Spectrum Auctions
Peter Cramton
University of Maryland

Prices are all over the place. Why?
• Auction design
• Auction competition
• Auction strategy
• Complex interaction of the above

Auction design
• Ascending auctions work well, but details are essential to success
  – Example: Need to understand existing market structure
• Key determinants of prices are
  – State of capital markets
  – Spectrum allocation
  – Sequencing
  – Reserve prices
  – Competition laws

US vs. Europe
• US uses simultaneous ascending auction
  – All licenses on the block at the same time
  – But some sequencing: AB, C, DEF, etc.
• Europe uses a sequence of ascending auctions
  – Clear sequencing
  – First mover advantage becomes important

Incumbent advantage
• Incumbent value = 3G value + value lost in 2G if do not win a license
• Entrant value = 3G value – extra cost of building network from scratch
⇒ Incumbents have strong advantage
⇒ Likely outcome is all incumbents win
Competition matters

<table>
<thead>
<tr>
<th>Country</th>
<th>Bidders to Licenses</th>
<th>New entrants only</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>13 for 5</td>
<td>9 for 1</td>
</tr>
<tr>
<td>Dutch</td>
<td>6 for 5</td>
<td>1 for 0</td>
</tr>
<tr>
<td>German</td>
<td>7 for 4 to 7 for 6</td>
<td>3 for 0 to 3 for 2</td>
</tr>
<tr>
<td>Italy</td>
<td>6 for 5</td>
<td>2 for 1</td>
</tr>
<tr>
<td>Austrian</td>
<td>6 for 4 to 6 for 6</td>
<td>3 for 1 to 3 for 3</td>
</tr>
<tr>
<td>Swiss</td>
<td>9 for 4</td>
<td>6 for 1</td>
</tr>
<tr>
<td>Swiss final</td>
<td>4 for 4</td>
<td>1 for 1</td>
</tr>
<tr>
<td>Belgium</td>
<td>4 for 4</td>
<td>1 for 1</td>
</tr>
</tbody>
</table>

Auction competition is endogenous

- Bidders will merge if big price impact
- Extra incentive to merge if
  - High prices in prior auctions
  - Low reserve price
  - Large value difference between marginal and sub-marginal bidder

German 3G Auction

- 12 blocks of 5 MHz each
- Can win at most 3, but at least 2
- Hence, between 4 and 6 winners
- 4 incumbents will surely win
- Question is whether incumbents give up 5 MHz to make room for 5th or 6th player

Strategy matters

- Other cases of poor bidding
  - Vodafone in UK auction
  - Verizon in US auction
    - Paid over $2B for each 2 x 5 MHz in NYC
    - Could have ended bidding at $.8B if got 1, not 2
    - Throwing good money after bad?

Bid limits appear to be whole billion of local or home currency

<table>
<thead>
<tr>
<th>UK 3G Auction</th>
<th>Crestnet</th>
<th>3G</th>
<th>5G</th>
<th>Spectrum</th>
<th>OneTel</th>
<th>WorldCom</th>
<th>Telephone</th>
<th>VNL</th>
</tr>
</thead>
<tbody>
<tr>
<td>home exchange</td>
<td></td>
<td>2.5</td>
<td>9.5</td>
<td>200</td>
<td>5.0</td>
<td>4.0</td>
<td>3.0</td>
<td>2.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3G Auction</th>
<th>Crestnet</th>
<th>3G</th>
<th>5G</th>
<th>Spectrum</th>
<th>OneTel</th>
<th>WorldCom</th>
<th>Telephone</th>
<th>VNL</th>
</tr>
</thead>
<tbody>
<tr>
<td>home exchange</td>
<td></td>
<td>2.5</td>
<td>9.5</td>
<td>200</td>
<td>5.0</td>
<td>4.0</td>
<td>3.0</td>
<td>2.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>German 3G Auction</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dropout</td>
<td></td>
</tr>
<tr>
<td>min</td>
<td>9.8</td>
</tr>
<tr>
<td>max</td>
<td>10.8</td>
</tr>
<tr>
<td>Bid limit</td>
<td>10 BDM</td>
</tr>
<tr>
<td>Why were prices so high?</td>
<td>Did high prices destroy telecom?</td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------------------------</td>
</tr>
</tbody>
</table>
| • Values based on stock prices, not expected cash flows  
  – Telecom bubble led to high values |
| • Winner’s curse  
  – 9 potential entrants in UK for 1 license |
| • Failure to see options  
  – Not offering 3G  
  – Acquiring weakest winner after auction |
| • Puts spectrum in hands best able to use it |
| • License fee is sunk cost  
  – Does not distort subsequent decisions  
  – Non-distortionary government revenues  
  – Transfer from shareholders to taxpayers |
| • Capital markets may punish overbidding  
  – Reduced capital available for future projects |

<table>
<thead>
<tr>
<th>Moving forward</th>
<th>Spectrum policy</th>
</tr>
</thead>
</table>
| • Package auctions with proxy bidding  
  – Mitigate demand reduction  
  – Better expression of preferences  
  – Better control of pace of auction  
  – Good price discovery to focus valuation analysis |
| • Two-sided auctions for encumbered spectrum  
  – Efficient reassignment of spectrum  
  – Encourage incumbent participation with new rights |
| • Command and control unworkable when technology is changing so rapidly |
| • Property rights  
  – Favor flexible use, tradeable rights, interference temperature at borders |
| • Commons  
  – Favor unlicensed spectrum, responsible use (hardware able to handle interference) |
| • Which model is best?  
  – Scarcity  
  – Externalities |