



PHOENIX FOR ADVANCED
LEGAL & ECONOMIC
C E N T E R PUBLIC POLICY STUDIES
www.phoenix-center.org

PHOENIX CENTER POLICY PAPER SERIES

Phoenix Center Policy Paper Number 42:

***A Policy Framework for Spectrum Allocation in Mobile
Communications***

T. Randolph Beard, PhD
George S. Ford, PhD
Lawrence J. Spiwak, Esq.
Michael Stern, PhD

(March 2011)

© Phoenix Center for Advanced Legal and Economic Public Policy Studies, T. Randolph Beard,
George S. Ford, Lawrence J. Spiwak and Michael Stern (2011).

Phoenix Center Policy Paper No. 42

A Policy Framework for Spectrum Allocation in Mobile Communications

T. Randolph Beard, PhD*
George S. Ford, PhD†
Lawrence J. Spiwak, Esq.‡
Michael Stern, PhD*

(© Phoenix Center for Advanced Legal & Economic Public Policy Studies, T. Randolph Beard, George S. Ford, Lawrence J. Spiwak and Michael Stern (2011).)

Abstract: With the *National Broadband Plan's* promise of an additional 500 MHz of spectrum for commercial purposes, the question of how to allocate those resources among competing uses and users will dominate the communications policy debate over the coming years. In this POLICY PAPER, we provide a theoretical analysis of some of the relevant tradeoffs involved in allocating spectrum among service providers, with a particular focus on incumbent-exclusion rules such as spectrum caps. Two key assumptions center the analysis: (i) more firms implies lower prices (i.e., Cournot competition); and (ii) more spectrum permits more advanced services due to greater capacity and throughput. The derived theoretical tradeoff is straightforward: In a setting with many firms with little spectrum, there are low prices but relatively less advanced services; however, in a setting with fewer firms with larger allotments of spectrum, there may be higher prices but also more advanced services. Our analysis highlights several key components of the spectrum allocation decision. First, an incumbent-exclusion rule is not "pro-entry," but instead seeks to select one form (price cutting) of entry over another (quality improving). Second, given the existing number of firms, the potential for sizeable competitive price effects is low. Third, the economic benefits of advanced wireless services are likely to be very high. Fourth, access to spectrum resources does not necessarily convey financial success, as spectrum is but one of many inputs necessary to provide service. In all, we believe these facts, interpreted in the context of the theory, suggest incumbent-exclusion rules are not welfare enhancing, at least in the United States.

* Senior Fellow, Phoenix Center for Advanced Legal & Economic Public Policy Studies; Professor of Economics, Auburn University.

† Chief Economist, Phoenix Center for Advanced Legal & Economic Public Policy Studies.

‡ President, Phoenix Center for Advanced Legal & Economic Public Policy Studies. The views expressed in this paper are the authors' alone and do not represent the views of the Phoenix Center, its Adjunct Fellows, or any of its individual Editorial Advisory Board members.

* Senior Fellow, Phoenix Center for Advanced Legal & Economic Public Policy Studies; Professor of Economics, Auburn University.

TABLE OF CONTENTS

I. Introduction	2
II. From <i>De Jure</i> Spectrum Caps to <i>De Facto</i> Spectrum Caps	10
III. Analytical Framework.....	16
A. Theoretical Model.....	20
B. Illustrations of the Theory	23
IV. “More” Spectrum Does Not <i>a fortiori</i> Mean “More” Firms.....	25
A. Theoretical Evidence	26
B. The Historical Evidence.....	27
V. Conclusions.....	29

I. Introduction

Across the globe, the mobile communications revolution is well under way. From advanced economies such as the United States, to developing economies like India, mobile telecommunications, in both voice and data forms, is quickly becoming the communications technology of choice. In the United States, it took less than fifteen years for wireless telephones to move from a thinly consumed service to effective ubiquity.¹ In 2010, there were 292.8 million wireless accounts in the United States, which translates to roughly 1.1 accounts for every citizen over ten years of age.² Mobile communications has evolved well beyond voice technology to now include enhanced communications services such as text messages, email, and broadband connectivity, which are, in fact, quickly becoming the dominant source of consumer value for mobile service. In the not so distant future, it is expected by some that mobile appliances, like the iPhone, will replace traditional computers for many consumers.³ For many individuals and households, mobile broadband may be the Internet connection of choice.⁴

¹ CTIA Wireless Quick Facts showing 28.1 million accounts in 1995 (0.11 per capita) to 292.8 million in 2009 (0.93 per capita) (available at: <http://www.ctia.org/advocacy/research/index.cfm/AID/10323>).

² *Id.* Population data provided by the U.S. Census Bureau (available at: <http://www.census.gov/popest/national/asrh/NC-EST2009-sa.html>).

³ See, e.g., N. Wingfield, *Time to Leave the Laptop Behind*, WALL STREET JOURNAL (Feb. 23, 2009) (available at: http://online.wsj.com/article_email/SB122477763884262815-1MyQjAxMDI4MjI0NjcyNzY3Wj.html); G. Kirbyson, *More of Us Cutting the Cord: Wireless Generation Unplugging Their Computers, Phones*, WINNEPEG FREE PRESS (August 2, 2010) (available at: <http://www.winnipegfreepress.com/local/more-of-us-cutting-the-cord-101144529.html>); B. Ray,

(Footnote Continued. . . .)

This rise in wireless connections, as well as the rapidly increasing demand for data services over such connections, is a mixed blessing. On the one hand, it provides an enormous economic boon to consumers, businesses, and providers, while on the other hand it is beginning to test the capacity of networks to provide such services. Data hungry services, such as wireless broadband, are straining the existing capacity of wireless networks, where the capacity is strongly influenced by the amount of spectrum available to the firms.⁵ In many countries, including the United States, spectrum is in short supply for commercial services, a fact that has not gone unrecognized by policymakers. Federal Communications Commission (“FCC”) Chairman Julius Genachowski recently observed that, “America is facing a looming spectrum crunch”⁶ because “the United States does not have nearly enough spectrum to meet its medium- and long-term mobile broadband needs.”⁷ Perhaps the single most important proposal in the *National Broadband Plan* is to make 500 Megahertz (“MHz”) of additional spectrum available by 2020 for the provision of mobile broadband services, with ideally 300 MHz of that spectrum being made available by 2015,⁸ a

Cutting the Cord: Future Mobile Broadband Tech, Reghardware.com (available at: http://www.reghardware.com/2009/07/14/future_wireless_tech/print.html).

⁴ *Id.*

⁵ Within limits, the capacity of fixed amount of spectrum can be enhanced by increasing the number of towers. A description of the capacity limitation of mobile broadband network is provided in CONNECTING AMERICA: THE NATIONAL BROADBAND PLAN, Federal Communications Commission (March 16, 2010) (available at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296935A1.pdf) (hereinafter the *National Broadband Plan*) at Ch. 5 and *The Broadband Availability Gap*, OBI TECHNICAL PAPER NO. 1, Federal Communications Commission (April 2010) at Ch. 4 (“Loosely speaking, if spectral efficiency of the air interface remains unchanged, capacity of the wireless network grows proportionately with spectrum allocation (p. 71)”) (available at: <http://www.broadband.gov/plan/broadband-working-reports-technical-papers.html>) (hereinafter “*Broadband Availability Gap*”); see also, *Mobile Broadband: The Benefits of Additional Spectrum*, FCC Staff Technical Paper (October 10, 2010) (available at: <http://download.broadband.gov/plan/fcc-staff-technical-paper-mobile-broadband-benefits-of-additional-spectrum.pdf>).

⁶ Prepared Remarks of Federal Communications Commission Chairman Julius Genachowski, *Mobile Broadband: A 21st Century Plan for the U.S.: Competitiveness, Innovation and Job Creation* (Feb. 24, 2010) (available at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296490A1.pdf).

⁷ Prepared Remarks of Federal Communications Commission Chairman Julius Genachowski, *Broadband: Our Enduring Engine for Prosperity and Opportunity*, NARUC Conference Washington, D.C. (February 16, 2010) (available at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296262A1.pdf).

⁸ *National Broadband Plan*, *supra* n. 5 at 26.

vision which President Obama formally endorsed by Presidential Memorandum.⁹

Allocating more spectrum to advanced mobile services (such as broadband) is widely viewed as a sensible, if not a necessary, public policy. However, merely stating that more spectrum is to be allocated to commercial mobile services leaves some highly relevant details unresolved. There are (at least) two important questions that must be answered when increasing the supply of spectrum: (1) how much new spectrum is to be allocated; and, more significantly, (2) who gets it?¹⁰ On the first, as noted a moment ago, the FCC has proposed to substantially increase the spectrum available for mobile services; but on the second, the agency has sent clear signals that it is concerned with increasing industry concentration (despite the fact that it approved every auction and wireless merger to date) and, by implication, that it would prefer to allocate any new spectrum primarily to new entrants and possibly smaller incumbents, rather than the largest incumbent providers, in order to “deconcentrate” the industry.¹¹

The allocation of spectrum among firms is a complex issue for which economic theory can provide key insights. To this end, we provide in this POLICY PAPER a theoretical analysis of some of the relevant tradeoffs involved in allocating spectrum among service providers. Informally, our analysis contemplates two (theoretical) states of the world. In the first, a fixed amount of spectrum is divided among many firms so that each firm has a “little” spectrum. In the other, that same fixed amount of spectrum is divided among fewer firms, so that each firm has “much” spectrum. Incorporating the modeling assumption that a firm with a larger holding of spectrum can provide more advanced services, other things constant, due to greater capacity and throughput than a

⁹ See Remarks by Lawrence H. Summers, *Technical Opportunities, Job Creation and Economic Growth* (June 28, 2010) (available at: <http://www.whitehouse.gov/administration/eop/nec/speeches/technological-opportunities-job-creation-economic-growth>).

¹⁰ There are, of course, many more important questions, such as how large are the blocks, are they licensed or unlicensed, are they auctioned, what is the geographic scope of the license, and so forth.

¹¹ See Section II *infra*. The Hirschman Herfindahl Index of industry concentration falls as market share shifts from larger to smaller firms.

firm with less spectrum,¹² the theoretical tradeoff is straightforward. In a setting with “many firms with little spectrum” there *may* be more price competition, but that competition takes place over relatively less advanced services.¹³ In a setting with fewer firms with larger allotments of spectrum, there may be less price competition (due to the Cournot assumption), but that competition occurs over more advanced services (due to the relationship between spectrum and the capacity to offer such services). Lower prices are good, and higher quality is good, but, if quality requires large amounts of a fixed allotment of spectrum, then the two may not occur together (as a result of the modeling assumptions).¹⁴ Consequently, the policymaker is asked to trade off between potentially lower prices for less advanced services, and potentially higher prices for more advanced services. It is not apparent, at first glance, which situation is “better.”

Since, however, either of the above-described outcomes can be supported as “best” under certain conditions, linking the theory to the current structure of the mobile telecommunications industry is required in order to render policy-relevant conclusions. We believe this linkage, properly understood, can render fairly strong prescriptions. First, while additional firms lead to lower prices (at least in the Cournot Competition framework, which is the standard for regulatory policy), at some point additional firms have almost no effect on price. In fact, economic theory suggests that the price cuts resulting from additional firms rapidly diminish, and there is evidence to support this theoretical result.¹⁵

¹² The form of the holdings is a significant factor. For example, having spectrum in paired bands permits greater bandwidth. See, e.g., *The Broadband Availability Gap*, *supra* n. 5 at 73. On the tradeoff between expanding capacity using more spectrum or more network, see *Mobile Broadband: The Benefits of Additional Spectrum*, *supra* n. 5.

¹³ In the Cournot setting, firms choose the quantities they will offer to the market, and then the market price is determined by the market that liquidates those quantities. (Such a setting is akin to firms that set sales targets.) With Cournot competition, price and profits fall as the number of firms increases, converging on the competitive equilibrium. This “more firms, lower price” mentality dominates regulatory debates, and it is reasonable to say that Cournot competition is the benchmark in regulatory settings. See S. Martin, *ADVANCED INDUSTRIAL ECONOMICS* (1993) at 17-35; D. Carlton and J. Perloff, *MODERN INDUSTRIAL ORGANIZATION* (2000), at 157-187.

¹⁴ *National Broadband Plan* at Ch. 5, *supra* n. 5, and *Broadband Availability Gap*, *supra* n. 5 at Ch. 4.

¹⁵ See, e.g., M. Salinger, R. E. Caves, and S. Peltzman, *The Concentration-Margins Relationship Reconsidered; Comments and Discussion*, 1990 BROOKINGS PAPERS ON ECONOMIC ACTIVITY 287-335 (1990); G. Whalen, *The Determinants and Performance Effects of Rivalry in Local Banking Markets*, 31 QUARTERLY JOURNAL OF BUSINESS AND ECONOMICS 38-52 (1992) (“concentration affected neither rivalry nor profitability in the expected manner (at 38)”); M. B. Slovin, M. E. Sushka, and C. D. Hudson, *Deregulation, Contestability, and Airline Acquisitions*, 30 JOURNAL OF FINANCIAL ECONOMICS

(Footnote Continued. . . .)

Price cuts are mostly exhausted after about three to five rivals are present in the market. From an empirical standpoint, FCC data indicates that *at present* about 91% of the population has access to four or more mobile providers. Consequently, adding new competitors to the mobile industry is expected to have a small impact on prices. The gains from dividing spectrum into smaller parts in an effort to create more firms (e.g., using spectrum caps) are therefore likely to be very low, even under favorable conditions.¹⁶ Alternately, the economic gains from having access to broadband services are typically viewed as being very large, so a policy of granting existing firms (who can maximize spillovers from their existing plant and customer relationships) sufficient spectrum to run scalable networks that support innovation in both applications and devices is likely to produce substantial economic benefits. Therefore, in effect, we have a situation where price changes are no longer a part of the calculus, since adding firms is expected to have a small effect on price competition. As such, the tradeoff revealed by the theory is simply between less- or more-advanced services, and the best policy is clear.

In large part, our analysis comports with the recommendations of the U.S. Department of Justice (“DOJ”), which address not simply the issue of how much spectrum should be allocated to the industry, but the importance of how much spectrum is given to a single firm. In a letter to the FCC, the DOJ observes, “[s]tated simply, without access to sufficient spectrum *a firm* cannot provide state-of-the-art wireless broadband services.”¹⁷ The DOJ also addresses, to some

231-252 (1991) (“changes in concentration after deregulation have no positive effect on carrier returns (at 231)”); J. R. Schroeter, *Estimating the Degree of Market Power in the Beef Packing Industry*, 70 *REVIEW OF ECONOMICS AND STATISTICS* 158-162 (1988) (“there has been no real worsening of the market’s performance during the period of increasing concentration (at 158)”); S. A. Rhoades, *Market Share as a Source of Market Power: Implications and Some Evidence*, 37 *JOURNAL OF ECONOMICS AND BUSINESS* 343-364 (1985) (“market share *per se* is a source of high profits, regardless of the level of concentration and after controlling for firm size (at 343)”); R.L. Beck and S. Mozejko, *Concentration and Price/Cost Margins Across Time in Canada*, 9 *REVUE CANADIENNE DES SCIENCES DE L’ADMINISTRATION* 40-47 (1992) (“when a shift occurs from a single-point-in-time to a sequential-points-in-time approach, there is no longer a consistent relationship between changes in concentration and changes in profit margins (at 40)”).

¹⁶ The Merger Guidelines, for example, recommends ignoring mergers where the HHI is 1800 or less, which is equivalent to 5 equal-sized firms. Thus, the fifth firm is viewed as trivial in terms of its effect on equilibrium prices.

¹⁷ January 4, 2010 *Ex Parte* Submission of The United States Department of Justice, *In the Matter of Economic Issues in Broadband Competition: A National Broadband Plan for Our Future*, GN Docket No. 09-51 (<http://fjallfoss.fcc.gov/ecfs/document/view?id=7020355122>) (emphasis supplied) (hereinafter “DOJ Letter”).

extent, the details of allocation decisions, observing “[t]he goal in assigning licenses to any such new spectrum designated for commercial services should be to ensure that it generates the greatest ultimate benefits to the consumers of those services.”¹⁸ Our economic model adopts this “greatest ultimate benefits” approach, which is standard economic fare.

Another important insight from the theory is that policymakers do not get to choose the number of firms offering mobile telecommunications services simply through its spectrum allocation decisions. Stated another way, the conventional wisdom that “more” spectrum somehow *a fortiori* means “more” firms simply is not true.¹⁹ Economics determines the viable number of providers, not the intentions of policymakers.²⁰ Mobile services cannot be supplied without spectrum, but having spectrum does not imply financial success. Spectrum is

¹⁸ DOJ Letter, *id.*, at 23-4.

¹⁹ See, e.g., Prepared Remarks June 14, 2010 of FCC Commissioner Mignon Clyburn, *Introduction to the Panel “Wireless Spectrum Needs: What is the Best Way to Serve All of the American People?”* Rainbow Push Coalition 39th Annual Convention, Chicago, Illinois (“[A]dditional spectrum could foster more competition in the wireless space, which in turn could yield more affordable prices”) (available at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-298781A1.pdf); Testimony of Gregory L. Rosston, Deputy Director and Senior Research Scholar, Stanford Institute for Economic Policy Research Deputy Director, Public Policy Program Stanford University, Federal Communications Commission *En Banc* Hearing on Broadband Network Management Practices, Stanford University (April 17, 2008) at 7 (available at: http://www.fcc.gov/broadband_network_management/041708/rosston.pdf) (“Obviously, it would be great if it were economic for multiple firms to string fiber optic cable around all neighborhoods in the United States. That is unlikely to happen. But the FCC has tools to make facilities-based competition more likely and more viable. First and foremost, the FCC should get even more spectrum out into the marketplace. And it is probably important that the spectrum not continue to go into the hands of the two incumbent landline telephone companies that also have by far the most valuable wireless spectrum.”)

²⁰ G. S. Ford, T. M. Koutsky and L.J. Spiwak, *Competition After Unbundling: Entry, Industry Structure and Convergence*, PHOENIX CENTER POLICY PAPER NO. 21 (Jul. 2005), reprinted in 59 FED. COMM. L.J. 331 (2007). This paper was cited at length and acknowledged by the FCC in its *Fourteenth CMRS Report*. In the *Matter of Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993 Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, FOURTEENTH REPORT, FCC 10-81, __ FCC Rcd __ (rel. May 20, 2010) (hereinafter “*Fourteenth CMRS Report*”); see also *National Broadband Plan*, *supra* n. 5, at 36-7; In the *Matter of Implementation of Section 19 of the Cable Television Consumer Protection and Competition Act of 1992, Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming*, FIRST REPORT, FCC 94-235, __ FCC Rcd __ (rel. September 28, 1994) Appendix H at ¶¶ 377-383 (discussing how the presence of high sunk costs may have a decisive effect on the evolution of local market structure and the possible trade-offs between the number of actual competitors in any local cable market and the intensity of price competition that might prevail)

simply one input to production and cannot singularly determine the financial viability of firms offering mobile communications services. This is apparent from the history of the mobile industry, which has undergone consolidation over much of its history (and may be due for more).²¹ This consolidation is merely the industry adjusting towards a sustainable structure; an equilibrium consisting of fewer firms than that licensed by the design of the early FCC spectrum allocation decisions. The reality is that, while we may want five, ten, or twenty mobile telephony service providers, the economics are unlikely to permit it.²² Consequently, the heavy use of incumbent-exclusion policies (such as spectrum caps or other limitations on spectrum use by firms) may not result in more providers, but may instead lead simply to inefficient use of scarce spectrum resources.²³

Finally, we present empirical evidence shedding light on the relationship between industry concentration and the amount of spectrum licensed for commercial services. While many believe and claim that more spectrum will necessarily lead to more competitors, this causal linkage has no basis in either theory (as just discussed) or empirics. While the PCS auctions in the mid-1990's broke the then- (government-created) duopolistic market, over the past decade the amount of spectrum allocated to commercial services has risen substantially, but at the same time industry concentration has risen slightly as mobile

²¹ M. Reardon, *Sprint CEO Sees "Logic" in Merger with T-Mobile*, CNET NEWS (July 13, 2010)(available at: http://news.cnet.com/8301-30686_3-20010427-266.html); A. Parker and P. Taylor, *Sprint's 4G Move Opens Way to Merger*, FT.com (July 12, 2010) (available at: <http://www.ft.com/cms/s/0/c4d6eb6a-8de0-11df-9153-00144feab49a.html>).

²² See *Fourteenth CMRS Report*, *supra* n. 20, at ¶ 61, n. 141, citing May 7, 2009 Written Statement of George S. Ford, Ph.D., Chief Economist, Phoenix Center for Advanced Legal & Economic Public Studies, Before the House of Representatives, Committee on Energy and Commerce, Subcommittee Telecommunications and the Internet, Hearing on "An Examination of Competition in the Wireless Industry" at 5, (estimating that three to five nationwide carriers will be able to provide mobile services, including mobile broadband).

²³ *C.f.* Clyburn Speech, *supra* n. 19 ("As we roll out more spectrum to auction across the board, what role will minority businesses play? I recently expressed my dismay over conflicting signals that are given out by the FCC and DOJ as to what kinds of bidders the federal government is seeking when it comes to conditions on spectrum reallocation. The concern is what happens to the spectrum that is being auctioned. Are we going to continue to see spectrum go to the largest providers? Or are there meaningful opportunities to be had for small and underrepresented businesses in this high-growth field? This aspect of the spectrum conversation cannot be ignored.")

communications gropes toward an equilibrium market structure.²⁴ Recent data show that more spectrum does not generally lead to lower industry concentration. In many respects, this finding should not be a surprise. As services advance, so do the sunk costs of building and maintaining the networks and, equally important, the cost of building and maintaining a customer base. In turn, equilibrium industry concentration rises.²⁵ This consequence of quality competition is explained theoretically in John Sutton's text, *Sunk Cost and Market Structure* (1995), and the logic of these "endogenous" sunk costs is embedded in recent FCC analysis.²⁶ Fortunately, research shows that higher concentration arising from the endogenous sunk costs resulting from quality competition can have positive welfare consequences.²⁷ The data also show that rising concentration has not been accompanied by rising prices. Average revenue per minute has fallen significantly and persistently over the past fifteen years, suggesting that market structure may not be a meaningful driver of price competition at historically relevant levels of industry concentration.²⁸

The paper is organized as follows. In Section II, we provide an overview of the FCC's treatment of concentration in the wireless industry, from the imposition of spectrum caps in the mid 1990's, to the abolition of these spectrum caps in 2001, to the re-imposition of *de facto* spectrum caps in the Harbinger merger review proceeding.²⁹ In Section III, we set forth an analytical framework to evaluate the important policy questions posited above. In Section IV, we deal specifically with the commonly held belief that "more spectrum" *a fortiori* means "more" firms. Concluding thoughts and policy recommendations are set forth in Section V.

²⁴ For a plain-language description of equilibrium industry structure, see *Competition After Unbundling*, *supra* n. 24.

²⁵ *Id.*

²⁶ J. Sutton, SUNK COST AND MARKET STRUCTURE (1991); *National Broadband Plan*, *supra* n. 5, at 62 ("The key insight is that in such industries the total number of firms is likely to be limited and may even shrink as the market grows.").

²⁷ See G. Ford and M. Stern, *Endogenous Sunk Costs, Quality Competition and Welfare*, PHOENIX CENTER POLICY PERSPECTIVE NO. 10-07 (December 2010) (available at: <http://www.phoenix-center.org/perspectives/Perspective10-07Final.pdf>).

²⁸ See Figure 4, *infra*.

²⁹ The purpose of a spectrum cap is to place an upper bound on the amount of spectrum available to mobile carriers, a rule that historically has been binding only for the larger carriers. The Harbinger rules restrict access by the largest wireless carriers to spectrum capacity in the secondary market, thereby operating in a similar capacity as a *de jure* spectrum cap.

II. From *De Jure* Spectrum Caps to *De Facto* Spectrum Caps

Implications of industry concentration have always been a difficult issue for the FCC. The potential for concentration in the wireless sector is especially acute due to the barrier to entry posed by the limited availability of spectrum.³⁰ As the Commission observed ten years ago in the *2000 Biennial Review*:

The requirement to obtain access to spectrum constitutes a barrier to facilities-based entry into the CMRS marketplace because the supply of suitable spectrum is limited. Facilities-based mobile telephony service cannot be offered without access to suitable spectrum, and a government license is required to use spectrum to provide CMRS.³¹

The Commission's first attempt at dealing with industry concentration was the imposition of spectrum caps in anticipation of the auction of PCS spectrum in 1994. At the time, there were two firms offering mobile telephone services in each market, one of which was the incumbent wireline provider. The Commission essentially proffered two explanations for its decision: First, the Commission was concerned that if licensees were able to aggregate sufficient amounts of CMRS spectrum, then it would be possible for them, unilaterally or in combination, to exclude efficient competitors, to reduce the quantity or quality of services provided, or to increase prices to the detriment of consumers.³² Second, the Commission reasoned that a spectrum cap would prevent licenses from artificially withholding (i.e., "warehousing") capacity from the market place.³³

Seven years later, the wireless telephone market had undergone a competitive transformation as the PCS spectrum permitted additional entry. At the end of 2000, the Commission found that about ninety-one percent of U.S. residents lived in a county that was served, at least in part, by three or more different providers, and seventy-five percent (75%) of the U.S. population lived

³⁰ *In Re 2000 Biennial Regulatory Review Spectrum Aggregation Limits For Commercial Mobile Radio Services*, FCC 01-328, REPORT AND ORDER, 16 FCC Rcd 22668 (December 18, 2001) (hereinafter "*2000 Biennial Review*") at ¶ 39.

³¹ *Id.* at ¶ 40.

³² *Id.* at ¶ 12.

³³ *Id.*

in a county where five or more providers offered service.³⁴ Moreover, the Commission found that market concentration, as measured by subscriber share, was falling.³⁵ On the other hand, the Commission found that when it used spectrum share as the capacity measure, the Hirschman Herfindahl Index (“HHI”) revealed “moderate” to “high” concentration.³⁶

Both supply-side and demand-side conditions in the mobile sector, including scale economies, tend to favor larger firms and thus promote relatively concentrated market outcomes. Building, maintaining, and operating a mobile communications business requires significant capital expenditures on both network and customer relationships. Industry concentration, as measured by indexes such as the HHI, is likely to be relatively high for the foreseeable future (greater than, say, the thresholds commonly used in the Merger Guidelines for defining concentrated markets).³⁷ But high concentration does not imply poor performance, and this point was not lost on the FCC. The Commission reasoned that “caution is appropriate in employing such measures” as the Hirschman Herfindahl Index because:

Although more concentrated markets can be less competitive and more vulnerable to anticompetitive activity than less concentrated markets, moderate to high concentration is not necessarily a threat to competition. For example, we have previously found that “an HHI analysis alone is not determinative and does not substitute for our more detailed examination of competitive considerations.” In the case of CMRS markets, for example, limits to economies of

³⁴ *Id.* at ¶ 31.

³⁵ *Id.* at ¶ 32.

³⁶ The HHI is an accepted measure of market concentration but has limitations in dynamic markets. The index is calculated by summing the squared market shares of each firm. For example, a market consisting of three equal sized firms has an HHI of 3,333 (= 332 + 332 + 332). The number’s equivalent is simply $[1/(HHI/1000)]$, where this ratio measures the number of hypothetical, equally sized firms in a market (irrespective of the actual distribution of market shares).

³⁷ HORIZONTAL MERGER GUIDELINES, U.S. Department of Justice and Federal Trade Commission (1997) (available at: http://www.justice.gov/atr/public/guidelines/horiz_book/hmg1.html). The 1997 MERGER GUIDELINES define as “highly concentrated” those markets with a HHI exceeding 1,800. In the proposed 2010 revisions to the MERGER GUIDELINES, however, a “highly concentrated” market is one with an HHI exceeding 2,500. HORIZONTAL MERGER GUIDELINES, FOR PUBLIC COMMENT (Released April 20, 2010) (available at: <http://www.ftc.gov/os/2010/04/100420hmg.pdf>).

scale, technological compatibility issues, difficulties in finding a willing seller at a reasonable price, and capital market constraints limit consolidation.³⁸

Here, the Commission rejected an exclusive reliance on HHIs and, instead, pointed to its then-recent *Sixth CMRS Report*³⁹, which found that the wireless market was performing well. Not only was subscribership up, but wireless prices were on the decline.⁴⁰ Moreover, the Commission found there were six nationwide wireless operators (AT&T, Cingular, Nextel, Sprint, Verizon, and VoiceStream) from whom consumers could choose.⁴¹ Finally, the Commission found that the “need for direct access to spectrum is not absolute because carriers can compete in the provision of CMRS without access to spectrum through resale, or a mobile virtual network operator (“MVNO”) arrangement.”⁴²

Given the above, the Commission held that it was persuaded that competition was robust enough in CMRS markets that it was no longer appropriate to impose overbroad *a priori* limits on spectrum aggregation that may prevent transactions that are in the public interest. As such, as part of the Commission’s mandatory *2000 Biennial Review*, the Commission eliminated the spectrum cap regime in favor of a more nuanced, case-by-case approach, accompanied by enforcement sanctions in case of misconduct. In so doing, the Commission reasoned that it now had the necessary “flexibility to reach the appropriate decision in each case, on the basis of the particular circumstances of that case.”⁴³

In the ten years that have followed the FCC’s removal of its original price caps, it has made new spectrum available to the market, most notably the 700

³⁸ *2000 Biennial Review*, *supra* n. 30 at ¶ 33. Indeed, as the Ninth Circuit recognized, “[r]eliance on statistical market share in cases involving regulated industries is at best a tricky enterprise and is downright folly where ... the predominant market share is the result of regulation.” *Metro Mobile CTS, Inc. v. New Vector Communications Inc.*, 892 F.2d 62, 63 (9th Cir. 1989).

³⁹ *Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services*, SIXTH REPORT, FCC 01-192, __ FCC Rcd __ (rel. July 17, 2001) (“*Sixth Annual CMRS Competition Report*”).

⁴⁰ *2000 Biennial Review*, *supra* n. 30 at ¶ 35-36.

⁴¹ *Id.* at ¶ 38.

⁴² *Id.* at ¶ 42.

⁴³ *Id.* at ¶ 50.

MHz and AWS spectrum made available from the DTV transition. At the same time, the Commission also approved several mergers and combinations of mobile licensees, thereby reducing the number of nationwide mobile carriers from six in 2000 to four in 2010.⁴⁴ In its *Fourteenth CMRS Report*, the Commission found, by its own calculations, that average HHI had increased, over the years 2003 to 2008, from 2151 to 2848, a rise of 697 points.⁴⁵ Again, the agency remarked that, “market concentration, by itself, is an imperfect indicator of market power,” and deliberately reached no conclusions on market power.⁴⁶

The evidence speaks for itself, however. By the FCC’s own account, the U.S. wireless market continues to perform exceptionally well. According to the *Fourteenth CMRS Report*, mobile subscribership was up,⁴⁷ and consumers were benefitting from aggressive price competition in both the pre-paid and post-paid markets from a variety of pricing plans.⁴⁸ Indeed, average revenues per voice minute continued to hover around \$0.05⁴⁹ and average revenue per text message was only around \$0.011.⁵⁰ Equally important, the Commission found that consumers benefited from the intense non-price rivalry among carriers, including (1) network upgrades; (2) product information and perception, which include advertising and marketing; and (3) downstream product differentiation,

⁴⁴ *Fourteenth CMRS Report*, *supra* n. 20 at ¶¶ 75-84.

⁴⁵ *Id.* at ¶ 51. Significantly, unlike the analysis to support its decision to remove spectrum caps in the *2000 Biennial Review*, *supra* n. 30, the Commission in the *Fourteenth CMRS Report* specifically refused to count MVNOs as a competitor in the mobile wireless market in its analysis of market structure. *See id.* at ¶ 65. The *Fourteenth CMRS Report* also reports an HHI of 2,220, which is computed by the investment firm Merrill Lynch. *See id.* at Table 41, p. 197.

⁴⁶ *Fourteenth CMRS Report*, *supra* n. 20 at ¶ 55 (“due to the complexities of estimating market power in an industry with high fixed costs that are recovered gradually over time, difficulties with analyzing pricing plans for bundles of services, and the difficulties in obtaining accurate and suitable cost data”).

⁴⁷ *Id.* at ¶ 155.

⁴⁸ *Id.* at ¶¶ 86-103. There are some who like to point to the OECD’s 2009 analysis which purports to show that the United States had among the highest mobile rates in the world, but the OECD’s analysis has been soundly discredited on its technical merits and should be given no probative value. G.S. Ford, PHOENIX CENTER PERSPECTIVE NO. 09-03: *Be Careful What You Ask For: A Comment on the OECD’s Mobile Price Metrics* (September 16, 2009) (available at: <http://www.phoenix-center.org/perspectives/Perspective09-03Final.pdf>).

⁴⁹ *Fourteenth CMRS Report*, *supra* n. 20 at ¶ 190.

⁵⁰ *Id.* at ¶ 192.

which includes handset/device and application offerings.⁵¹ According to the FCC's analysis, therefore, the higher concentration naturally resulting from mergers in the mobile sector has not diminished market performance.⁵²

Nonetheless, the FCC's enlightened economic analysis of concentration and performance is inconsistently applied. In its recent *Phoenix Forbearance Order*, for example, the Commission directly links concentration to market power in the most stringent of manners.⁵³ Even in the mobile sector, the agency appears often to be of two minds. Despite providing significant evidence of good market performance in the *Fourteenth CRMS Report* and rejecting market shares as a per-se indicator of market power, the agency recently revealed its interest in spectrum limitations by promulgating a rule limiting access to secondary-market spectrum by the largest mobile carriers—a *de facto* spectrum cap—in its Harbinger decision.⁵⁴

⁵¹ See *id.*, Section IV.B.

⁵² Of course, the mere mention of a rising HHI led some to conclude there was a competitive problem. For example, in the Approving Statement of FCC Commissioner Michael Copps to the *Fourteenth CMRS Report*, the Commissioner opined:

I have been warning about for years—that competition has been dramatically eroded and is seriously endangered by continuing consolidation and concentration in our wireless markets. One number sticks out like a sore thumb: the Herfindahl-Hirschman Index—a widely-recognized and highly-credible measurement of industry concentration—shows that the concentration of mobile wireless service providers has skyrocketed to a weighted average of 2848.

Commissioner Copps ignores the fact that the *Report* explicitly rejects this direct linkage between concentration and competition (“market concentration, by itself, is an imperfect indicator of market power”) and its conclusions regarding good market performance. The media also focused on the HHI statistics. See, e.g., T. Shields, *FCC Says Wireless Concentration Rises*, BLOOMBERG (May 20, 2010); T. Ford, *FCC Finds Wireless Sector “Concentrated”*, RCR WIRELESS NEWS (May 20 2010).

⁵³ *In the Matter of Petition of Qwest Corporation for Forbearance Pursuant to 47 U.S.C. § 160(c) in the Phoenix, Arizona Metropolitan Statistical Area*, FCC 10-113, MEMORANDUM OPINION AND ORDER, __ FCC Rcd __ (rel. June 22, 2010) (FCC drew conclusions of market power based primarily on market share). For a critical review of the agency's approach, see G.S. Ford and L.J. Spiwak, PHOENIX CENTER PERSPECTIVE NO. 10-08, *The Impossible Dream: Forbearance After the Phoenix Order* (December 16, 2010) (available at: <http://www.phoenix-center.org/perspectives/Perspective10-08Final.pdf>).

⁵⁴ Schizophrenia is not limited to the present Commission. Despite declaring the mobile market effectively competitive in 2006, *In the Matter of Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993 Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, ELEVENTH REPORT, FCC 06-142, __ FCC Rcd __ (rel. September 29, 2006), the Federal Communications Commission under the leadership of Kevin Martin imposed open platform mandates to the C-Block of the 700 MHz auction. See *Service Rules for the 698-746, 747-762 and 777-792 MHz Bands*, WT Docket No. 06-150,

(Footnote Continued. . .)

There, Harbinger Capital Partners sought to acquire Mobile Satellite Service (“MSS”) provider SkyTerra.⁵⁵ Although the respective Chiefs of the International Bureau, the Wireless Bureau, and the Office of Engineering and Technology raised serious concerns about the merged entity’s potential dominance of the MSS market (including a finding that Harbinger had ownership positions in MSS competitor TerreStar, along with a variety of other wireless competitors), what tipped the Bureau Chiefs’ hands was their acceptance of the merged entity’s promise to build a “4G” terrestrial (as opposed to satellite) wireless network that will provide coverage in the United States to at least 100 million people by December 31, 2012, at least 145 million people by December 31, 2013, and at least 260 million people by December 31, 2015.⁵⁶ While one can certainly see the appeal of Harbinger’s offer, the Bureau Chiefs went one step further by adopting a *de facto* spectrum cap without an opportunity for public notice and comment.⁵⁷

In particular, Harbinger first promised that, should it seek to make spectrum available “to either of the two largest terrestrial providers of CMRS and broadband services,” the merged entity would need to obtain Commission

Revision of the Commission’s Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems, CC Docket No. 94-102, Section 68.4(a) of the Commission’s Rules Governing Hearing Aid-Compatible Telephones, WT Docket No. 01-309, Biennial Regulatory Review – Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services, WT Docket 03-264, Former Nextel Communications, Inc. Upper 700 MHz Guard Band Licenses and Revisions to Part 27 of the Commission’s Rules, WT Docket No. 06-169, Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band, PS Docket No. 06-229, Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010, WT Docket No. 96-86, Declaratory Ruling on Reporting Requirement under Commission’s Part 1 Anti-Collusion Rule, WT Docket No. 07-166, SECOND REPORT AND ORDER, FCC 07-132 (rel. Aug. 10, 2007) at ¶¶ 189-230 (available at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-07-132A1.pdf) (“700 MHz Second Report and Order”).

⁵⁵ *In the Matter of SkyTerra Communications, Inc. and Harbinger Capital Partners Funds, Applications for Consent to Transfer of Control, MEMORANDUM OPINION AND ORDER AND DECLARATORY RULING, DA 10-535 (Rel. March 26, 2010)(hereinafter the Harbinger Order).*

⁵⁶ *Id.* at ¶ 46.

⁵⁷ Indeed, contrary to this Administration’s promise of “transparency”, although the ex partes containing voluntary commitments were made on March 26, 2010, the Commission did not post these ex partes on EDOCs until March 29th—*three days after the order was released on delegated authority.* See March 26, 2010 letter to Marlene Dortch from Henry Goldberg, *et al.* (available at <http://fjallfoss.fcc.gov/ecfs/document/view?id=7020397552>). Thus, it was impossible by administrative fiat to for the public to have an opportunity to comment on Harbinger’s “voluntary commitment” of a *de facto* spectrum cap.

approval. Second, the merged entity would be required to live up to the buildout schedule proposed in the order. Finally, the merged entity would first obtain Commission approval before allowing traffic to the two largest terrestrial providers' accounts to amount to more than twenty five percent (25%) of SkyTerra's total traffic on its terrestrial network in any Economic Area.⁵⁸ These "voluntary commitments" have no apparent connection to any specific anticompetitive harm revealed by the Bureau Chiefs' competitive analysis. Thus, it is reasonable to interpret this *de facto* "spectrum cap"⁵⁹ as revealing a renewed interest in using regulation to modify market structure in mobile communications by limiting access to spectrum resources by some or all incumbent firms. For this reason (among others), we believe our analysis is timely and potentially helpful in the formulation of spectrum policy.

III. Analytical Framework

Economic theory and antitrust policy in general, are firmly and rightly geared toward encouraging entry by new firms in most situations. Although economics has identified a number of cases in which entry may not be socially optimal (e.g., cases of extreme scale economies or "natural monopoly"), there is a recognizable bias towards encouraging entry in most discussions of public policy.⁶⁰ This pro-entry orientation is easily discerned in any examination of the history of U.S. telecommunications regulation, with leading examples including the unbundling regulations of the 1996 Telecommunications Act, rules against discriminatory pricing and mandates for interconnection, and auction rules intended to increase the likelihood of spectrum license awards to new entrants.

Although this bias towards entry is understandable, it is important to recognize that economic theory also has established that the social benefits of entry, while potentially very large in the cases of monopoly and highly

⁵⁸ *Harbinger Order*, *supra* n. 55 at ¶ 72.

⁵⁹ The Harbinger Decision is plainly a backdoor attempt to regulate indirectly by adjudication rather than by industry-wide rulemakings. On such matters, *see, e.g.*, T. M. Koutsky and L. J. Spiwak, *Separating Politics from Policy in FCC Merger Reviews: A Basic Legal Primer of the "Public Interest" Standard*, 18 *COMMLAW CONSPPECTUS* 329 (2010); *see also* FCC Commissioner Meredith Attwell Baker, *Towards a More Targeted and Predictable Merger Review Process* (March 3, 2011) (available at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-304946A1.pdf) citing *id.*

⁶⁰ There are limitations on the number of firms that can serve a market. This economic reality does not disqualify the entry-preference, but merely tempers it. *See Competition After Unbundling*, *supra* n. 20.

concentrated markets, can diminish fairly rapidly as more firms enter.⁶¹ This “drop-off” in the impact of entry depends, of course, on the nature of market competition, the costs of entry, and the probable alternative path competition would take should entry not occur. For example, the model exhibiting the greatest effect of entry is surely the Bertrand duopoly with identical firms and products, in which the entry of a single additional firm converts industry performance from monopolistic to perfectly competitive.⁶² In this framework, entry by any additional firms has no social return. At the other end of the spectrum, a cartelized industry, which adopted an entrant into its collusive structure, would exhibit no social benefit from entry, regardless of the number of entrants considered. In more realistic intermediate cases, of course, entry will reduce prices, although at a diminishing rate as entry proceeds. The Cournot model of competition is the standard for intermediate cases, and the logic of this model lies at the heart of most public policy arguments favoring entry.

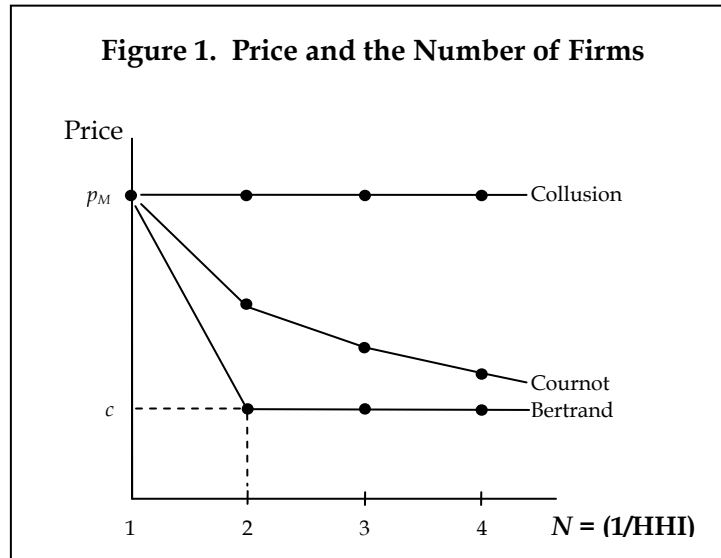


Figure 1 illustrates the relationship between the number of firms and prices under alternative assumptions about the nature of competition.⁶³ In the figure,

⁶¹ See, e.g., J. Tirole, *THE THEORY OF INDUSTRIAL ORGANIZATION* (1995) at pp. 218-21; J. Kwoka, *The Effect of Market Share Distribution on Industry Performance*, 61 *REVIEW OF ECONOMICS AND STATISTICS* 101-9; *Competition After Unbundling*, *supra* n. 20.

⁶² *Competition After Unbundling*, *id.*

⁶³ The figure adapted from Sutton (1995), *supra* n. 26 at p. 34.

price is measured on the vertical and the number of firms N (or $1/\text{HHI}$) on the horizontal.⁶⁴ The monopoly price is labeled p_M and marginal cost is labeled c . First, consider the relationship between the number of firms and price under Cournot competition. As shown by the line labeled “Cournot,” as the number of firms increases the price gradually falls toward marginal cost (that is, the perfectly competitive outcome). Note that while price continually falls with increases in N under Cournot competition, most of the price cuts from competition are realized with the first few firms. In contrast to this steady decline in prices under Cournot competition, Bertrand competition reveals marginal cost pricing obtained with only two firms (i.e., duopoly).⁶⁵ The line labeled “Bertrand” reveals this sharp decline in price from p_M to c between the first and second firm. As just mentioned, after the second entrant, additional firms have no effect on price, so the HHI and other measures of concentration are meaningless in the Bertrand framework. Finally, there is a line labeled “Collusion.” If firms are able to collude perfectly, then the price is held at the monopoly price regardless of the number of firms. As with Bertrand, the number of firms tells us almost nothing about price. Clearly, it is Cournot Competition that is consistent with the common view that more firms implies “more competition” in the form of lower prices. The failure to see prices rise as concentration rises in the mobile sector (see Figure 2), however, suggests that price competition may actually be more intense than Cournot Competition (though admittedly this applies a static framework in a dynamic setting).⁶⁶

⁶⁴ If firms are identical, then $\text{HHI} = 1/N$. If there are two equal sized firms, then the market shares are 50% and the HHI is 0.50. With three firms, the shares are 33% and the HHI is 0.33.

⁶⁵ This intense competition creates an interesting predication called the Bertrand Paradox. If there are fixed costs, then the marginal cost pricing outcome with two firms ensures both firms earn negative profits. Thus, entry does not occur. Put simply, competition is so intense that it never happens. The Bertrand Paradox is highly relevant for public policy analysis in telecommunications markets, and we have incorporated the idea in earlier works including J.B. Duvall and G.S. Ford, *Changing Industry Structure: The Economics of Entry and Price Competition*, PHOENIX CENTER POLICY PAPER NO. 10 (April 2001) (available at: <http://www.phoenix-center.org/pcpp/PCPP10Final.pdf>) and reprinted in 7 TELECOMMUNICATIONS & SPACE LAW JOURNAL 11 (2001); *Competition After Unbundling*, *supra* n. 20; G.S. Ford, T.M. Koutsky and L.J. Spiwak, *Network Neutrality and Industry Structure*, PHOENIX CENTER POLICY PAPER NO. 24 (April 2006)(available at: <http://www.phoenix-center.org/pcpp/PCPP24Final.pdf>) and reprinted as T. R. Beard, G.S. Ford, T.M. Koutsky and L.J. Spiwak, *Network Neutrality and Industry Structure*, 29 HASTINGS COMM/ENT L.J. 149 (2007).

⁶⁶ Some economic models allow the intensity of competition to vary continuously from Bertrand to Perfect Collusion. See, e.g., M. Waterson, *ECONOMIC THEORY OF THE INDUSTRY* (1984) at

(Footnote Continued. . . .)

Thus, in any particular circumstance, it is vital to evaluate the likely effects of entry in light of both the observed industry structure, and the probable alternative path competition could take if some form of entry were prohibited. These considerations are particularly relevant to the evaluation of the FCC policy of the “spectrum cap” (or favoritism in the auction rules), which is, in effect, a prohibition on entry by a class of credible incumbents. If one assumes, as seems correct, that the FCC policy is effective, in the sense that it changes the outcome of the spectrum auction by altering which firm(s) obtains the desired spectrum license, then it is necessary to evaluate the outcome the policy produces in comparison with the outcome obtained in the absence of the policy. Thus, if the practical effect of an incumbent-exclusion rule is to keep some firm, for example Firm 1, from obtaining the spectrum, then one needs to examine both what Firm 1 would have done with it, had it been allowed to win, and what the ultimate winner will do with it. It would then be possible to compare the welfare consequences of these two cases and make a credible judgment on the social welfare consequences of the prohibition.

The welfare comparison described above is not simple, but a simple model can form the conceptual basis for the comparison. This is our purpose in this section. We begin by noting that, looked at broadly, an incumbent-exclusion policy (such as spectrum caps), if it makes sense, is actually a prohibition on entry imposed on a subset of firms who already own related assets. Further, for the policy to make any difference, it is necessary that these prohibited firms be likely to actually win the spectrum in the absence of the policy, else the policy is meaningless. The relevance of the policy, in turn, suggests that the analyst should assume that the profits available to the firm prohibited from acquiring the spectrum must exceed those a favored entrant could obtain, or else the banned entrant would not win the auction anyway. Thus, for the incumbent-exclusion policy to make sense from the social perspective, it must be that entry by the favored entrant creates welfare gains, for example by lowering market prices, which are sufficient to overcome the fact that the banned entrant (e.g., an incumbent) values the spectrum asset more than anyone else does.

This logic appears to underlie the FCC’s spectrum cap policy and other regulatory handicaps placed on incumbent firms. In other words, by prohibiting a large incumbent from winning the spectrum at auction, the FCC expects another firm to use the spectrum to support entry into wireless voice

Ch. 2; Martin, *supra* n. 13, at Ch. 2. The effects of the intensity of competition on market structure is detailed in *Competition After Unbundling*, *supra* n. 20.

communications and related services, thus increasing competition in these markets.

What use, though, should one assume the unwelcome bidder would make of the spectrum had it been allowed to buy it? Here, some speculation is necessary, yet it appears highly likely that this asset would not be used merely to provide greater quantities of the same voice communication products currently offered by the firm over other frequencies. Evidence suggests that such voice applications are not currently widely congested in the U.S. market, so the utilization of this spectrum in that application is unlikely to be a part of the incumbent firm's plans. Rather, discussions in the business press and elsewhere point to the introduction of broadband/information type services, which are regarded as complements to existing wireless voice grade products, and would probably be sold together with them in packages.⁶⁷

In contrast to this "complementary entry," if the incumbent-exclusion rule effectively caused a "new" entrant to join existing wireless firms in offering a standard product in competition to the offerings of the incumbents, then one would expect to see the equilibrium price of this standard offering fall in response to competitive entry. As outlined earlier, though, the extent of this price reduction would depend on the current market structure and the nature of competition in the market. In the past, the prevalent structure in many mobile markets in the U.S. was a duopoly, but that has of course changed substantially in recent years, and most customers now enjoy multiple vendor options for these services.

A. *Theoretical Model*

In order to make our analysis both general and simple, we proceed as follows. First, the standard voice market can be described as a Cournot oligopoly, with n firms selling identical products at identical marginal costs, which we normalize to zero. We identify Firm 1 as the seller prohibited by the auction rules from acquiring a newly available spectrum asset (which we term an incumbent-exclusion rule). In the absence of the incumbent-exclusion rule, Firm 1 would win the bid for the spectrum, and would use it to offer a complementary good that would benefit its voice service customers, conveying a competitive advantage. In the interest of simplicity and to render conservative results, we

⁶⁷ In the United States, mobile broadband services are typically sold with mobile voice services.

assume that Firm 1 can make no profits whatsoever from the sale of this complementary good except through the effects of its sale on the demand for its voice product. All consumer surplus and seller profits from this complementary good are ignored, so that our analysis will not be biased towards any finding that the incumbent-exclusion rule is socially wasteful.⁶⁸ In our analysis, Firm 1 would win the bidding for the spectrum asset in the absence of the rule, and would use the spectrum differently than the bidder winning the asset under the exclusion rule. Further, the firm winning the asset under the incumbent-exclusion rule will dutifully enter the voice services market, increasing competition and reducing prices.

Suppose first that there was no incumbent-exclusion rule. In that case, let the prices earned by the firms be given by the simple price equations:

$$P_1 = (a + \Delta) - Q \quad (1)$$

$$P_i = a - Q \quad \text{for } i = 2, 3, \dots, n \quad (2)$$

where $Q = q_1 + q_2 + \dots + q_n$ and where a and Δ are positive known constants. Here the parameter a represents market size and Δ represents the additional value created for customers of Firm 1 due to creation of the complementary product.⁶⁹ We note also that, under the incumbent-exclusion rule, Equations (1) and (2) continue to describe the market if one takes $\Delta = 0$, and lets n rise to $n + 1$. Recall that all prices are net of marginal costs.

In the absence of the exclusion rule, we assume a Non-cooperative Nash Equilibrium in quantities of the usual Cournot sort. First order conditions for this solution are:

$$a + \Delta - Q - q_1 = 0 \quad (3)$$

for Firm 1 and

⁶⁸ If one took into account the surpluses potentially rising from the complementary good, then the spectrum cap would not only prohibit incumbent purchase of the spectrum, but would also prohibit the introduction of a "new" product. Under our assumptions, this new product may be introduced by anyone, but since it is not by itself profitable, only a firm with existing voice services would introduce it. Thus, in order to capture this effect without biasing the findings, we assume no direct profits from the sale of the complement.

⁶⁹ The value a shifts the market demand curve, whereas Δ is a shift in demand only for Firm 1.

$$a - Q - q_i = 0 \quad \text{for } i = 2, 3, \dots n. \quad (4)$$

Under symmetry for firms 2, 3, ... n , the solutions are:

$$q_i = (a - \Delta)/(n + 1) \quad \text{for } i = 2, 3, \dots n \quad (5)$$

$$q_1 = (a + n\Delta)/(n + 1) \quad (6)$$

which satisfy the second order conditions and are unique so long as $\Delta < a$. Calculating market output in the equilibrium, we obtain:

$$Q = \frac{n}{n + 1}a + \frac{1}{n + 1}\Delta \quad (7)$$

so that market output Q is increasing in Δ . This result implies that the common price for Firms 2 through n , denoted P_i , falls as Δ increases. Thus, the introduction of the competitive advantage to Firm 1 causes its rivals' prices to fall, in the same way that a decrease in the costs of a given firm will cause other firms to price more competitively in response. As for P_1 , the advantage Δ causes P_1 to rise, but less than the increase in consumer value created by the complementary good. Since $P_1 = P_i + \Delta$, the equilibrium response is:

$$\frac{dP_1}{d\Delta} = \frac{n}{n + 1} < 1. \quad (8)$$

Given these responses, it is clear that the social welfare consequences of the incumbent-exclusion rule will depend on a comparison of the benefits of the complementary good and resulting competitive effects, versus the benefits of increased competition through conventional entry into the standard good market.

In our assessment of the welfare effects of an exclusion rule, we start by "stacking the deck" against the finding that the incumbent-exclusion rule is bad policy by focusing on consumer welfare only. This biases the analysis because firms are always harmed with entry in a Cournot framework; to begin, we ignore this effect on firms, thus inflating the (positive) welfare consequences of an incumbent-exclusion rule. The simple linear form of demands and normalized marginal costs implies that consumer surplus with entry by Firm 1 with the complementary good is just:

$$CW(n, \Delta) = \frac{1}{2}Q^2 \quad (9)$$

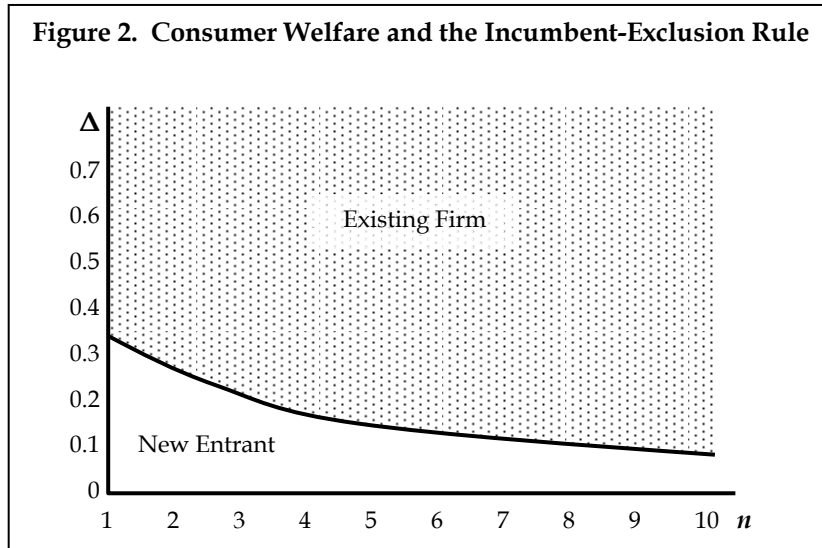
Similarly, with the incumbent-exclusion rule, consumer surplus can be suggestively written as $CW(n + 1, 0)$, and simple algebra establishes that $CW(n, \Delta) > CW(n + 1, 0)$ if, and only if:

$$\frac{\Delta}{a} > \frac{1}{n + 2} \quad (10)$$

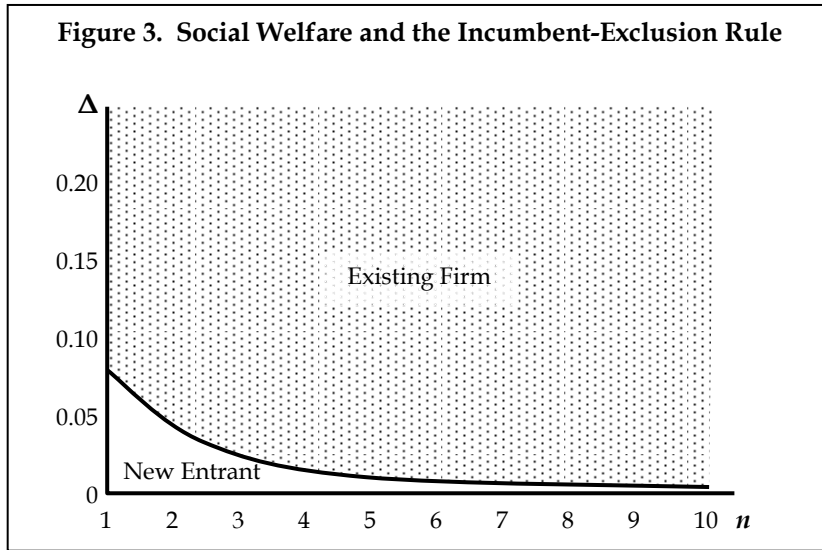
Condition (10) is elegant and highly suggestive: as an approximation, the incumbent-exclusion rule actually reduces consumer welfare, ignoring any benefits or costs to firms and benefits from the complementary market itself, whenever the effect of the complement on the value of the standard good, as a percentage of willingness to pay for the standard good, exceeds the statistic $1/(n + 2)$. Put another way, it is clear that society would prefer introduction of the complementary good over further entry into the standard good market when either (1) the complement is sufficiently value-creating (a large Δ), or (2) the existing market is sufficiently competitive to begin with (a large n , or intense rivalry).

B. *Illustrations of the Theory*

Simple graphs are sufficient to illustrate the basic logic of these findings in both the consumer-only, and consumer plus producer surplus cases. Consider Figure 2 below. Here, we normalize a to be equal to 1, so that one can view the vertical axis representation of Δ . The shaded region above the curve illustrates the set of parameter values for which consumers would be better served by abandoning the entry prohibitions embodied in the incumbent-exclusion rule. The curve has negative slope because the value created by the complementary good in the standard market need not be as large when the standard good market is sufficiently competitive to begin with. The logic is important. The larger the number of firms in the market (that is, the more competitive is the existing market), the more likely an incumbent-exclusion rule is bad policy. So, while the spectrum caps (a form of an incumbent-exclusion rule) that applied early in the evolution of mobile services may have made sense given the duopoly structure of the market, in the present environment, when nearly every consumer has a choice among 4 providers, the incumbent-exclusion rule is not as easily supportable on welfare grounds. Further, historically, the potential for important innovative services was much less than today, given the evolution of wireless broadband services.



Similarly, Figure 3 provides the same analysis when total social welfare is used (consumer plus producer surplus). Note that we have significantly rescaled the vertical axis. As explained above, including both consumer and producer surplus greatly tilts the analysis towards a finding of welfare harm from the incumbent-exclusion rule as modeled here, but only because the consumer welfare standard alone is biased. In Figure 1, the breakeven Δ at 2 firms is 0.25, whereas in Figure 3 the breakeven Δ is only about 0.05, the latter being a relatively small addition to value. This difference arises because in Cournot competition (and all “intermediate” models of competition) entry reduces prices, albeit at a decreasing rate. Low prices reduce aggregate firm profits (i.e., a component of producer surplus). By forcing entry to take a form that reduces the profits of all incumbent firms, the incumbent-exclusion policy is unlikely to increase social welfare unless it provides very significant benefits to consumers through the competition-price reduction effect. However, that effect is not very large in Cournot and similar models once one gets beyond a few firms.



These figures highlight several features of the incumbent-exclusion policy debate, which have been given too little weight in previous discussions, perhaps because concentration was much higher historically and no services were contemplated other than voice service. As is always the case, the social value of a policy cannot be determined unless one compares the likely outcomes with and without the policy. Given the present high levels of competition in the domestic mobile market, it is unlikely that additional entry will lead to substantial competitive price effects. The *CRMS Reports*, and the FCC merger approvals, consistently indicate that the agency believes there is no meaningful relationship between concentration and market performance under current market conditions.⁷⁰ The price gains from more entry, then, are expected to be small or absent altogether. Alternately, the benefits of expanding spectrum assets for the purpose of providing broadband services are presumed to be high. The policy bias, it seems, should be in favor of more spectrum in the hands of existing firms. Further evidence in this regard is provided in the next section.

IV. “More” Spectrum Does Not *a fortiori* Mean “More” Firms

The notion that more spectrum leads to more firms, or that incumbent-exclusion rules lead to more firms, is based on the presumption that the only factor limiting the number of firms in the amount of, or access to, spectrum

⁷⁰ In some instances, divestitures of spectrum assets are required in mergers and acquisitions. Such regulation actions are specifically intended to alleviate market power concerns.

resources. This view ignores the substantial capital investments and expenses required to build, maintain, and operate a mobile network. Moreover, it ignores the complexities and realities of managing a large customer base, and the interdependencies in demand and cost across the range of products offered over such networks. Put simply, dividing a chunk of spectrum into 10 pieces does not imply 10 firms are financially viable. It is the supply-side and demand-side conditions of the market, of which spectrum resources are but a part, that determine the equilibrium number of firms.⁷¹ In the above analysis, we assumed that the spectrum leads to greater numbers of financially viable firms, so as to give the incumbent-exclusion policy the most favorable theoretical treatment. Economics and history, however, suggest otherwise.

A. *Theoretical Evidence*

The prior analysis looks at the tradeoff between additional entry-based competition and the utility derived from the creation of a complementary good. This analysis assumed that entry and exit into the standard market was costless. In reality, there are likely to be substantial fixed costs associated with entry by a new firm into the telecommunications marketplace. The presence of fixed costs allows a long-run characterization of the number of firms likely to be present in the market. Entry and exit are assumed to occur until economic profits are driven to zero.

The profit level of a firm producing the standard good will be a comparison of its net revenue (net price times quantity) and the level of fixed costs. We will denote the fixed costs by the symbol F . Combining equations (7) and (2) yields the (net) price level of the standard good and equation (5) provides a characterization of the quantity. Setting the profit level of the standard good equal to zero will provide a characterization of the long-run number of firms present in the standard market. The number of long-run firms, n_{LR} , will solve the following equation:

$$\left[\frac{a - \Delta}{n_{LR} + 1} \right]^2 - F = 0. \quad (11)$$

⁷¹ *Competition After Unbundling*, *supra* n. 20; *Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming*, Appendix H, *supra* n. 20.

If the number of firms is treated as a continuous variable, then the impact of the sale of new spectrum on one of the existing firms (for the creation of a complementary good) can be characterized by:

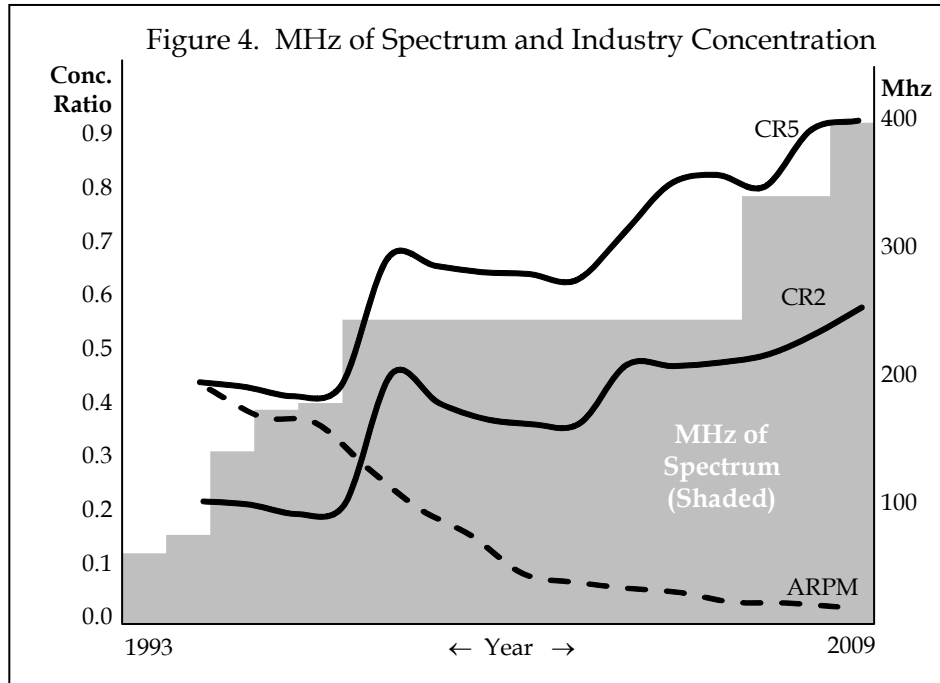
$$\frac{dn_{LR}}{d\Delta} = \frac{-1}{\sqrt{F}}. \quad (12)$$

The long-run loss to competition in the standard market could therefore be quite low if there are relatively large fixed costs associated with entry into the standard market. (In reality, the fixed costs are very large, limiting the number of successful firms to a small number.) Furthermore, the loss of competition might even be zero due to the fact that the number of firms is, in reality, a discrete value. The amount of new spectrum may be insufficient to actually support an additional firm in the standard marketplace due to the fixed costs. In such a case, making the new spectrum available to an existing firm would generate welfare gain via the development of a complement without any long-run loss of competition in the standard market. In other words, there may not be a tradeoff between more quality or more firms, since the number of firms that can viably serve the market may be insensitive to spectrum policy due to the underlying supply- and demand-side economic conditions of the market.

B. *The Historical Evidence*

Figure 4 illustrates the relationship between the market shares of the largest mobile telephony firms and the total MHz of spectrum made available by the FCC to such firms over the period 1993 through 2009. Total spectrum is shown by the shaded area in the figure and is rising over the entire time period. In 1993, there was 50 Mhz of spectrum used for mobile telephony. Including all auctioned spectrum, this number rose to 361 Mhz by 2009.⁷²

⁷² Auction data is available at: http://wireless.fcc.gov/auctions/default.htm?job=auctions_home. There are other calculations of available spectrum for commercial uses, but the sum of auctioned spectrum presented here is a sensible and unbiased one.



The Concentration Ratio, CR_n , is used to measure industry concentration. The Concentration Ratio is computed as the sum of the n largest firms in the market. That is, CR_2 measures the summed market shares of the two largest firms, and CR_5 the market share of the five largest firms. Both the CR_2 and the CR_5 are illustrated in the figure.⁷³ Finally, the average revenue per minute for mobile telephony is provided. All data is computed at the national level.

The figure shows clearly the following. First, the amount of spectrum has risen, yet industry concentration, as measured by the concentration ratio, has not declined. Thus, historical evidence does not support the notion that more spectrum means a lower level of industry concentration. Second, while concentration has risen over this interval, the price of mobile telephony has fallen consistently over the period.⁷⁴ Therefore, historical evidence also does not support the notion that higher concentration leads to higher prices. The latter result has important implications for the theory. If changes in concentration (or

⁷³ The data is compiled from the FCC's CMRS Reports (various years).

⁷⁴ Average revenue per minute data is compiled from the FCC's CMRS Reports (various years). The data is adjusted by the Consumer Price Index (www.bls.gov).

the number of firms) do not impact market performance, then the gains from an incumbent-exclusion rule are likely to be small and the net losses large.

We note that these data cover many years, and technology has evolved over the years. As such, the trends in the figure are merely suggestive. Nevertheless, the historical data cannot be ignored and, if considered, provide important insights for the economic value of incumbent-exclusion policies.

V. Conclusions

With the *National Broadband Plan's* promise of 500 additional megahertz of spectrum for commercial purposes, the question of how to allocate those resources among competing uses and users will dominate the communications policy debate over the coming years. The value of that spectrum depends critically on allocation choices. In this PAPER, we provide a policy-relevant, economically-motivated framework to aid in such decisions, with a focus on incumbent-exclusion rules, including but not limited to, formal spectrum caps. The analysis focuses on the efficacy of exclusion rules, or similar regulations limiting access by existing firms to new spectrum, for promoting economic welfare, and maximizing the value of spectrum resources. At a basic level, the analysis describes the tradeoffs between dividing a fixed amount of spectrum into (a) many small pieces or (b) few big pieces. Since advanced services, such as mobile broadband, demand that each firm possess large amounts of spectrum, the relevant tradeoff is potentially between many firms selling less advanced services versus few firms selling more advanced services.

Our analysis highlights several key components of the spectrum allocation decision. First, an incumbent-exclusion rule is not "pro-entry," but instead seeks to select one form of entry (many low quality) over another (few high quality). Given the nature of the rule, the social value of an incumbent-exclusion rule cannot be determined unless one compares the likely outcomes with and without the policy, recognizing that the types of entry may vary across regimes. Second, given the existing level of competition in the domestic mobile market, the potential for sizeable competitive price effects is low. Third, given the high social value of broadband, and the potential for mobile broadband to substitute for fixed line services, the economic benefits of advanced wireless services is likely to be very high. Fourth, access to spectrum resources does not necessarily convey financial success. Actual financial performance in the mobile sector suggests that the market is leaning to fewer rather than more competitors, so efforts to force more entry through spectrum policy is likely to fail, leaving scarce spectrum resources fallow. While more competition is always enticing, and

public policy often plays a role in promoting competition, the Commission must be realistic in its expectations.

The policy tradeoffs described here are theoretical and valid regardless of one's predilections about spectrum policy. As we discuss, resolving the inherent ambiguity between more of one thing and less of another must turn on the evidence. We see it one way. Whether one adheres to our particular interpretation of the facts has no bearing on the usefulness of the theoretical framework presented here, however. We hope our analysis is helpful.