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Spectrum economics: serving public policies

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The rise of economic considerations in spectrum management

Until the 1990' technology and engineering considerations have prevailed in the management of the radio spectrum. In the last decades of the 20th century, however, the widespread view was that the promise of breakthroughs in telecommunications technologies were being hindered by the powers of legal monopolies, and that competition had to be introduced into the industry. In mobile communications, spectrum limited availability dictated that competition had to be managed ex-ante and the number of licensed operators had to be predetermined by governments and National Regulatory Authorities (NRAs). To overcome the apparent limitations of administrative procedures in selecting the competing licensees, auctions were adopted following the USA's successful example in 1994. They were considered more transparent, quicker, and removed the need for governments to pick winners.

The way had been paved by the Ronald Coase's seminal 1959 paper ⁽¹⁾ advocating that spectrum assignment should be based on market and pricing mechanisms, where property rights are assigned with the objective of maximising output from a scarce resource. Its logic helped open the telecommunications industry to competition and brought about a change in business culture and practices. The belief that "market mechanisms" in spectrum management were an optimal means of solving assignment problems and promoting the industry and the economy was widely shared on the eve of the 3rd millenium, as illustrated by the 2002 FCC spectrum policy task force report ⁽²⁾, the 2002 UK Martin Cave independent Review of radio spectrum management ⁽³⁾, and the European Commission 2005 Communication "A Market-based approach to spectrum management in the European Union" ⁽⁴⁾.

The privileged area of economic approaches in spectrum usage has been and still is mobile telephony. It does not mean that economic considerations are absent in other commercial areas of frequency allocations, like broadcasting, satellite or PMSE, but they remain implicit or in the background. As for "free" unlicensed spectrum, it definitely plays a role in wireless connectivity, but smaller than it was considered early in the 21st century.

Spectrum auctions, a quintessential economic process, have allowed a competitive entry into the newly de-monopolised mobile communications market. At some point, in mobile, auctions had become synonymous with assignment. Auctions are "exciting" ⁽⁵⁾, they bring emotion into the otherwise dreary world of wireless technologies. Auction based frequency assignment has delivered the communications revolution we all benefit from today. However, after the truly competitive phase among pioneers, there has come a moment in which auctions have mostly taken place among

(1) COASE R.H. (1959) "The federal communications commission", *Journal of Law and Economics*, vol. 2., pp. 1-40, Oct.

(2) Federal Communications Commission Spectrum Policy Task Force (2002), ET Docket No. 02- 135 November https://sites.nationalacademies.org/cs/groups/bpasite/documents/webpage/bpa_048826.pdf

(3) CAVE M. (2002), *Review of radio spectrum management, An independent review for the department of trade and industry and HM Treasury*, March https://web1.see.asso.fr/ICTSR1Newsletter/No004/RS%20Management%20-%202_title-42.pdf

(4) COM (2005), 400, Communication from the Commission European Parliament and the Council, A Market-based approach to spectrum management in the European Union.

(5) <https://telecoms.com/501033/french-watchdog-outlines-mid-band-spectrum-auction-rules/>

a restricted group of usual suspects, which now have no choice but to bid to win, not to waste two decades of investments in their customer base. There is a growing body of evidence that spectrum auctions in their current configuration not only fail to stimulate connectivity investments, but also hinder them. Auctions now mostly maintain entry barriers protecting a strong oligopoly.

Studies show spectrum auctions have not delivered the best possible benefits from mobile

Over the last two decades, spectrum policy has been widely governed by high-level, generic, economic principles. The first one is that auctions are an effective process to select those operators that can use the frequencies most valuably. Evidence suggests that potential shortcomings with this assumption abound in relation to the deployment of communications networks⁽⁶⁾.

The second one is that by licensing a public resource, governments have a legal obligation to maximise the price, or, more correctly, to use market mechanisms to determine the amount paid by buyers that balances supply and demand of radio frequencies. This is a bold assumption that for the state to handle public funds optimally, it must behave as a private agent in the management of its assets. The evidence, however, shows that discrepancies arise between misguided public policies in spectrum assignment and the realisation of public objectives in industry and market growth.

The (2017) paper by Kuroda, Toshifumi, Baquero Forero, Maria Del Pilar⁽⁷⁾, compares the evolution of market outcomes in 47 countries after the assignment of mobile spectrum by auctions and beauty contests held from 2000 to 2008: “Findings suggest that auctions used to raise public revenues not only transfer profits to the government but also sacrifice consumer surplus.”

A study by PolicyTracker, LS Telcom & VVA (2017) for the European Commission⁽⁸⁾ finds that “... the grouping with the highest auction prices also had the poorest network availability. This questions the common view that operators who pay high prices for spectrum must invest in their networks to make this money back.” Countries where operators have paid the most for spectrum over the past decade, showed the worst 4G network availability.

Hazlett and Munoz (2012) demonstrated that efficiencies associated with retail services in mobile markets are about 240 times as large as those associated with licence revenues⁽⁹⁾.

Finally, a research report, “Impact of Spectrum Prices on Consumers” by GSMA and NERA (2019)⁽¹⁰⁾, “provides strong evidence to directly link spectrum prices with slow network rollouts, reduced network quality and poorer mobile coverage”.

These empirical studies confirm the analytical assumptions by Pogorel & Bohlin (2017) that spectrum auctions aimed at high spectrum fees do not serve to stimulate investments and network deployment⁽¹¹⁾. Consequently, most governments and regulators re-orient at least partially

(6) The frequent use of the term “market failure” in the telecommunications networks context is questionable. Achieving 100% penetration cannot be the universally expected outcome in all markets. “Limited market penetration” would be more appropriate.

(7) KURODA T. and BAQUERO FORERO M. D. P. (2017), “The effects of spectrum allocation mechanisms on market outcomes: Auctions vs beauty contests”, *Telecommunications Policy*, June, Vol. 41(5-6), pp. 341-354.

(8) European Commission, Study on spectrum assignment in the European Union, 4 October 2017, <https://publications.europa.eu/en/publication-detail/-/publication/2388b227-a978-11e7-837e-01aa75ed71a1/language-en>

(9) HAZLETT T W and MUÑOZ R E. (2012), *What Really Matters in Spectrum Allocation Design*, p. 102.

(10) GSMA (2019), *The Impact of Spectrum Prices on Consumers*, 11 September, 2019, <https://www.gsma.com/spectrum/resources/effective-spectrum-pricing/>

(11) POGOREL G. and BOHLIN E. (2017), “Spectrum 5.0: Improving assignment procedures to meet economic and social policy goals, A position paper”, Working paper; https://www.researchgate.net/publication/316524026_Spectrum_50_Improving_assignment_procedures_to_meet_economic_and_social_policy_goals_A_position_paper

spectrum assignment conditions. Budget deficits however remain a looming consideration that contributes directly to the attractiveness of auctions. While revenue raising is an understandable and valid political choice, it comes with its own costs in terms of deprioritising other broader economic and social perspectives. In spectrum auctions, the means have superseded the aims, and a “successful” auction in the literature has been taken as one achieving high fees rather than positive social returns. It is true social and economic impacts, whatever the efforts recently devoted to analysing them, can be conceptually and practically hard to precisely measure and quantify. Overall there is a growing awareness that there are choices to be made and that spectrum assignment procedures can be effectively designed to deliver on these choices.

The blind faith in a solid relationship between spectrum auctions on one hand and mobile deployment on the other has given way to a wide array of hybrid criteria procedures that have in common the trade-off between frequency fee requirements and the speed of territory and population coverage.

Re-thinking spectrum assignment to better align public policy objectives and industry strategies

Governments having faced “...widespread public dissatisfaction around coverage, particularly outside urban areas”. (Ofcom, 2016⁽¹²⁾), are now concerned by uncertainties surrounding mobile business models.

The 2018 example of 4G licences renewal in France⁽¹³⁾, extended terms of payment introduced in countries like Spain, Sweden⁽¹⁴⁾, and India, and the possible abolition of fee maximisation in Colombia⁽¹⁵⁾, are indications that something is beginning to give in the field of auctions. Japan eventually endorsing a “comprehensive strategic approach for 5G spectrum” putting aside auctions, shows that policymakers are perhaps willing to look at new, more dynamic approaches to spectrum assignment with a stronger focus on high-level economic objectives.

In setting objectives, it is important to keep in mind that spectrum having no intrinsic value, its value resides exclusively in the contribution its use makes possible for society and the economy. Appropriately designed policies reconcile public objectives and industry strategies. Competition being rightly at the heart of telecommunications industry dynamics, competitive propositions from candidate operators on investment and deployment objectives are central to effective assignment processes. With deployment objectives imbedded in the license, operators know precisely how to define and implement their business model and strategy. The frequency fee paid to the government tends to lose its central status and is considered a normal counterpart of the use of spectrum resources for network deployment.

Contemporary examples of state of the art assignment procedures include the following.

Auctions on frequency fees with improved coverage obligations

Auctions with coverage obligations have been frequent in spectrum assignments in Europe: 25/25 assignments in the 800 MHz band and 12/23 in the 2.6 GHz band (Magi)⁽¹⁶⁾. Coverage

(12) OFCOM (2016), “Letter to telecommunications operator”, quoted in “Mobile World Live”, December 16.

(13) ARCEP, <https://www.arcep.fr/actualites/les-communiqués-de-presse/detail/n/new-deal-mobile-1.html>, 2 August 2018.

(14) PTS (2014), “Swedish Spectrum Strategy”, *The Swedish Post and Telecom Authority* PTS-ER-2014:16 2014-04-15

(15) PolicyTracker, <https://www.policytracker.com/colombia-may-abolish-maximised-spectrum-prices>.

(16) MAGI A. (2017), “Assessment of the socio-economic impact of mobile broadband auctions”, Thesis for the Master’s degree, Politecnico di Torino, March.

obligations are increasingly extensive and accurately defined, as demonstrated by Ofcom in UK⁽¹⁷⁾, BNetzA in Germany⁽¹⁸⁾, and as in the cases of Italy⁽¹⁹⁾ and France⁽²⁰⁾.

NRAs, based on their appraisal of the public interest, have opened auctions with dual objectives: combining 90-95% coverage conditions and a spectrum fee auction⁽²¹⁾. The 2018 Danish award came up with an innovative twist in the coverage/investment combination: “Winning bidders will have the option of bidding for extra coverage obligations in exchange for a reduction in their licence price”⁽²²⁾. This scheme opens the possibility for the regulator and the operator to avoid the dilemma between pre-defined, and operator-defined objectives.

Negotiated frequencies-for-investments

In the ARCEP (2018) “New Deal” example⁽²³⁾, which covers the renewal of French 4G licences, mobile operators are bound to an intensive and accelerated country coverage program. A similar scheme is implemented in Japan in 2019⁽²⁴⁾. The challenge of this approach is the competition angle: Is it a deal limited to existing licence holders, or are new entrants admitted to the negotiating table? How are they selected? To combine the competition imperatives with the “New Deal”, a 2-stage process could be implemented: Select one or more new entrants through tender, then negotiate their investments.

In the investment centred assignment procedures, frequency fees do not play the central role. The procedure must nevertheless determine what charges should be paid for the use of spectrum as a limited public resource. Japan for instance has a long experience of techno-economic frequency fee determination⁽²⁵⁾.

Extended licence duration has been advocated by powerful voices from both operators and the European Commission. The argument is that an extended investment horizon can drive more investment⁽²⁶⁾. Most national governments and many NRAs have resisted this move. There is a need for sufficient duration to correspond to investment cycles and to allow investors to recover their expenses and fully exploit their investments. But, as stated by one NRA⁽²⁷⁾ “... the duration cannot be too long, in order to allow the State, within a reasonable time, to be able to regain possession of the resource where necessary for the purpose of maintaining the efficient use of the scarce resource over time⁽²⁸⁾”.

(17) OFCOM (2018), *Advice to Government: Further options for improving mobile coverage*, <https://www.ofcom.org.uk/phones-telecoms-and-internet/coverage/advice-government-improving-mobile-coverage>, 14 September 2018.

(18) Bundesnetzagentur (2019), “Mobile broadband – Spectrum for 5G” https://www.bundesnetzagentur.de/EN/Areas/Telecommunications/Companies/FrequencyManagement/Electronic-CommunicationsServices/ElectronicCommunicationServices_node.html

(19) AGCom (2018), *Delibera n. 231/18/CONS*, p. 76 316.

(20) ARCEP (2019), <https://www.arcep.fr/la-regulation/grands-dossiers-reseaux-mobiles/la-5g.html>

(21) OFCOM (2018), *ibid*.

(22) Telecompaper (2018), *Danish govt issues final rules for 700 MHz, 900 MHz, and 2 300 MHz auctions*, Monday 25 June.

(23) ARCEP (2018), <https://www.arcep.fr/cartes-et-donnees/new-deal-mobile.html>

(24) IDATE-EU 5G Observatory (2019), “Japan assigns 5G spectrum to four operators”, April 16

<https://5gobservatory.eu/japan-assigns-5g-spectrum-to-four-operators/>

(25) Ministry of Industry and Communications, Japan (2019), “Spectrum User Fee”, <https://www.tele.soumu.go.jp/e/fees/index.htm>

(26) JEANJEAN F. and LIANG J. (2018), “Mobile investment per capita tends to increase with license duration”, February 20, Working Paper, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3184200

(27) AGCom, <https://www.agcom.it/documents/10179/3478659/Allegato+7-8-2018/637af9a9-8a60-4b3e-8ac0-3ce2c-d808ac4?version=1.0>

(28) The debate on licence duration was particularly contested during negotiations on the European Electronic Communications Code (EECC), with the co-legislators finally settling on 20 years (15+5) minimum duration.

The bottom line is, frequency fees, CAPEX and OPEX, license duration, enter into a familiar investment calculus mastered by operators. Two main factors can disrupt the process: a too high reserve price set in the auction, and the auction process itself, which can prove to be wildly unpredictable as happened in 2018 in Italy⁽²⁹⁾.

A range of economic tools for public policies

Regulation principles across the Atlantic regarding network access, competition monitoring, have diverged now for 20 years. The American experience, for instance incentive auctions of broadcasting spectrum, could certainly provide food for thought. As for China, it has focused on administrative licensing. The general context, the authoritarian political governance and scale makes it impossible to compare wireless developments with the EU, but the country's rapid progress on 5G demands attention. As for Japan, it has stuck for 5G to administrative assignment of spectrum and techno-administrative determination of spectrum fees.

We observe a trend of spectrum assignment procedures to better balance the legitimate imperative of raising revenues for the government with the achievement of broader economic and social objectives. The fixation on auctions on fees as the panacea for competition has been put aside and the focus instead is on assignment processes that underpin the competitive dynamics required to maximise and then realise the full potential of spectrum use to drive economic and social progress. Once policy objectives have been prioritised, governments and regulators now have at their disposal a wide range of spectrum assignment designs to adjust their spectrum assignment procedures to public policy goals.

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<https://ieeexplore.ieee.org/document/7926934>
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(29) CORCOM (2018), <https://www.corrierecomunicazioni.it/telco/aste-frequenze-litalia-fara-scuola-in-europa-ec-co-le-posizioni-in-campo/>

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