The Choice of Direct Dealing or Electronic Brokerage in Foreign Exchange Trading

Michael Melvin
Arizona State University
&
Lin Wen
University of Redlands
MARKET PARTICIPANTS: Customers

• End-users
  – Multinational firms
  – Central banks
  – Hedge funds

• Traditionally trade with dealers, not each other

• Trades private info to dealers
MARKET PARTICIPANTS: Dealers

• Trade with customers

• Low transparency

• Trade with each other—interbank market
  – Multiple of customer trades
    • Passing “hot potato” positions
INTERBANK TRADING

• Since 1930s, direct telephone trading

• Since 1960s voice brokers speaker boxes

• 1987, Reuters Dealing 2000-1

• Until early 1990s, trade split almost in half between direct dealing and voice brokers
ELECTRONIC BROKERS

• 1992, Reuters Dealing 2000-2

• 1993, Minex and EBS

• 1995, EBS/Minex merger
ELECTRONIC BROKERS

• Market and Limit orders
  – price/time priority
  – Anonymous prior to trade
  – Lower costs
  – Greater transparency
  – Continuous multilateral interaction
CUSTOMER INTERNET TRADING

• Nonbank sites
  – Take prices from interbank market
  – Not elect. Brokers, site is counterparty to trades
  – May 1996, Deal4Free (CMC Group)
  – March 2001, OANDA

• Bank sites
  – Request quotes from several banks
  – August 1996, FX Connect (State Street)
  – April 2000, Currenex
    • Multiple bank quotes and crossing network

• Increases competition and lowers costs
ELECTRONIC BROKERS

- Start from a base of zero in 1992

<table>
<thead>
<tr>
<th></th>
<th>April 2001</th>
<th>April 1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRB of NY</td>
<td>54%</td>
<td>32%</td>
</tr>
<tr>
<td>Bank of England</td>
<td>66%</td>
<td>30%</td>
</tr>
<tr>
<td>Bank of Japan</td>
<td>48%</td>
<td>37%</td>
</tr>
</tbody>
</table>
Question: How would a trader choose when facing two competing trading venues?

– Theoretical model
  • Choice of trading venue for large and small traders

– Empirical Analysis
  • Tests hypotheses

– Summary & Discussion
Trading Venues

• Direct Dealing (DD)
  – Immediacy of transaction
  – Transaction cost $s$ (dealer’s bid-ask spread)

• Electronic Brokerage (EB)
  – Waiting time discount factor $\delta$
  – Transaction cost $c$
    $c < s$
Theoretical Model

• Players
  – One large trader who trades a large amount
  – Many small traders who trade 1 unit

• Strategies
  – Go to DD
  – Go to EB
  – Don’t trade
Theoretical Model

• Asset (Currency)
  – a random future value $v$
  – Expectation $E(v) = u$
  – Variance $\sigma_v$

• Payoff
  – DM: $u_i - s$
  – CN: $\delta(u_i - c)$
Effective Discount Rate

- Effective Discount Rate:
  - For a small trader: \( \delta_s = E\beta^{t_s} \)
  - For a large trader: \( \delta_l = E\beta^{t_l} \)
  - \( \beta \): discount factor, \( 0 < \beta < 1 \)
  - \( t_s \): number of periods it takes for a small trader to find a match
  - \( t_l \): number of periods it takes for a large trader to find a match

\[
F_l(t) \leq F_s(t) \quad Et_l \geq Et_s \cdot E\beta^{t_l} \leq E\beta^{t_s}
\]
Optimal Decision Rules

- Trade with DD
  
  if \( u - s > \delta(u - c) \), and \( u - s > 0 \)

- Trade with EB
  
  if \( u - s < \delta(u - c) \), \( \delta(u - c) > 0 \)

- Indifferent
  
  if \( u - s = \delta(u - c) > 0 \)

- No trade
  
  if \( \delta(u - c) < 0 \), \( u - s < 0 \)
Optimal Outcome

- $u < c$ nobody would trade
- $c < u < s$ exclusive EB trading
- $u > s$ two possible equilibria when DD & EB coexist
  - *The large trader trades with DD and small traders go to the EB.*
    \[
    (s - \delta_l c) / (1 - \delta_l) < u < (s - \delta_s c) / (1 - \delta_s), \delta_s > \delta_l;
    \]
  - *The large trader trades on EB and small traders trade with DD.* (ruled out)
Empirical Analysis

• Data Description
  – Reuters D2000-2 electronic brokerage
  – Mark/Dollar
  – Oct 6-10, 1997, 130,535 orders
  – Available Information: order type, order entry time, removal time, removal code, price, quantity ordered and quantity dealt
Duration time of orders

• Average duration for limit orders is longer than that for market orders
• Mean waiting time is longer for unsuccessful limit orders than filled limit orders
• Time of day effect
• Clustering in the duration data
## Descriptive Statistics for Duration

<table>
<thead>
<tr>
<th></th>
<th>Filled Limit Orders</th>
<th>Failed Limit Orders</th>
<th>Filled Market Orders</th>
<th>All sample</th>
</tr>
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<tbody>
<tr>
<td><strong>Number of Orders</strong></td>
<td>38239</td>
<td>70453</td>
<td>21783</td>
<td>130475</td>
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<tr>
<td><strong>Mean (min)</strong></td>
<td>1.7886</td>
<td>3.4331</td>
<td>0.0012</td>
<td>2.3782</td>
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<tr>
<td><strong>Std Deviation</strong></td>
<td>10.8107</td>
<td>18.6327</td>
<td>0.0008</td>
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<tr>
<td><strong>Range</strong></td>
<td>398.394</td>
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<td><strong>Skewness</strong></td>
<td>19.2068</td>
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<td>17.4444</td>
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<td><strong>Kurtosis</strong></td>
<td>494.4853</td>
<td>308.2410</td>
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<td>446.8854</td>
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<tr>
<td>Time of Day</td>
<td>Average Duration</td>
<td>Number of Orders</td>
<td>Percentage</td>
<td></td>
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<tr>
<td>------------</td>
<td>------------------</td>
<td>-----------------</td>
<td>------------</td>
<td></td>
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<tr>
<td>0</td>
<td>10.2146</td>
<td>477</td>
<td>0.37%</td>
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<tr>
<td>1</td>
<td>6.7147</td>
<td>692</td>
<td>0.53%</td>
<td></td>
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<tr>
<td>2</td>
<td>10.8359</td>
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<td>0.24%</td>
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<tr>
<td>3</td>
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<td>64</td>
<td>0.05%</td>
<td></td>
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<tr>
<td>4</td>
<td>9.0134</td>
<td>200</td>
<td>0.15%</td>
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<tr>
<td>5</td>
<td>5.5536</td>
<td>891</td>
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<tr>
<td>6</td>
<td>2.6893</td>
<td>5595</td>
<td>4.29%</td>
<td></td>
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<tr>
<td>7</td>
<td>2.3079</td>
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<td>11.10%</td>
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<tr>
<td>8</td>
<td>2.3178</td>
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<td>11.57%</td>
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<td>9</td>
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<td>7.43%</td>
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<td>10</td>
<td>3.2417</td>
<td>7360</td>
<td>5.64%</td>
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<tr>
<td>11</td>
<td>2.1809</td>
<td>13006</td>
<td>9.96%</td>
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<td>12</td>
<td>1.5406</td>
<td>16790</td>
<td>12.86%</td>
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<td>13</td>
<td>1.4885</td>
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<td>14</td>
<td>1.5596</td>
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<td>11.12%</td>
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<td>15</td>
<td>2.391</td>
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<td>4.92%</td>
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<td>16</td>
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<td>1.64%</td>
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<td>17</td>
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<td>18</td>
<td>3.1406</td>
<td>1510</td>
<td>1.16%</td>
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<td>19</td>
<td>4.6772</td>
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<td>20</td>
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<td></td>
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<td>22</td>
<td>43.329</td>
<td>29</td>
<td>0.02%</td>
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<tr>
<td>23</td>
<td>44.7129</td>
<td>69</td>
<td>0.05%</td>
<td></td>
</tr>
</tbody>
</table>
Estimation of duration model

Three Hypotheses

• Size Effect
• Price Impact
• Liquidity Effect
ACD model

- **ACD Model**
  - Duration $x_i = \psi_i \varepsilon_i$
  - Conditional duration $\psi_i$
  - $\varepsilon_i$ is an IID error sequence

- **EACD (flat hazard function)**

- **Weibull ACD (monotone hazard function)**
ACD model

• Burr ACD model
  – Inverted U-shaped Hazard function
  – Hazard function increasing for small duration and decreasing for long duration
  – Nests EACD and WACD model as special cases
Burr-ACD

- **Burr-Distribution:**
  - Density Function: 
    \[
    f(\psi_i) = \psi_i \cdot \frac{(\sigma^2)^{\frac{1}{\kappa}} \cdot \Gamma\left(\frac{1}{\sigma^2} + 1\right)}{\Gamma(1 + \frac{1}{\kappa}) \cdot \Gamma\left(\frac{1}{\sigma^2} - \frac{1}{\kappa}\right)}
    \]
  - Hazard Function: 
    \[
    h(x_i | x_{i-1}, \ldots, x_1; \theta) = \frac{\kappa \cdot \xi_i^{-\kappa} \cdot x_i^{\kappa-1}}{1 + \sigma^2 \cdot \xi_i^{-\kappa} \cdot x_i^\kappa}
    \]

- **EACD**
  \[
  h(x_i | x_{i-1}, \ldots, x_1) = \frac{1}{\psi_i}
  \]

- **WACD**
  \[
  h(x_i | x_{i-1}, \ldots, x_1) = x_i^{\gamma-1} \gamma
  \]
Representative Hazard Functions

Weibull 0.5, 0
Burr 2, 0.5
ACD model

Concerns:

– Dependent Variable: Conditional duration
– Right hand side of estimation equation needs to be positive
– Non-negativity constraints on the coefficients of exogenous variables
Log ACD Model

• Log-ACD Model
  – Duration \( x_i = \exp(\psi_i) \varepsilon_i \)
  – \( \psi_i \): Logarithm of conditional duration
  – \( \varepsilon_i \) is an IID sequence as in ACD model.

• Log-ACD(1,1) specification
  \[
  \psi_i = \omega + \alpha \ln(x_{i-1}) + \beta \psi_{i-1}
  \]
Censoring

• Potential bias from ignoring unfilled orders or partial fills
• Estimate joint likelihood

\[
\prod_{i=1}^{n} f(x_i; X_i)^{c_i} g(x_i; X_i)^{1-c_i} = \prod_{F} f(x_i; X_i) \prod_{C} g(x_i; X_i)
\]
Model Estimation

• Over peak European business hours 8:00am – 5:00 pm GMT

• Variables
  – SIZE: Quantity submitted in millions of dollars
  – PRICEDIF: submission price - last transaction price
  – DEPTH: depth of order book
Model Estimation

• Dummy variables
  – DummyBP
    • 1 for buy orders with pricedif>0; 0 otherwise
  – DummyBN
    • 1 for buy orders with pricedif<0; 0 otherwise
  – DummySP
    • 1 for sell orders with pricedif>0; 0 otherwise
  – DummySN
    • 1 for sell orders with pricedif<0; 0 otherwise
Model Estimation

- Burr Log-ACD (1,1) model

\[ \psi_i = \omega + \alpha \ln(x_{i-1}) + \beta \psi_{i-1} + \delta_1 SIZE_i + \delta_2 Dummy_{BP_i} + \delta_3 Dummy_{BN_i} + \delta_3 Dummy_{SP_i} + \delta_4 Dummy_{SN_i} + \delta_5 DEPTH_i \]
## Model Estimates (filled orders)

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>T-Stat</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIZE</td>
<td>0.0197</td>
<td>0.0085</td>
<td>2.33</td>
<td>0.0197</td>
</tr>
<tr>
<td>DummyBP&lt;sub&gt;i&lt;/sub&gt;</td>
<td>-1.2171</td>
<td>0.0402</td>
<td>-30.31</td>
<td>0.0000</td>
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<tr>
<td>DummyBN&lt;sub&gt;i&lt;/sub&gt;</td>
<td>1.7880</td>
<td>0.0368</td>
<td>48.59</td>
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<tr>
<td>DummySP&lt;sub&gt;i&lt;/sub&gt;</td>
<td>1.7140</td>
<td>0.0355</td>
<td>48.31</td>
<td>0.0000</td>
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<tr>
<td>DummySN&lt;sub&gt;i&lt;/sub&gt;</td>
<td>-1.2902</td>
<td>0.0389</td>
<td>-33.17</td>
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<tr>
<td>LDEPTH</td>
<td>-0.0084</td>
<td>0.0003</td>
<td>-30.20</td>
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<tr>
<td>MDEPTH</td>
<td>-0.0101</td>
<td>0.0004</td>
<td>-25.22</td>
<td>0.0000</td>
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</tbody>
</table>
Model Estimates (censored orders)

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>T-Stat</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIZE</td>
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<td>0.0007</td>
<td>-64.78</td>
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<td>-14.19</td>
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</tr>
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</table>
Estimated Hazard Function

Hazard Function

Duration

Burr, 0.6544, 0.5135
Conclusions

• Explain choice of trading venues
  – Large traders prefer direct dealing while small traders utilize the electronic brokerage

• Empirical results consistent with hypotheses from theory.
  – Large orders wait longer on EB given the depth of the market and price competitiveness.