

Generalizing US Spectrum Experience

Discussant Paper for:

US Wireless License Auctions: 1994-2009

by Thomas W. Hazlett

Australian Competition and Consumer Commission 2009 Regulatory Conference

'Regulation of Infrastructure in a Time of Transition'

Gold Coast, July 30, 2009

Gary Madden, CEEM

Generally Accepted Benefits of Auctions

- Transparent assignment process based on price
 - Limits the potential for lobbying activity
- Generally raise more revenue than other assignment modes

History of US Auctions

- Congressional authorisation for competitive bidding granted in 1993
 - 34 years after Coase (1959) highlights potential benefit from auctions

- From 1994-2009 85 auctions are held, in which:
 - 27,484 licences are sold
 - \$52.6bn of revenue is paid to the US government

Potentially Testable Hazlett Propositions

- Claimed to apply to US auction processes
 1. Auctions replaced highly inefficient assignment modes (p. 7)
 2. Auction assignment is efficient (p. 5)
 3. Auctions invigorate retail competition (p. 5)
 4. Spectrum price distortion is not solely explained by market conditions (p. 12)
 5. Bidding credits intensity bidding, eroding any potential entrant advantage (p. 17)

- Plausible that the same properties would apply to other regional auctions
- Less clear that propositions apply to national licences

Uniqueness of the US Institutional Setting

- US spectrum licences are highly fragmented
 - 734 local franchise areas
 - 2,074 personal communication services licences
 - More than 47,000 specialised mobile radio licences

- Operators seek adjacent spectrum blocks
 - Benefit from licence synergies and complementarities

- Licence aggregation risk is mitigated by allowing combinatorial bidding

Regional Spectrum Licences

- Data drawn from DotEcon *Spectrum Awards Database*
 - Contains descriptive characteristics for spectrum assignments from 1999-2008

- Australia, Brazil, Canada and the US assign regional licences
 - All are assigned by auction

Table 1. 3G Regional Spectrum Assignments, 1999–2008

| Country | Year | Mode | Licences |
|---------------|------|---------|----------|
| Australia | 2001 | Auction | 58 |
| United States | 2006 | Auction | 1122 |
| Brazil | 2007 | Auction | 36 |
| Canada | 2008 | Auction | 292 |

Source: DotEcon Spectrum Awards Database (2008).

National Spectrum Licences, 1999-2001

Table 2a. 3G National Auction and Beauty Contest Spectrum Assignments, 1999–2001

| Country | Year | Mode | Licences |
|----------------|------|----------------|----------|
| Finland | 1999 | Beauty Contest | 4 |
| Spain | 2000 | Beauty Contest | 4 |
| United Kingdom | 2000 | Auction | 5 |
| Ireland | 2000 | Beauty Contest | 8 |
| Japan | 2000 | Beauty Contest | 3 |
| Netherlands | 2000 | Auction | 5 |
| Germany | 2000 | Auction | 6 |
| Italy | 2000 | Auction | 5 |
| Austria | 2000 | Auction | 17 |
| Norway | 2000 | Beauty Contest | 4 |
| Switzerland | 2000 | Auction | 4 |
| Korea Republic | 2000 | Beauty Contest | 3 |
| Sweden | 2000 | Beauty Contest | 4 |
| Portugal | 2000 | Beauty Contest | 4 |
| Poland | 2000 | Auction | 5 |
| New Zealand | 2001 | Auction | 41 |
| Belgium | 2001 | Auction | 4 |
| Singapore | 2001 | Auction | 4 |
| France | 2001 | Beauty Contest | 4 |
| Greece | 2001 | Auction | 4 |
| Denmark | 2001 | Auction | 4 |
| Hong Kong | 2001 | Auction | 4 |
| Slovenia | 2001 | Auction | 3 |
| Czech Republic | 2001 | Auction | 4 |
| Israel | 2001 | Auction | 5 |

National Spectrum Licences, 2002-2007

Table 2b. 3G National Auction and Beauty Contest Spectrum Assignments, 2002–2007

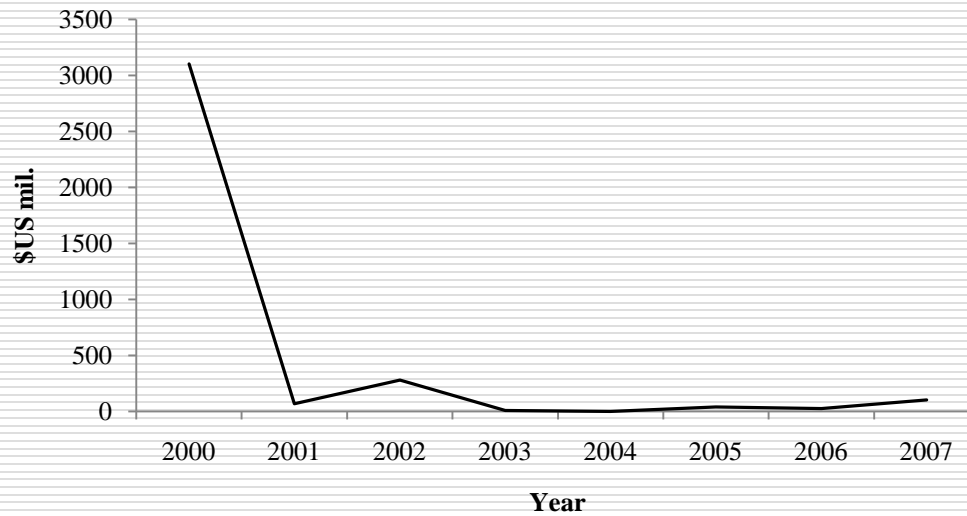
| Country | Year | Mode | Licences |
|-----------------|------|----------------|----------|
| Liechtenstein | 2002 | Auction | 4 |
| Taiwan | 2002 | Auction | 5 |
| Luxembourg | 2002 | Beauty Contest | 4 |
| Ireland | 2002 | Beauty Contest | 4 |
| Slovak Republic | 2002 | Beauty Contest | 3 |
| Malaysia | 2002 | Beauty Contest | 3 |
| France | 2002 | Beauty Contest | 2 |
| Bahrain | 2003 | Beauty Contest | 1 |
| Luxembourg | 2003 | Beauty Contest | 1 |
| Estonia | 2003 | Beauty Contest | 4 |
| Norway | 2003 | Auction | 2 |
| Indonesia | 2003 | Beauty Contest | 4 |
| Saudi Arabia | 2004 | Auction | 1 |
| Romania | 2004 | Beauty Contest | 4 |
| Hungary | 2004 | Auction | 4 |
| Croatia | 2004 | Beauty Contest | 3 |
| Bulgaria | 2005 | Auction | 3 |
| Latvia | 2005 | Auction | 1 |
| Poland | 2005 | Beauty Contest | 1 |
| Denmark | 2005 | Auction | 1 |
| Indonesia | 2006 | Auction | 3 |
| Georgia | 2006 | Auction | 3 |
| Egypt | 2006 | Auction | 1 |
| Slovak Republic | 2006 | Beauty Contest | 1 |
| Slovenia | 2006 | Auction | 2 |
| Macao | 2006 | Beauty Contest | 3 |
| Estonia | 2007 | Auction | 1 |
| Ireland | 2007 | Beauty Contest | 1 |
| Nigeria | 2007 | Auction | 4 |
| Russia | 2007 | Beauty Contest | 3 |

National Spectrum Licences

- National spectrum licences issued in 56 assignments from 1999-2007
 - 25 are by beauty contest
 - 31 are by auction

- No clear link between geographic size and national/regional licences

Annual Average 3G Winning Bids



- A structural break in spectrum prices after 2002

Further Reading

- ❑ Madden, G., Morey, A. and Bohlin, E. (2009), 'An Econometric Analysis of 3G Spectrum Valuations', (under review)
- ❑ Madden, G. and Morey, A. (2009), 'The Beauty Contest Licencing of 3G Spectrum', (under review)
- ❑ Madden, G. and Morey, A. (2009), 'Market Entry via Licence Assignments in 3G Markets'

Proposition 1

Auctions have replaced highly inefficient assignment modes

Table 2c. National Assignments, 1999-2007

| | 1999-2001 | 2002-2007 |
|----------------|-----------|-----------|
| Auction | 16 | 15 |
| Beauty Contest | 9 | 16 |

- Since 2001 beauty contests are more common (see Table 2b)
 - This result is at variance with Hazlett's proposition
-

Proposition 2

Auction assignment is efficient

- Klemperer defines efficient spectrum assignment
 - "the sum of the valuations of operators awarded the licences is maximised"*
(Klemperer, 2002: 844)
- Efficiency is not directly observable

Indirect Assessment of Efficiency

- High spectrum-valuing firms more likely to use licences
- Hence, measure of efficiency is number of licences in service
- Must wait long enough since the assignment to deploy networks

Licence Efficiency

Table 3. Licences Assigned in Western Europe, 1999–2003

| | <i>Auction</i> | | <i>Beauty Contest</i> | | <i>Total</i> | |
|-------------------|----------------|-----|-----------------------|-----|--------------|-----|
| | No. | % | No. | % | No. | % |
| Licences Assigned | 41 | 100 | 29 | 100 | 70 | 100 |
| In Service | 28 | 68 | 23 | 79 | 51 | 73 |
| Not in Service | 13 | 32 | 6 | 21 | 19 | 27 |

Source: Gruber (2007).

- Greater portion of licences not in service assigned by auction (32%)
 - 21% in beauty contests
- Suggests spectrum valuations possibly inefficient in auctions
- Alternative measure is the degree to which network obligations are met

Proposition 3

Auctions invigorate retail competition

- Excess licences defined as assigned licences in excess of incumbents

- Consider cases where entrant number is greater than excess licences
 - 9 of 25 auctions (36%) (see Table 4a)
 - 5 of 20 beauty contests (25%) (see Table 4b)
 - Only consider cases where both entrants and incumbents can win licences

- Indicates that auctions are more effective in encouraging entry

Excess Licences and Entrants, Auctions

Table 4a. Excess Licences and New Entrants by Assignment, 1999–2007

| Country | Year | Excess Licences ^b | Entrants ^c |
|----------------|------|------------------------------|-----------------------|
| Austria | 2000 | 2 | 2 |
| Germany | 2000 | 2 | 2 |
| Italy | 2000 | 0 | 0 |
| Netherlands | 2000 | 0 | 0 |
| Poland | 2000 | 2 | 0 |
| Switzerland | 2000 | 1 | 1 |
| United Kingdom | 2000 | 0 | 0 |
| Belgium | 2001 | 0 | 0 |
| Czech Republic | 2001 | 1 | 0 |
| Denmark | 2001 | 0 | 1 |
| Greece | 2001 | 0 | 0 |
| Israel | 2001 | 1 | 0 |
| New Zealand | 2001 | 1 | 2 |
| Singapore | 2001 | 0 | 0 |
| Slovenia | 2001 | 1 | 0 |
| Liechtenstein | 2002 | 2 | 0 |
| Taiwan | 2002 | 1 | 2 |
| Hungary | 2004 | 1 | 0 |
| Bulgaria | 2005 | 0 | 0 |
| Denmark | 2005 | 0 | 1 |
| Latvia | 2005 | 0 | 1 |
| Egypt | 2006 | 0 | 1 |
| Georgia | 2006 | 0 | 2 |
| Indonesia | 2006 | 0 | 1 |
| Slovenia | 2006 | 0 | 1 |
| Russia | 2007 | 0 | 0 |
| Total | | 9 | 11 |

Excess Licences and Entrants, Beauty Contests

Table 4b. Excess Licences and New Entrants by Assignment, 1999–2007^a

| Country | Year | Excess Licences ^b | Entrants ^c |
|-----------------|------|------------------------------|-----------------------|
| Finland | 1999 | 0 | 0 |
| Spain | 2000 | 1 | 1 |
| Japan | 2000 | 0 | 0 |
| Norway | 2000 | 1 | 1 |
| Korea Republic | 2000 | 0 | 0 |
| Sweden | 2000 | 1 | 2 |
| Portugal | 2000 | 1 | 1 |
| France | 2001 | 1 | 0 |
| Luxembourg | 2002 | 1 | 1 |
| Ireland | 2002 | 0 | 1 |
| Slovak Republic | 2002 | 0 | 0 |
| Malaysia | 2002 | 0 | 0 |
| France | 2002 | 1 | 0 |
| Estonia | 2003 | 1 | 0 |
| Luxembourg | 2003 | 0 | 1 |
| Croatia | 2004 | 0 | 1 |
| Romania | 2004 | 0 | 0 |
| Poland | 2005 | 1 | 1 |
| Ireland | 2007 | 0 | 1 |
| Russia | 2007 | 0 | 0 |
| Total | | 9 | 11 |

Further Evidence

- ❑ Assignment data used for an econometric analysis
- ❑ Seek to identify determinants of 3G market entry
- ❑ Dependent variable is equal to 1 if licence won by entrant, 0 otherwise
- ❑ Univariate Probit model used in estimation

Entrant Regression

| Variable | Coefficient | Std. Error | t-stat. | Elasticity |
|---|-------------|------------|----------|------------|
| <i>Spectrum Package Attributes</i> | | | | |
| DURATION | -0.6 | 0.04 | -1.71* | -2.75 |
| INITIAL | -0.33 | 0.18 | -1.18* | -0.48 |
| REVISED | 2.84 | 0.69 | 4.13*** | 5.52 |
| WITHHOLD | -11.40 | 3.24 | -3.52*** | -3.84 |
| <i>Licence Award Process</i> | | | | |
| ACOMP | -0.33 | 0.26 | -1.28 | -0.94 |
| AUCTION | 1.28 | 0.51 | 2.53** | 2.19 |
| DEPOSIT | 0.08 | 0.05 | 1.56 | 0.98 |
| EXCESS | 0.58 | 0.27 | 2.16** | 0.91 |
| PCONC | -0.47 | 0.60 | -0.78 | -0.03 |
| SCONC | -0.15 | 0.61 | -0.25 | -0.03 |
| <i>Post-award Financial Performance Obligations</i> | | | | |
| FEE | 1.91 | 0.68 | 2.82*** | 0.78 |
| PERCENT | 0.77 | 0.28 | 2.75*** | 0.23 |
| <i>Post-award Network Performance Obligations</i> | | | | |
| COVTIM | 2.93 | 1.37 | 2.15** | 0.85 |
| SHARE | -0.14 | 0.61 | -0.23 | -0.07 |
| <i>Spectrum Payment Mode</i> | | | | |
| ANNUAL | 3.61 | 1.27 | 2.83*** | 3.94 |
| NEITHER | 3.01 | 1.27 | 2.38** | 1.89 |
| UPFRONT | 1.48 | 0.75 | 1.98** | 2.20 |

□ Auction positive at 5%

□ Elasticity 2.19%

Proposition 4

Spectrum price distortion not solely explained by market conditions

- Spectrum price regression identifies determinants of national prices
 - US\$ per MHz per population
 - Spectrum premium is modelled (price – reserve)
 - Use 3G auction data

- NRA-controlled variables identified as main determinants of prices

Elasticity Estimates

Table 6. NRA-Controlled Variable Elasticity Estimates

| Category | Variable | Elasticity |
|-----------------------------|----------|--------------|
| Spectrum package attributes | DURATION | -1.50 |
| | REVISED | 0.08 |
| | ENTRANT | -0.03 |
| | RESERVE | 0.12 |
| Licence award process | DEPOSIT | 0.15 |
| Financial obligations | ANNUAL | -0.19 |
| Network obligations | SHARE | 0.43 |
| | COVER | -1.00 |
| | TIME | 1.66 |

Note: Bold indicates coefficient is significant.

Elastic Determinants of Price

- Longer licence duration has a negative effect
 - Business operations myopic, favour shorter pay back periods

- Higher coverage requirements has a negative effect
 - More onerous deployment obligations diminish spectrum value

- Longer time to meet deployment obligations has a positive effect
 - More time adds value to licences

Inelastic Determinants of Price

- ❑ Higher reserve price increases premiums
- ❑ Higher annual payments decrease premiums
- ❑ Revised licences have higher premiums

Proposition 5

Bidding credits intensify bidding, eroding potential entrant advantage

Table 7. Entrant Concessions, 1999–2008

| Country | Year | Assignment Mode | Concession |
|-----------------|------|-----------------|------------|
| Italy | 2000 | Auction | s |
| UK | 2000 | Auction | s, p |
| Greece | 2001 | Auction | s |
| Israel | 2001 | Auction | p |
| Ireland | 2002 | Beauty Contest | s, p^a |
| Slovak Republic | 2002 | Beauty Contest | s |

- s indicates additional spectrum is made available to entrants
- p indicates spectrum price is discounted to entrants
- Price and spectrum concessions are rare

Entrant Regression

| Variable | Coefficient | Std. Error | t-stat. | Elasticity |
|---|-------------|------------|----------|------------|
| <i>Spectrum Package Attributes</i> | | | | |
| DURATION | -0.6 | 0.04 | -1.71* | -2.75 |
| INITIAL | -0.33 | 0.18 | -1.18* | -0.48 |
| REVISED | 2.84 | 0.69 | 4.13*** | 5.52 |
| WITHHOLD | -11.40 | 3.24 | -3.52*** | -3.84 |
| <i>Licence Award Process</i> | | | | |
| ACOMP | -0.33 | 0.26 | -1.28 | -0.94 |
| AUCTION | 1.28 | 0.51 | 2.53** | 2.19 |
| DEPOSIT | 0.08 | 0.05 | 1.56 | 0.98 |
| EXCESS | 0.58 | 0.27 | 2.16** | 0.91 |
| PCONC | -0.47 | 0.60 | -0.78 | -0.03 |
| SCONC | -0.15 | 0.61 | -0.25 | -0.03 |
| <i>Post-award Financial Performance Obligations</i> | | | | |
| FEE | 1.91 | 0.68 | 2.82*** | 0.78 |
| PERCENT | 0.77 | 0.28 | 2.75*** | 0.23 |
| <i>Post-award Network Performance Obligations</i> | | | | |
| COVTIM | 2.93 | 1.37 | 2.15** | 0.85 |
| SHARE | -0.14 | 0.61 | -0.23 | -0.07 |
| <i>Spectrum Payment Mode</i> | | | | |
| ANNUAL | 3.61 | 1.27 | 2.83*** | 3.94 |
| NEITHER | 3.01 | 1.27 | 2.38** | 1.89 |
| UPFRONT | 1.48 | 0.75 | 1.98** | 2.20 |

□ PCONC, SCONC insignificant

□ Other variables matter

References

- Coase, R. (1959), 'The Federal Communications Commission', *Journal of Law and Economics* 2, 1–40
- Klemperer, P. (2002), 'How (Not) to Run Auctions: The European 3G Telecom Auctions', *European Economic Review* 46, 829–45