td>524.4</td>
<td>128.1</td>
<td>466.6</td>
</tr>
<tr>
<td></td>
<td>(19.9)</td>
<td>(4.3)</td>
<td>(17.4)</td>
</tr>
<tr>
<td>Chi-X Volume (€1000/min)</td>
<td>49.4</td>
<td>4.5</td>
<td>42.8</td>
</tr>
<tr>
<td></td>
<td>(2.0)</td>
<td>(0.2)</td>
<td>(1.8)</td>
</tr>
<tr>
<td>Chi-X Share Volume (%)</td>
<td>8.6</td>
<td>3.4</td>
<td>8.4</td>
</tr>
<tr>
<td>Euronext Time-Weighted Quoted Half Spread (bps)</td>
<td>3.47</td>
<td>5.00</td>
<td>3.70</td>
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<tr>
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<td>(0.07)</td>
<td>(0.14)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>Chi-X Time-Weighted Quoted Half Spread (bps)</td>
<td>3.44</td>
<td>14.76</td>
<td>5.09</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.98)</td>
<td>(0.20)</td>
</tr>
<tr>
<td>Time-Weighted Generalized Inside Half Spread (bps)</td>
<td>2.63</td>
<td>4.20</td>
<td>2.86</td>
</tr>
<tr>
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<td>(0.18)</td>
<td>(0.24)</td>
<td>(0.18)</td>
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<tr>
<td>Euronext Time-Weighted Quoted Depth (€1000)</td>
<td>121.4</td>
<td>30.6</td>
<td>108.1</td>
</tr>
<tr>
<td></td>
<td>(2.4)</td>
<td>(0.3)</td>
<td>(2.0)</td>
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<tr>
<td>Chi-X Time-Weighted Quoted Depth (€1000)</td>
<td>53.3</td>
<td>21.0</td>
<td>48.5</td>
</tr>
<tr>
<td></td>
<td>(1.2)</td>
<td>(1.1)</td>
<td>(1.0)</td>
</tr>
<tr>
<td>Effective Half Spread (bps)</td>
<td>2.89</td>
<td>3.90</td>
<td>3.04</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.10)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Adverse Selection, 30 min (bps)</td>
<td>2.62</td>
<td>3.74</td>
<td>2.78</td>
</tr>
<tr>
<td></td>
<td>(0.14)</td>
<td>(0.21)</td>
<td>(0.14)</td>
</tr>
</tbody>
</table>

- Chi-X adds substantially to overall liquidity supply
- Adverse selection is 90% of passive order cost

N=1078 (14 stocks, 77 days)
caught on tape! a middleman
one broker id net chi-x position in ing on jan 30, 2008
caught on tape! a middleman
another broker id net euronext position in ing on jan 30, 2008
caught on tape! a middleman
‘one+another’ broker id net position in ing on jan 30, 2008

middleman’s inventory aggregated across markets

net inventory at end of trading day is: 0 shares
Caught on tape! A middleman: statistics

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<tr>
<th>variable (units)</th>
<th>large</th>
<th>small</th>
<th>all</th>
</tr>
</thead>
<tbody>
<tr>
<td>middleman participation rate euronext trades (%)</td>
<td>8.2 (0.3)</td>
<td>4.8 (0.3)</td>
<td>7.7 (0.3)</td>
</tr>
<tr>
<td>middleman participation rate chi-x trades (%)</td>
<td>35.7 (1.8)</td>
<td>35.2 (2.3)</td>
<td>35.6 (1.8)</td>
</tr>
<tr>
<td>middleman relative use of passive orders in euronext (%)</td>
<td>78.6 (0.8)</td>
<td>53.5 (2.7)</td>
<td>74.9 (0.9)</td>
</tr>
<tr>
<td>middleman relative use of passive orders in chi-x (%)</td>
<td>76.9 (0.5)</td>
<td>84.8 (0.8)</td>
<td>78.0 (0.5)</td>
</tr>
<tr>
<td>fraction of days with zero net change in inventory</td>
<td>0.33</td>
<td>0.60</td>
<td>0.46</td>
</tr>
</tbody>
</table>

N=1078 (14 stocks, 77 days)

- Middleman trades at high frequency and is primarily passive
- Middleman mean-reverts position within the day
caught on tape! a middleman: effective spread

<table>
<thead>
<tr>
<th>variable (units)</th>
<th>large</th>
<th>small</th>
<th>all</th>
</tr>
</thead>
<tbody>
<tr>
<td>middleman effective half spread (bps)</td>
<td>3.25 (0.06)</td>
<td>4.72 (0.11)</td>
<td>3.47 (0.07)</td>
</tr>
<tr>
<td>nonmiddleman effective half spread (bps)</td>
<td>2.81 (0.06)</td>
<td>3.81 (0.10)</td>
<td>2.96 (0.06)</td>
</tr>
<tr>
<td>middleman adverse selection, 30 min (bps)</td>
<td>2.54 (0.17)</td>
<td>3.98 (0.66)</td>
<td>2.75 (0.17)</td>
</tr>
<tr>
<td>nonmiddleman adverse selection, 30 min (bps)</td>
<td>2.64 (0.15)</td>
<td>3.78 (0.21)</td>
<td>2.81 (0.14)</td>
</tr>
<tr>
<td>middleman realized spread, 30 min (bps)</td>
<td>0.72 (0.17)</td>
<td>0.74 (0.62)</td>
<td>0.72 (0.16)</td>
</tr>
<tr>
<td>nonmiddleman realized spread, 30 min (bps)</td>
<td>0.17 (0.14)</td>
<td>0.03 (0.17)</td>
<td>0.15 (0.13)</td>
</tr>
</tbody>
</table>

N=1078 (14 stocks, 77 days)

- passive order profit higher for middleman (vs. nonmiddleman)
- is the middleman solving a ‘no-trade’ deadlock?
speed comparison across markets

<table>
<thead>
<tr>
<th></th>
<th>large</th>
<th>small</th>
<th>all</th>
</tr>
</thead>
<tbody>
<tr>
<td>same-second euronext and index midquote change (#/day)</td>
<td>426 (24)</td>
<td>637 (40)</td>
<td>457 (25)</td>
</tr>
<tr>
<td>same-second chi-x and index midquote change (#/day)</td>
<td>1256 (52)</td>
<td>1257 (58)</td>
<td>1256 (50)</td>
</tr>
<tr>
<td>correlation(Δ euronext midquote, Δ index midquote)</td>
<td>0.33 (0.01)</td>
<td>0.16 (0.01)</td>
<td>0.31 (0.01)</td>
</tr>
<tr>
<td>correlation(Δ euronext midquote, Δ index midquote)</td>
<td>0.46 (0.02)</td>
<td>0.15 (0.01)</td>
<td>0.41 (0.01)</td>
</tr>
</tbody>
</table>

14 stocks, 77 days

- chi-x midquotes reflect index information fastest
cointegration model for quote informativeness

a cointegration model for a vector of prices is defined

$$\Delta p_t := [\text{index}_t \mid \text{midq}\_euronext_t \mid \text{midq}\_chi\_x_t \mid \text{trade}\_price_t]'$$

the cointegration model becomes (cf. Hasbrouck (1995))

$$p_t = \varphi_1 \Delta p_{t-1} + \varphi_2 \Delta p_{t-2} + \cdots + \beta (A'p_{t-1}) + \varepsilon_t$$

with two stochastic trends (stock price and index) i.e.

$$\beta' = \begin{pmatrix} 0 & \beta_{22} & \beta_{32} & \beta_{42} \\ 0 & \beta_{21} & \beta_{31} & \beta_{41} \end{pmatrix}, \quad A' = \begin{pmatrix} 0 & 1 & -1 & 0 \\ 0 & 1 & 0 & -1 \end{pmatrix}$$

a natural construct for the efficient price is the martingale

$$f_t := \lim_{t \to \infty} E^*[p_{t+k} | p_t, p_{t-1}, \ldots]$$
'capm $r^2$' vs middleman participation
cointegration model for quote informativeness

quote informativeness is established by linear projections of $\Delta f_t$, its index component, and its nonindex component, on ‘surprise’ midquote changes (2nd and 3rd element of $\varepsilon_t$)

a projection of $y$ on $x$ is denoted by

$$P_x(y) := x'\beta$$
quote informativeness on $\Delta f$ (dot size=volume)
quote informativeness on $\Delta f$ (dot size=volume)

Euronext midquote price update informativeness on index component
Chi-X midquote price update informativeness on index component

relative size of index component in efficient price innovation (%)
quote informativeness on $\Delta f$ (dot size=volume)
correlations in the cross-section and through time

<table>
<thead>
<tr>
<th>variable (units)</th>
<th>corr type</th>
<th>middleman participation rate</th>
<th>chi-x share #trades</th>
<th>middleman relative use of passive orders</th>
<th>chi-x minus euronext quote informativeness, $(P_c-P_e)(\Delta f)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘CAPM R² (%)</td>
<td>between</td>
<td>0.67* (0.27)</td>
<td>0.75** (0.27)</td>
<td>0.07 (0.27)</td>
<td>0.64* (0.27)</td>
</tr>
<tr>
<td></td>
<td>within</td>
<td>0.46** (0.05)</td>
<td>0.13** (0.04)</td>
<td>0.04 (0.07)</td>
<td>0.23** (0.08)</td>
</tr>
<tr>
<td>middleman particip. (%)</td>
<td>between</td>
<td>0.89** (0.27)</td>
<td>0.53* (0.27)</td>
<td>0.78** (0.27)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>within</td>
<td>0.41** (0.05)</td>
<td>0.08 (0.05)</td>
<td>0.20** (0.05)</td>
<td></td>
</tr>
<tr>
<td>chi-x #trades (%)</td>
<td>between</td>
<td>0.23 (0.27)</td>
<td></td>
<td>0.67* (0.27)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>within</td>
<td>–0.15** (0.05)</td>
<td></td>
<td>0.05 (0.04)</td>
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<tr>
<td>middleman passive (%)</td>
<td>between</td>
<td></td>
<td></td>
<td>0.52* (0.27)</td>
<td></td>
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<tr>
<td></td>
<td>within</td>
<td></td>
<td></td>
<td>–0.02 (0.04)</td>
<td></td>
</tr>
</tbody>
</table>

14 stocks, 77 days
now open all boxes for diff-in-diff

dutch stocks ‘treated’

belgian stocks ‘untreated’

pre chi-x

post chi-x
diff-in-diff to establish chi-x treatment effect
post- minus pre-event dutch stocks who were ‘treated’ with chi-x
post- minus pre-event belgian stocks who were not treated

<table>
<thead>
<tr>
<th>variable (units)</th>
<th>Netherlands/‘treated’</th>
<th>Belgium/‘untreated’</th>
<th>diff-in-diff</th>
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<tbody>
<tr>
<td></td>
<td>pre</td>
<td>post</td>
<td>Δ</td>
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<tr>
<td>20-min realized volatility (bp/min)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>3.9</td>
<td>7.6</td>
<td>64%**</td>
</tr>
<tr>
<td></td>
<td>(0.1)</td>
<td>(0.3)</td>
<td>(4%)</td>
</tr>
<tr>
<td>volatility intertrade information Δf (bp)</td>
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<tr>
<td></td>
<td>1.9</td>
<td>2.9</td>
<td>41%**</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(0.1)</td>
<td>(3%)</td>
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<td>generalized inside half spread (bps)</td>
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<tr>
<td></td>
<td>2.93</td>
<td>2.86</td>
<td>0%</td>
</tr>
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<td>(0.03)</td>
<td>(0.18)</td>
<td>(2%)</td>
</tr>
<tr>
<td>quoted depth (€1000)</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>213</td>
<td>108</td>
<td>−62%**</td>
</tr>
<tr>
<td></td>
<td>(2)</td>
<td>(2)</td>
<td>(2%)</td>
</tr>
<tr>
<td>effective half spread (bps)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.61</td>
<td>3.04</td>
<td>13%**</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.06)</td>
<td>(2%)</td>
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<tr>
<td>adverse selection, 30 min (bps)</td>
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<tr>
<td></td>
<td>1.89</td>
<td>2.78</td>
<td>32%**</td>
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<td></td>
<td>(0.09)</td>
<td>(0.14)</td>
<td>(6%)</td>
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<tr>
<td>#trades (/min)</td>
<td>11.05</td>
<td>20.39</td>
<td>59%**</td>
</tr>
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<td>(0.34)</td>
<td>(0.63)</td>
<td>(3%)</td>
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<tr>
<td>adjusted #tradesa (/min)</td>
<td>11.05</td>
<td>19.80</td>
<td>56%**</td>
</tr>
<tr>
<td></td>
<td>(0.34)</td>
<td>(0.61)</td>
<td>(3%)</td>
</tr>
<tr>
<td>volume (€1000/min)</td>
<td>446</td>
<td>509</td>
<td>10%*</td>
</tr>
<tr>
<td></td>
<td>(16)</td>
<td>(18)</td>
<td>(4%)</td>
</tr>
<tr>
<td>adjusted volumea (€1000/min)</td>
<td>446</td>
<td>496</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td>(16)</td>
<td>(18)</td>
<td>(4%)</td>
</tr>
</tbody>
</table>

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- chi-x introduction improves liquidity supply
- yet, it lowers volume
diff-in-diff to establish chi-x treatment effect

<table>
<thead>
<tr>
<th>variable (units)</th>
<th>Netherlands/′treated′</th>
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<th>diff-in-diff</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pre</td>
<td>post</td>
<td>Δ</td>
<td>pre</td>
<td>post</td>
</tr>
<tr>
<td>agency #trades (/min)</td>
<td>3.1 (0.1)</td>
<td>4.0 (0.1)</td>
<td>22%**</td>
<td></td>
<td></td>
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<tr>
<td>agency volume (€1000/min)</td>
<td>219 (7)</td>
<td>202 (7)</td>
<td>−10%**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>agency trades that are passive (%)</td>
<td>52.7 (0.1)</td>
<td>56.3 (0.1)</td>
<td>6%**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>effective half spreada (bps)</td>
<td>2.6 (0.0)</td>
<td>3.1 (0.1)</td>
<td>15%**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>adverse selection passivea, 30 min (bps)</td>
<td>2.0 (0.1)</td>
<td>3.2 (0.2)</td>
<td>43%**</td>
<td></td>
<td></td>
</tr>
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</table>

a: for passive agency orders

- careful interpretation as belgian benchmark is lacking
- less agency activity?
- gross profits reduced to zero on passive agency orders?
conclusions (déjà vu)

- middlemen quickly process public news which in theory
  - solves ‘no-trade’ deadlock between uninformed early investor and informed late investor who trade through take-it-or-leave-it (limit) orders (+)
  - creates adverse selection if both investors are uninformed (-)
- empirically 07-08 sample belgian and dutch stocks shows
  - adverse selection is largest part of passive order markup
  - in-sample, chi-x (a venue friendly to middlemen) is introduced for dutch stocks; coincidentally a highly active new middleman shows up who
    - participates more when public news is ‘important’
    - trades primarily passive (∼80%)
- a diff-in-diff analysis shows that the chi-x introduction
  - raised overall liquidity supply
  - lowered volume
middlemen in limit order markets

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\textsuperscript{2}tinbergen institute, vu university amsterdam

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