Spectrum Value

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Four Factors Determine Spectrum Value

• Demand for wireless services
• Technology
• Physical characteristics of the spectrum
• License rules and definitions
Spectrum Value
- Does Not -
Always Increase
Data on Spectrum Value from Auctions and Secondary Trades
## Major Secondary Spectrum Trades

Selected major secondary spectrum transactions.

<table>
<thead>
<tr>
<th>Buyer</th>
<th>Seller</th>
<th>Year auctioned</th>
<th>Year resold</th>
<th>Band type</th>
<th>$MHz-POP At auction</th>
<th>$MHz-POP At resale</th>
<th>Annualized percent increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verizon</td>
<td>NorthCoast</td>
<td>1997</td>
<td>2002</td>
<td>PCS</td>
<td>$0.26</td>
<td>$1.69</td>
<td>45%</td>
</tr>
<tr>
<td>Verizon</td>
<td>Qwest</td>
<td>1997</td>
<td>2004</td>
<td>PCS</td>
<td>$0.50</td>
<td>$1.26</td>
<td>14%</td>
</tr>
<tr>
<td>Verizon</td>
<td>NextWave</td>
<td>1996, 1997</td>
<td>2004</td>
<td>PCS</td>
<td>$1.59</td>
<td>$1.90</td>
<td>2.3%</td>
</tr>
<tr>
<td>Aloha Partners</td>
<td>LIN TV</td>
<td>2002, 2003</td>
<td>2007</td>
<td>700 MHz</td>
<td>$0.05</td>
<td>$0.25</td>
<td>39%</td>
</tr>
<tr>
<td>AT&amp;T</td>
<td>Aloha Partners</td>
<td>2002, 2003</td>
<td>2007</td>
<td>700 MHz</td>
<td>$0.03</td>
<td>$1.34</td>
<td>121%</td>
</tr>
<tr>
<td>T-Mobile, Metro PCS, others</td>
<td>NextWave</td>
<td>2006</td>
<td>2008</td>
<td>AWS-1</td>
<td>$0.16</td>
<td>$0.44</td>
<td>69%</td>
</tr>
<tr>
<td>AT&amp;T</td>
<td>Qualcomm</td>
<td>2003, 2008</td>
<td>2010</td>
<td>700 MHz</td>
<td>$0.33</td>
<td>$1.07</td>
<td>79%</td>
</tr>
<tr>
<td>Sprint</td>
<td>Wirefree</td>
<td>2005</td>
<td>2010</td>
<td>PCS</td>
<td>$0.83</td>
<td>$0.58</td>
<td>-6.9%</td>
</tr>
<tr>
<td>Verizon</td>
<td>SpectrumCo, Cox</td>
<td>2006</td>
<td>2011</td>
<td>AWS-1</td>
<td>$0.45</td>
<td>$0.74</td>
<td>10.4%</td>
</tr>
<tr>
<td>Sprint</td>
<td>US Cellular</td>
<td>1995</td>
<td>2012</td>
<td>PCS</td>
<td>$1.00</td>
<td>$0.96</td>
<td>-0.3%</td>
</tr>
<tr>
<td>AT&amp;T</td>
<td>NextWave</td>
<td>1997, 2006</td>
<td>2012</td>
<td>AWS-1, WCS</td>
<td>$0.00</td>
<td>$0.26</td>
<td>32%</td>
</tr>
<tr>
<td>AT&amp;T</td>
<td>Verizon</td>
<td>2008</td>
<td>2013</td>
<td>700 MHz</td>
<td>$4.07</td>
<td>$4.98</td>
<td>4.1%</td>
</tr>
<tr>
<td>Grain Management</td>
<td>Verizon</td>
<td>2008</td>
<td>2013</td>
<td>700 MHz</td>
<td>$4.31</td>
<td>$5.15</td>
<td>3.6%</td>
</tr>
<tr>
<td>T-Mobile</td>
<td>US Cellular</td>
<td>2008</td>
<td>2013</td>
<td>AWS-1</td>
<td>$0.25</td>
<td>$0.96</td>
<td>16.4%</td>
</tr>
<tr>
<td>VerizonT-Mobile</td>
<td>Verizon</td>
<td>2008</td>
<td>2014</td>
<td>700 MHz</td>
<td>$1.58</td>
<td>$2.17</td>
<td>5.5%</td>
</tr>
<tr>
<td>T-Mobile</td>
<td>Verizon</td>
<td>2008</td>
<td>2014</td>
<td>700 MHz</td>
<td>$1.27</td>
<td>$1.75</td>
<td>5.5%</td>
</tr>
</tbody>
</table>

Spectrum Price Indices

Source: Wallsten, 2016
Price & Quantity of Spectrum as Function of Wireless Services

- Supply
- Demand

$p^*$
$q^*$
Four Factors Determine Spectrum Value

• Demand for wireless services

• Technology

• Physical characteristics of the spectrum

• License rules and definitions
Increase in Demand for Wireless Services Increases Spectrum Value, All Else Equal
Increase in Demand for Wireless Services Increases Spectrum Value, All Else Equal

But All Else is NOT Equal!
Spectrum Value - May Not - Always Increase Even When Demand for Wireless Services Does
Four Factors Determine Spectrum Value

- Demand for wireless services
- Technology
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Innovation Improves Spectral Efficiency

technological improvements reduce the cost of transmitting any given amount of data (normalize however you please)
Technological Improvements
Reduce Spectrum Value, All Else Equal
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Physical Characteristics of the Spectrum

Higher Frequencies \( \triangleleft \) Lower Price/MHz-pop

Due to propagation characteristics—higher frequencies need more investment to provide given level of service over any given area.
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License Rules and Definitions

Allowed Uses
• More Flexible

Geographic Area Covered
• Topography: Flat, boring \(\uparrow\) Mountainous, Urban \(\downarrow\)
• More economic activity \(\uparrow\)
• Size of Area Covered \(\uparrow\) (very large worth less than small, but among smaller sizes unclear) \(\downarrow\)

Bandwidth \(\downarrow\) (in a linear regression; I suspect true relationship is nonlinear)

Paired \(\uparrow\)

Any Restrictions / Obligations \(\downarrow\)
Private and public values may differ. Some obligations may benefit society but reduce the private value of the spectrum.

(Then the debate is whether those are net benefits)
Four Factors Determine Spectrum Value

- Demand for wireless services  
  Change quickly

- Technology

- Physical characteristics of the spectrum  
  Never changes

- License rules and definitions  
  Slow change