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Spectrum (A)

Many of the important transactions businesses enter into involve *synergies*. Hiring a department, putting together mergers, and network creation of just about any kind all involve putting together an entity with value greater than the sum of its parts. But trading to realize these synergies in a competitive market entails risks that can thwart the realization of the full synergy value. To illustrate the issues and remedies, we will simulate the telecommunication's market for bandwidth licenses.

This write-up contains public information, available to all traders. Private information available to only your team, will be posted to your team in a separate file.

Spectrum Background

Since its inception in 1934, the Federal Communications Commission (FCC*)* has been entrusted with the regulation of the radio spectrum, for both interstate and international broadcasting. The FCC's major powers include issuing and revoking licenses and well as monitoring the content of public broadcasting programs.

An FCC license is required to use bandwidth to operate, for example, radio stations, television channels and cell phone networks, and so is of paramount importance to the operators of these entities. A spectrum license entitles the owner to exclusive access to a particular radio wavelength; that is, to emit electromagnetic waves at a particular frequency over a specified broadcast area. A license typically lasts from 6 to 15 years, after which it needs to be renewed.

At first, the FCC gave away spectrum licenses, but later began to sell them.

Synergies and the Exposure Problem

The transaction of these licenses is risky due to the complementarities that tend to exist between them. Specifically, the value of a license often depends on what other licenses the operator owns. A cell phone license for New York, for example, is typically more valuable if the operator also owns the adjacent licenses in Philadelphia and Washington. These kinds of synergies can open the purchaser up the *exposure problem*, the risk incurred in buying a particular license now while the future acquisition of complementary licenses is uncertain. Cramton (2002) illustrates the exposure problem in the context of two people bidding in an auction for parking space:

This note was prepared as the basis for class discussion.

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"One bidder with a car and a trailer requires both spaces: she values two spots together at $100 and a single spot is worth nothing; the spots are perfect complements. The second bidder has a car, but no trailer. Either spot is worth $75...the spots are perfect substitutes. Note that the efficient outcome is for the first bidder to get both spots for a social gain of $100, rather than $75 if the second bidder gets a spot.

"Yet any attempt by the first bidder to win the spaces is foolhardy. The first bidder would have to pay at least $150 for the spaces, since the second bidder will bid up to $75 for either one. Alternatively, if the first bidder drops out early, she will "win" one license, losing an amount equal to her highest bid."

Sales of Licenses through Lottery and the Coase Theorem

When the FCC began to sell licenses, it did so through a lottery system. For the purpose of creating licenses, the country was divided into zones, each with certain bandwidth restrictions and certain classifications. Licenses were simply awarded randomly, chosen from a list of qualified applicants willing to pay the fee. Sorting out license complementarity issues was left to the secondary market where licenses trade privately.

What made the commission confident this procedure would lead to a good outcome? There is a famous proposition known as the *Coase Theorem* (after Ronald Coase, 1991 Nobel Prize winner in economics), implying that this sort of property assignment can be socially efficient. As it happens, Coase stated his theorem in 1959 as a proposal for the regulation of radio frequencies. At the time, the major issue was the potential for adjacent stations to interfere with one another by broadcasting on the same frequency band. Coase argued that this problem was nothing that the commission needed to worry about. So long as there were clear, tradable property rights, the station that put the highest value of the broadcast would have an incentive to pay the other station not to interfere. A mutually advantageous deal will solve the problem (at least so long as the deal's transaction costs are not prohibitively high). The upshot is that, so long as there are no impediments to trade, the initial allocation of property rights does not matter in the sense that the market will ensure that these rights eventually end up in the hands of those who can put them to the most profitable use. This was also the thinking behind the FCC's lottery system for licenses.

The Spectrum Market Simulation

The spectrum market simulation captures, in broad strokes and on a smaller scale, the dynamics of the secondary market for spectrum licenses that take place after the lottery distribution phase. For the purpose of the simulation, the country is divided into 13 regions, A through M. Each of these regions has 8 cellular phone licenses, labeled A1, A2, … A8, etc, all the way through M8.

Each of 26 teams (including yours) has been allocated 4 licenses through the FCC lottery system. In addition, each team starts with $1000 in cash. There is going to be a secondary market, allowing teams to trade licenses to exploit potential synergies.

Licenses and synergies in the simulated market

Each license has a face value of $100. Teams realize synergies by collecting more than one license in a region. Different teams are strong in different regions; so how much synergy a company realizes from having two A licenses, for example, differs from team to team. More specifically, each team is given private information about their synergies in the form of a table that only they can view. The table has the following form:

Numbers in columns are total value for each quantity of licences in a given region								
Region	**One**	**Two**	**Three**	**Four**	**Five**	**Six**	**Seven**	**Eight**
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Suppose for the moment that this is your synergy table. (There is no region Z in the game; we made it up along with the synergy numbers, to demonstrate how you read the chart.) Synergies depend only on the number of licenses a team collects in a region. If you own just one (any one) Z license, the table tells you it is worth $100. If you own two (any two), the total value of your region Z holdings is $230 (a $30 synergy). If you own five Z licenses (any 5), the total value of your Z holdings is $565 (a $65 synergy).

Remember, the value of your region holdings depends only of the number of licenses you hold in that region. *Specifically, from the table above, if the only Z license you own is Z5, it is worth $100, NOT $460.* To realize $460, you need to own four (any four) Z licenses.

Your team's objective in this market is to trade to maximize the value of your portfolio, equal to the sum total of your team's dollar value plus your cash holdings.

Logistics

You will be given your team's id and password to access the electronic trading platform. There you will find your private information on your team's personal license valuations. The file also includes an item that will be public information: your team's initial endowment of firms.

Licenses are traded either through individual negotiation or through auction. Traders may set up and run their own auctions or can use the auction feature on the Spectrum website. Those who run their own auctions can set their own rules. Website auctions run for a fixed time, are first-price sealed bid, and must be initiated by a seller. Once initiated, the auction lasts 5 minutes. The seller may announce a minimum (reserve) price for the license. To announce an auction, the seller goes to the START AUCTION page on the Spectrum website. A bidder submits a bid on

the website by selecting the auction (Click on Bid >>). Note: The website will not accept any new auctions if there is less than 5 minutes left in the market.

Important: Closing a deal requires specifying the buyer, seller, and sale price to the Spectrum website, which will update the portfolios and cash balances of both teams – until this is done, the sale is not official. A deal is completed by the selling team logging in to the Spectrum website and going to the COMPLETE SELL TRANSACTION page. The buying team inputs their ID and password, the correct company is selected and the price is specified. The Submit button completes the deal. Deals made through the website auction feature will update automatically. Deficit spending is not permitted. Non-cash deals, swaps, and bundled sales (selling two licenses for a single price) are not permitted; they must be broken out as a series of single license transactions.

Preparation

Prior to the market, get together with your team to discuss strategy. Be sure you understand the rules; you will have an opportunity to ask questions prior to the opening of trade. Tour the Spectrum trading platform at (see class assignment for platform link). Browse the site's trading features, and your team's own private trading page, and come prepared to trade!

References

Coase, Ronald H., "The Problem of Social Cost," *Journal of Law & Economics*, 1960, 3, p. 1-23.

Cramton, Peter, "Spectrum Auctions," *Handbook of Telecommunication Economics Volume 1*, M. Cave, S. Majumdar and I. Vogelsang (eds.), 2002, 605-639.