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Proposed FCC Incentive Spectrum Auctions: The Importance of Re-Optimizing Spectrum Use

by

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The Federal Communications Commission is currently requesting authorization from Congress to undertake incentive auctions. The purpose of the incentive auctions would be to allow up 120 MHz of high-quality spectrum currently used by television (TV) broadcasters to be reallocated to a more economically beneficial use. In light of the economic and social benefits that accrue from broadband availability and adoption, the public policy goal is to free up additional spectrum that could be used to provide mobile broadband services. Inherently, this objective assumes that the economic and social gains to our country from the availability of additional spectrum for broadband outweigh the economic and social costs of compensating TV broadcasters for voluntarily agreeing to vacate their current channels in favor of either relocation to new channels, channel sharing, or ceasing over-the-air transmissions.

I first show, briefly, the tremendous economic and social benefits that result from the widespread availability of broadband services. I then provide an overview of the proposed incentive spectrum auctions and explain the various factors that are relevant to the auction design in order to translate theory into practice in a way that achieves the most beneficial results for society. Finally, while recognizing that designing successful

auctions is not without challenge, I express confidence that, if given flexibility as to design, the FCC can accomplish the task of freeing up spectrum for use by fast-growing mobile broadband services, while, at the same time, raising revenues for the U.S Treasury that it otherwise would not receive.

The Economic and Social Benefits of Broadband Service

In terms of the economic impact of broadband, there is extensive evidence from academic research concerning the positive effects of broadband on productivity. Macroeconomic level studies have focused more generally on the Information, Communications, and Technology (ICT) sector and its impact on labor productivity and per capita gross domestic product (GDP). For example, academic research by different authors has found that the ICT sector contributed to between 56% to 67% of labor productivity growth in the U.S. in the late 1990s, and 38% of labor productivity growth from 2000 to 2006.[1]

More disaggregated studies suggest that these observed aggregate effects are not distributed evenly across communities or industry sectors. Several papers find a link between local skills, or types of work and workers, or intensity of ICT usage and positive gains from ICT. Among these are papers that focus specifically on Internet usage. [2] In other words, the observed positive effects of broadband usage appear to occur in particular industries and/or communities with specific traits and do not appear to lead to productivity and growth effects in other industries/communities.[3] This is an important fact to recognize as this means that the simple introduction of broadband to a community will not necessarily lead to productivity gains in that community. Hence, it will not necessarily lead to convergence of productivity and income levels between the last communities to be reached by broadband and the rest of the nation. Still, the availability and quality of broadband services have been strong drivers of growth in specific industries. And it is the growth in those sectors that appears to have driven aggregate growth in the U.S. economy.

In contrast to the productivity effects of broadband availability, consumer gains from broadband are not region-specific. There are many ways in which broadband can be useful to consumers. Consumers can use Voice over Internet Protocol (VOIP) over broadband as an alternative to traditional telephone services. In combination with the Internet, broadband service provides access to a wealth of information. This information varies tremendously from news, to community affairs, to job postings, to information on hobbies, and so forth. Broadband service thereby lowers search costs and potentially leads to better matches in jobs, goods, services, community activities, and even dating.[4] It facilitates both social and professional networking and increases the geographic market for goods and services.[5] Finally, broadband can also be used for online gaming and entertainment, which provide value to the consumer.[6]

Importantly, broadband usage is increasingly mobile, thus demanding greater amounts of spectrum. This is happening in three ways. First, more people are using mobile devices. In 1995, there were 33.8 million wireless subscribers. In 2010, there were

302.9 million wireless subscribers. That is close to a ten-fold increase in only 15 years. Moreover, more households are becoming wireless-only households. In 2005, only 8.4% of households were wireless-only, by 2010, 26.6% were wireless only. Second, mobile devices are becoming more sophisticated, and as a consequence, are creating much more data traffic. For example, a smartphone uses 24 times more spectrum than a regular cell phone. A tablet uses 122 times more spectrum than a regular cell phone, and a laptop uses 515 times more spectrum.[7] Third, over time people are using these mobile devices more intensively. All three of these dimensions are combining to create tremendous growth in the demand for spectrum. In contrast, less than 10% of U.S. television households currently use over-the-air broadcasts as their primary source of television and, with time, this number is steadily declining.[8]

Thus, the overriding conclusion from numerous academic studies is that high-quality broadband availability, and widespread usage, are crucial to continued U.S. growth, innovation, and welfare. Therefore, the nation's goal should not only be to make more spectrum available for wireless broadband, but also to make it available as soon as possible. Allowing broadcasters to voluntarily participate in a reverse auction ("incentive auction") and thereby receive compensation for vacating their licensed spectrum is expedient, and it will allow for a timely repurposing of up to 120 MHz of this premium spectrum. To this effect, the current FCC proposal for incentive auctions is of great potential benefit to our economy, and further, it will generate revenues for the government that otherwise would not be available.

The Theory and Practice of Incentive Auctions

The FCC is currently requesting authority from Congress to undertake a two-sided auction which would allow the FCC to compensate TV broadcasters for vacating some spectrum (the buy-side/reverse auction) and then auction the released spectrum for new uses (the sell-side/forward auction).

Television broadcasters will participate (if they wish) in the reverse auction. A reverse auction is an auction where bids reflect the price required by bidders to undertake a certain action. In this case, it will be the price required by a broadcaster to be willing to vacate its current channel. Hence, broadcasters should be bidding based on the impact of this action on their profits. Broadcasters who lose fewer profits from vacating their current bands will be willing to move for less compensation, and hence they will bid a lower price. Those who would lose greater profits will require a higher price in order to commit to relinquishing their channels.

This reverse auction will ask for different bids for offers to do different pre-specified actions. Specifically, the FCC will ask for bids from the broadcasters for offers to do one of three possible things: channel-share in the same market, move to an upper VHF or lower VHF band, or discontinue over-the-air broadcasting. The bids by a broadcaster likely will differ for each of these actions, because the impact on their profits will differ based on which of these offers is accepted in the auction. Individual television broadcasters will know the true valuation of these possible outcomes. If there is

sufficient competition within the reverse auction for a given market, and the reverse auction is designed properly, the TV broadcasters will have the incentive to bid their true valuations. The issue of sufficient competition within a market is not trivial in this case.

For the released spectrum to be of value to non-broadcast uses such as mobile broadband, there needs to be a contiguous band of spectrum within each market. This means that the auction will be of little value if only some channels within a key band are vacated by TV broadcasters. If some broadcasters are allowed to remain in key bands, there will be little to no value to gaining random bits of spectrum. In order to achieve a contiguous band of spectrum, the FCC *must* be allowed to relocate TV broadcasters to a different channel, while compensating them for the actual costs of the move. This is crucial for two reasons, both of which impact competition in the reverse auction.

The first reason mandatory relocation and repackaging of spectrum by the FCC is necessary is the problem of holdouts. Consider the following purely illustrative example. Suppose the FCC is hoping to clear channels 40 to 50. A broadcaster who is currently using channel 45, and knows it cannot be involuntarily relocated, can act as a "holdout" in the auction. That broadcaster could hold out in order to demand compensation that greatly exceeds the true valuation of that particular channel to the broadcaster. Even worse, the broadcaster could hold out and refuse to vacate at any price, deliberately sitting on the spectrum to impede competition from other technologies capable of delivering content. Similarly, other broadcasters in that same band would have incentives to exaggerate the prices they require to relocate, channel-share, or cease over-the-air transmissions.

At best, the holdout problem would lead to higher payouts by the government to all broadcasters on channels 40 to 50. It would lower government revenues from the auction, and it would lead to decreased economic efficiency because broadcasters in the key channels would be paid more than the true value of their over-the-air broadcasting on those channels. With higher overall prices necessary to clear spectrum, it would also be likely that less spectrum, in the end, could be cleared for other uses. At worst, the holdout problem (without mandatory relocation) could prevent the FCC from being able to recover enough spectrum to be able to offer it up for other higher-value uses, undermining the entire undertaking.

The second reason relocation is necessary is that it will increase competition across broadcasters in the same market. Continuing with the previous example, if mandatory relocation is possible, a broadcaster on channel 20 will be relevant competition for broadcasters in channels 40 to 50. Suppose the channel 20 broadcaster bids a lower price to vacate its channel than, say, the broadcaster on channel 45. Suppose also that the bid from the broadcaster on channel 20 is low enough to be a winning bid, but that the bid from the broadcaster from channel 45 is above the winning price. Then the broadcaster originally on channel 45 can continue broadcasting over-the-air, but it can be moved to the now vacated channel 20. If such relocation were not possible, the bids of broadcasters outside of channels 40 to 50 would not be relevant to the bids of broadcasters within that key band. Competition from broadcasters outside the key band

thus increases the incentives of broadcasters in that band to bid their true valuations. This competition will increase total government revenues by keeping the reverse auction bids lower and closer to true vaulations.

Therefore, to repeat, in order to vacate a sufficiently large and contiguous band of spectrum within each market, the FCC *must* be allowed to relocate TV broadcasters to other channels.

Choosing the Winning Auction Bids

Based on the bids made by TV broadcasters, the FCC will be able to estimate a supply curve for spectrum in a market. Bids made by entities hoping to win the license for using the spectrum similarly will define a demand curve for spectrum in a market. The FCC will choose different winning bids on the reverse and forward auctions. If the winning bid for TV broadcasters to vacate spectrum were exactly equal to the winning bid on the buy side, then there would be no government revenue. Moreover, it would likely lead to a greater release of spectrum than is being suggested by the FCC. Instead, the FCC will use the supply and demand curves to determine the winning bids that will allow approximately 120 MHz to be released and repurposed in each market. The ability of the FCC to determine the supply curves also means that the FCC will be able to make sure a sufficient number of over-air-broadcast channels remain within each market after the auction.

To estimate a possible range of bids from the forward market, FCC Auction 73 (700 MHz Auction) is useful, because the bands under consideration are reasonably similar in traits to the bands in the 2008 auction. In that auction there was wide variation by market. The lowest winning bid was for $.03/megahertz-pop and the highest winning bid was for $3.86/megahertz-pop. Overall values also depended on the exact frequencies being sold. In this proposed auction, there will be similar variation by market and frequency.

Furthermore, it is crucial to understand that any additional rules imposed either by the FCC or Congress regarding the use of these spectrum bands will lower the overall value to bidders in the forward auction and will lower the winning bids. Moreover, if the rules create any uncertainty, this will lower bids even further.

Conclusion

The FCC has a tremendous amount of experience and expertise in the design of auctions. Still, this will be a far more complex auction than those held in the past and will require a great deal of research and planning. The FCC undertook similar research when it first began auctioning spectrum. This included, but was not limited to, working with academic specialists in auction theory and design. I have confidence in the ability of the FCC staff to again undertake such a task. However, given that the FCC itself does not yet know exactly how to optimally execute the auction, it will need flexibility in designing the auction.

The FCC will need to be able to work to find the least costly way to clear various amounts of contiguous spectrum in each market based on the price offers from television broadcasters. Given that the goal is to only repurpose up to 120 MHz of spectrum, along with general estimates of the value placed on use of that spectrum by TV broadcasters relative to mobile broadband, there will be a wide difference in the offer prices and the purchase prices. Hence, even with payments to TV broadcasters, the FCC incentive auction would likely generate large revenues for the government, perhaps in the range of revenues generated by the 700 MHz auction – close to $19 billion. More importantly for the overall U.S. economy, the incentive auction will help move a scarce resource to a more valuable use to the benefit of our economy and society. The value of optimal usage of this spectrum likely will dwarf the revenues received by the government.

This will be a difficult undertaking for the FCC. However, if given the authority and flexibility to properly design the incentive auction, it is an undertaking of which the FCC is capable of executing. The benefits of this auction will so greatly outweigh the costs that I hope Congress will allow the FCC to undertake this incentive auction.

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[1] Jorgenson (2001). Oliner and Sichel (2000). Stiroh's (2002) Jorgenson, Ho, and Stiroh (2008). Other papers demonstrating positive effects of ICT include Brynjolfsson and Hitt (2003), Waverman, Meschi, and Fuss (2005) Bloom, Sadun, and Van Reenen (2007), and Greenstein and Spiller (1995). For a more complete overview of these studies see Connolly and Prieger (2009).

[2] Forman, Goldfarb, and Greenstein (Feb 2009) look at use of "advanced Internet technology" by businesses and wage growth from 1995 to 2000 by county in US. They find that the use of advanced internet technology is only associated with wage growth in 180 counties which were, as of 1990, already well off in terms of income (top quartile), education (top quartile), population (over 100,000), and fraction of firms in IT-intensive industries (top quartile). There was little evidence of an impact in rural areas. Hence, advanced internet technology can only explain one percent of wage growth for the average county, but it does explain one quarter of the differences in wage growth between well off counties and others. Beaudry, Doms, and Lewis (2006) find that local skills and variations in personal computer use from 1980-2000 correlate with wage growth. Kolko (1999, 2002) finds that IT use is associated with fastest employment growth in agglomerated areas due to the presence of local skills. Autor, Levy, and Murnane (2003) demonstrate that computers have differential effects for different types of work and workers. Byrnjolfsson and Yang (1997) show that the realization of ICT benefits depends on organizational capital ("intangible assets"). Koellinger (2006) shows that firms that use ICT more intensively, innovate more. Yildmaz and Dinc (2002) find that telecommunications infrastructure promotes productivity growth in service sectors. Jorgenson, Ho, Samuels, and Stiroh (2007) estimate that "… much

of the post-2000 gains reflect faster TFP growth in industries that were the most intensive users of information technology."

[3] Bresnahan, Brynjolfsson, and Hitt (2002), Autor (2001), Corali and Van Reenen (2001), Beaudry, Doms, and Lewis (2006), Kolko (1999, 2002), Autor, Levy, and Murnane (2003), Byrnjolfsson and Yang (1997), Koellinger (2006), and Yildmaz and Dinc (2002). Jorgenson, Ho, Samuels, and Stiroh (2007) estimate that "… much of the post-2000 gains reflect faster TFP growth in industries that were the most intensive users of information technology." For a more complete overview of these studies see Connolly and Prieger (2009).

[4] Forman, Ghose, and Goldfarb (2009).

[5] Arora and Gambardella (2005 and OECD 2006) look at lowered costs of retail shopping for isolated consumers and Stevenson, Betsy (2003) looks at job searches.

[6] Goolsbee and Klenow (2006) estimate large consumer welfare gains from internet use by analyzing time use and wage data to proxy for the opportunity cost of people's time.

[7] Cisco, 2011.

[8] FCC OBI Technical Paper No. 3, "Spectrum Analysis: Options for Broadcast Spectrum," June 2010, p. 7.