Note on Thailand's 3G Auction: Design, Spectrum Valuation, Reserve Price and Outcome

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1. INTRODUCTION

On October 16, 2012, the National Broadcasting and Telecommunications Commission (NBTC), Thailand's independent telecommunication services regulator, held a long-awaited auction for nine blocks of 5x2 mega-hertz (MHz) mobile spectrum within the International Mobile Telecommunications band 2.1 giga-hertz (GHz), or 3G spectrum. After a previously planned auction had been cancelled by the Administrative Court in 2010, the October auction became the country's first mobile spectrum auction. It was a highly anticipated event as Thailand had been lagging behind its neighbors in adopting 3G technology.

The whole auctioning process was also controversial. Many issues, such as caps on winning bandwidth, spectrum valuation and reserve price, were the subject of extensive discussion by the public and intense debate among academics. The outcome of the auction has been much criticized for being uncompetitive; even the allegation of collusion has been raised by some critics.

This paper is aimed at summarizing academic arguments and providing an economic perspective on these issues. It begins in section 2 with a brief review of the design of auctions. In section 3 spectrum valuation methodology is examined and how the reserve price was determined. The outcome of the auction is discussed in section 4, and section 5 concludes with details of reactions following the auction.

2. A BRIEF OVERVIEW OF AUCTION DESIGN

It is widely accepted among economists and regulators that auctions, with sufficient and fair competition, deliver a more efficient outcome in allocating scarce resources (e.g., mobile phone spectrum) than other allocation mechanisms, such as lotteries or "beauty contests" (Cramton 1997; Klemperer 2004; Milgrom 2004) or any form of bilateral bargaining (Myerson and Satterthwaite 1983). Auctions also provide an objective, comprehensible and non-discriminatory process for resource allocation. In a well-designed auction, bidding competition ensures that resources are allocated to bidders who can utilize them most efficiently and at the same time have the highest willingness to pay.[1]

Efficient allocation was a clear auction objective of NBTC. There were 45x2 MHz paired spectrums in the 2.1 GHz band to be auctioned off. NBTC decided to break these down into nine identical, individual blocks of 5x2 MHz each. The number of licenses was not fixed in advance; bidders could form licenses, each up to the maximum of three blocks, or 15 MHz. This arrangement in principle enabled bidders to decide the bandwidth of their licenses based on their private valuations.[2] All blocks were allocated by a simultaneous ascending bid auction.

A cap on the amount of spectrum allocated to each bidder was originally imposed at four blocks, or 20 MHz, but NBTC later decided to lower the cap to three blocks, or 15 MHz. The move, according to NBTC, was to ensure a level playing field in post-auction competition among operators. Since there are three major incumbents in the mobile phone industry in Thailand, the 20-MHz cap meant that an auction could result in two operators winning 20 MHz each, leaving the remaining operator with a paltry 5 MHz license. NBTC argued that 5 MHz would not be viable commercially (NBTC 2012: 26) even though this would seem to have contradicted NBTC's original intention of breaking up the spectrum into nine small blocks of 5 MHz each in order to encourage the entry of small operators, as 5 MHz was considered feasible for a mobile company to operate (NBTC 2012: 13).

The decision to reduce the spectrum cap to three blocks, or 15 MHz, per bidder was criticized by many economists. Auctions work well when access to the market is competitive as when there are more bidders

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than spectrum licenses. It was straightforward to speculate that there would be no bidding competition in an auction where three strong bidders (incumbents) were competing for nine objects, each of whom could not win more than three of those objects. NBTC defended its position by pointing out that there would still be sufficient incentive for operators to bid more aggressively because there were physical differences between the different spectrum bands and the highest bidder could choose a band with the best properties. However, international experience suggested that spectrum differences are slight if significant at all. Examples include the Switzerland 3G auction in 2000 where four bidders were competing for four licenses and competition for better bands yielded only 2.5 percent more than the reserve price (Klemperer 2002a).

3. SPECTRUM VALUATIONS AND RESERVE PRICES

NBTC commissioned a research group from the Faculty of Economics, Chulalongkorn University (hereafter referred to as the "Chula researchers" or "researchers," and the research paper will be referred to as the "Chula study (research)" or the "research paper") to estimate spectrum valuations and determine a reserve price. In estimating spectrum valuation, the researchers conducted econometric analyses using cross-country data on 3G auction results. Observations were from 69 license auctions in 17 countries. The researchers regressed auction-winning prices (US dollars per MHz per capita) on various explanatory variables, such as real GDP, per capita GDP, total MHz under auction, population density, number and duration of license, ratio of telecommunications sector revenue to real GDP, ratio of high school graduates to total population, year dummy, and telecommunications boom dummy. The econometric model estimated 3G spectrum "valuations" at US$ 0.64/MHz per capita, or roughly 6,440 million baht, for each spectrum block of 5x2 MHz.

From an econometrics point of view, cross-country regression is vulnerable to omitted variable bias when unobservable factors unique to each country and invariant over time, such as country size or institutional factors (country fixed effects), are not incorporated into the regression models. The problem could lead to serious consequences: estimation results becoming biased and inconsistent. The researchers acknowledged this and addressed the problem by applying the method of fixed effect panel data regression, which could mitigate the problem. However, one omitted variable, namely the level of competition in the auction (e.g., the ratio between bidders to auctioned objects) was not constant in any country or any auction over time. Rather, it varied from one auction to another and was not accounted for by fixed effect estimation. Since this variable is correlated to other included variables in the model, for example "license offered" and "total MHz," estimations with this variable omitted would yield biased and inconsistent results.[3] Unfortunately, direction and size of the bias are difficult to pin down.

In putting aside the issue of potentially biased estimation, it is important to note that this estimated value should not be interpreted as social valuation or social benefit of the spectrum because the data representing "spectrum value" in the estimation are operators' winning bids from previous auctions in various countries. Countries in the data set have different economic structures and auction designs as well as levels of auction success (or auction competition) ranging from an extremely successful one to a fiasco in terms of revenue generated. Since the level of auction competition was not controlled for in the study, the estimated valuation of 6,440 million baht per spectrum slot should be carefully interpreted as the expected auction revenue was conditioned on an underlying economic structure. Loosely speaking, the estimated value already took into account many cross-country economic differences but left unaccounted the level of auction competition. Therefore, this should be the revenue that could be expected if the auction to be held by NBTC would be more or less as competitive as previous auctions in other countries. Higher revenue could also be expected if the auction would be more competitive than the cross-country average.

The researchers also proposed that NBTC set an "optimal" reserve price at 67 percent of their estimated spectrum valuation, or approximately 4,315 million baht per spectrum block. NBTC decided to follow this proposal by slightly adjusting the reserve price to 4,500 million baht per slot, which represented about 70 percent of the estimated valuation.

It is interesting to examine how the researchers came up with the number 0.67 as a discounting factor used to set a reserve price. Before proceeding to the methodology used by the Chula researchers, some aspects of the underlying economic rationale for reserve price-setting are worth mentioning. In principle, optimal reserve prices balance between two conflicting risks, and both reduce allocative efficiency.

The first inefficiency risk involves a scenario when reserve prices are set too low. The reserve price is a tool used to "protect" sellers against risks of uncompetitive auctions or collusion between bidders which arises from a failure in auction design. Not only could low reserve prices result in revenue that is significantly lower than market value, but they could also facilitate distorted auction outcomes as bidders would have a strong incentive to bid strategically or even collusively to reduce demand and generate large savings. The further are reserve prices from market value, the stronger are the incentives for strategic demand reduction behaviors. Therefore, where there is a risk of an auction being uncompetitive, there is a case for setting reserve prices that are closer to market prices (DotEcon 2012b).

The second inefficiency risk results from setting reserve prices that are too high. If competition in an auction is expected to be strong, the price discovery mechanism or bidding competition will ultimately deliver winning prices that reflect market value regardless of their starting level. In this circumstance, it is appropriate to set "low but non-trivial" reserve prices as they minimize the inefficiency risk when efficient demand is priced off by reserve prices that are set too high.

Although the Chula study acknowledged inefficiency risks associated with reserve prices, it took neither those risks nor the anticipated uncompetitive auction into consideration when proposing the reserve price. Instead, the suggested reserve price, i.e., 67 percent of the estimated auction revenue set in the Chula study, was arbitrary. The researchers obtained this figure by calculating the ratio between the reserve price and the winning price of each auction in the data set and then finding the sample mean of these ratios, which is 0.67. The researchers then proposed that 67 percent of the estimated auction revenue was the optimal reserve price for Thailand's 3G spectrum.

It is difficult to justify why Thailand would use the averaged ratio of reserve and final prices from other countries with different auction designs and level of auction competition as a discount factor for calculating the optimal reserve price.

The only understandable explanation for this would be that the researchers hoped that by setting the reserve price at 67 percent of the estimated valuation, based on average international experiences, the final price would then rise back to the estimated valuation so that Thailand's ratio between the reserve and final prices would be just the same as the international mean. Clearly, this proposal lacks solid economic justification, as there is no guarantee that Thailand's 3G auction, with different design and competition intensity, would provide a reserve-to-final-price ratio similar to what happened elsewhere. In addition, the final price could not and should not be fixed in advance. The seller would want an auction to be as competitive as possible so that the object would be sold to the highest-valuation bidder offering the highest price. Therefore, relating the reserve price to the winning price before an auction was meaningless. A ratio between the reserve and final prices was the result of auction design and competition; it should never be an objective in determining the reserve price.

In setting the reserve price at 70 percent of the estimated revenue, NBTC argued that a low reserve price would encourage the entry of new operators and would make a post-auction market structure more competitive (NBTC 2012: 18). However, it became clear soon afterwards that no new operator participated in the auction. In the case of Thailand, it was not difficult to foresee that competition during the auction would be minimal, if there would be any at all. Only the three existing incumbents were considered as serious potential bidders, but they did not need to fight each other in order to get their spectrum share, as NBTC's winning spectrum caps limited each bidder to win no more than 15 MHz of spectrum from the total of 45 MHz bandwidth being auctioned.[4] A reserve price set closer to the estimated spectrum value would have been more appropriate, as an uncompetitive auction could not facilitate a price discovery mechanism.

In addition, the risk of choking off efficient demand and leaving some spectrum blocks unsold should be very low. This is because the spectrum valuation of 40.5 billion baht over the 15 years of license duration estimated by the Chula researchers is relatively small compared with the annual revenue-sharing concession fees of 48 billion baht that all three incumbents paid in 2011.[5]

4. AUCTION OUTCOME

As expected by many academics and industry experts, only the "big three" incumbents, namely Advanced Info Service Public Company Limited (AIS), Total Access Communication Public Company Limited (DTAC) and True Corporation Public Company Limited (TRUE), participated in the auction without any new entrant being encouraged to do so. With only three bidders, the imposed spectrum caps implied that all bidders were guaranteed 3G spectrums if they agreed to pay the reserve price.

The auction ended after seven rounds and all nine spectrum blocks were sold. DTAC and TRUE showed no intention of competing; each of them secured three blocks, all at the reserve price. The remaining three blocks went to the market leader, AIS, which bid unnecessarily aggressively, so much so that the company even outbid itself, not once or twice but three times, in spectrum blocks for which the company was already winning. AIS might have wanted to win in order to choose frequency bands before the other operators could do so, but with DTAC and TRUE being uninterested, offering a price one step higher than these competing bidders, lower bids would have been enough. Instead, AIS inexplicably bid its three spectrum blocks at a price five steps higher than the reserve price and that offered by rival bidders.

In conclusion, the total revenue raised by the auction was 41,625 million baht (US$ 0.46/MHz/population) or 2.8 percent higher than the reserve price and 16,335 million baht or 28.2 percent less than the expected revenue suggested by the Chula researchers.[6]

As the highest bidder, AIS was the first to choose frequency bands and it chose the band next to its potential business partner and 2G-concession granter, TOT, which had already been allocated the right-most frequency location a few years previously. TRUE was the second to choose after winning the tiebreaker and it selected a frequency location next to AIS, leaving DTAC with the left-most frequency location. Interestingly, this unchosen frequency was once famously

described by the director of NBTC's National Telecom Commission as the "best location" for which bidders would compete to own.

The fact that all but one bidder offered to buy at the reserve price and the "best location" was the last one selected suggests that frequency differences were insignificant and there was virtually no competition in the auction.

5. POST-AUCTION REACTIONS

Public reactions to the auction outcome has been mixed. Despite suspicions that the auction outcome gave large windfall gains to the operators, some were thankful that the long-overdue 3G services would be rolled out soon, while many others questioned and criticized the uncompetitive outcome. To appease the critics, NBTC announced a plan to regulate 3G services and reduce prices at least 20 percent over the duration of the license.

There have also been several attempts by operators, NBTC and its consultants to claim through the media that uncompetitive auctions are common internationally, i.e., Thailand's 3G auction revenue was appropriate and is the highest among ASEAN countries (hereafter referred to as "the Claim"). The intention is to address criticism that the auction was uncompetitive and that spectrums were sold at a lower-than-expected price. The Claim pointed to winning price data (in US dollars/MHz/population) for some selected countries and years, such as Germany, Indonesia, Malaysia, Republic of Korea, and Singapore, and argued that Thailand's auction price was already high compared with these countries.

However, the Claim was based on a very small set of chosen samples (10 auctions), which produced an unrigorous analysis compared with an econometric analysis that NBTC commissioned, which covered more samples (69 auctions) and took all factors that the Claim used for its argument, such as license duration, per capita income and year of auction plus other additional factors ignored by the Claim, such as population density or share of telecom industry revenue to GDP. Therefore, the expected revenue estimated by the Chula researchers was academically rigorous, comprehensive and more reliable.

The claims of NBTC and the operators that Thailand's price was the highest among ASEAN countries are incorrect. For example, Singapore's 3G auction in 2010 yielded a total revenue of US$ 0.61/MHz/population,[7] which is significantly higher than Thailand's US$ 0.46/MHz/population. As for the case of Indonesia in 2006, the auction rules were different. All winners had to pay twice the amount of their bid in the first year and then pay the lowest winning bid every year over 10 years of the duration of the license. Therefore, bidders essentially offered the annual installment in the Indonesian 3G auction not the final price. Judijanto (2006) calculated the final price of the Indonesian 3G auction at US$ 0.40-0.50/MHz/population, which is fairly high considering that it is an island country and the duration of the license is 10 years.

In addition, spectrum prices for some countries mentioned in the Claim, such as the Republic of Korea in 2011, and Germany and Singapore both in 2010, are not from the first round of 2.1 GHz spectrum allocations. These countries had allocated a large chunk of 2.1 GHz spectrums in the past (Germany and Singapore using auctions and the Republic of Korea using a so-called beauty contest) so that most of the demand has been served. The objectives of the subsequent rounds of allocations were either to increase capacity and improve service quality or to increase competition by introducing new entrants. For example, the Republic of Korea prohibited two incumbent operators from participating in the auction in 2010 (KCC 2011; Lee et al. 2012). Lower reserve prices were set to encourage the entry of the new operator into an already mature market.[8]

ENDNOTES

[1] Efficiency is an appropriate objective for a spectrum auction over revenue because the importance to the economy of services and competition in downstream industry. Although they do not coincide, efficient allocation and revenue maximization are largely an aligned objective (DotEcon Ltd 2012a).

[2] This is a different auction design from the auction previously planned in 2010, which later was halted by the court, where the number of licenses could be reduced according to the "n-1" rule in order to ensure that there would be more bidders than licenses.

[3] The importance of auction competition in determining the winning bid is emphasized in many studies. For example, see Klemperer (2002b) and Madden et al. (2010), among others.

[4] One of the major impediments to market access of the telecommunications industry is Foreign Dominance Notification, which widened the scope of restrictions on foreign connectedness well beyond just shareholding. It gives NBTC discretionary power to refuse and revoke licenses. The notification was criticized for its potentially anti-competitive effects. Confusing, vague and subjective criteria would discourage new operators and limit foreign investment and could be used as a tool to limit entry.

[5] The risk of efficient demand being priced off by a high reserve price is significantly reduced as at least two incumbent operators signaled their prepared auction budgets (that should be biased downward) in media interviews (See http://www.siamturakij.com/home/news/print_news.php?news_id=413358028 and http://www.thairath.co.th/content/eco/233466).

[6] The ratio between reserve price and final price is 97 percent, which is much higher than the international average of 67 percent used to calculate the reserve price.

[7] Based on a 2010 population of 5.08 million persons. The Singapore spectrum was priced at S$ 20 per 5 MHz block (IDA 2010).

[8] The Singapore reservation price in the 2010 auction was 40 percent less than that in the auction in 2001; see (IDA 2010) and http://www.ida.gov.sg/doc/Policies%20and%20Regulation/Policies_and_Regulation_Level3/Results%20of%203G%20Spectrum%20Rights%20Auction/3G_Spectrum_Rights.pdf

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