APPENDIX

Comments on Directions for Future Research

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The empirical results reported in the body of this Report provide a broadly-based global perspective on the pricing of international mobile telecommunications network terminating access service used by U.S. international telecommunications carriers to complete long distance telecommunications originating in the United States.[2] For the first time, the Report, based on a large statistical sample of the implicit prices[3] for international mobile telecommunications network terminating access services around the globe, documents over time for the period 2003-2010, i.e., a time-series, and across destination countries, i.e., a cross-section, both the level and trends in the prices of foreign mobile telecommunications access service paid by U.S. international carriers in producing end-to-end international telecommunications services. The Report carefully documents the recent history of movements in the pricing of foreign mobile network terminating access service and calibrates the persistent anomaly ("mobile settlement rate premium" which may reflect above-cost mobile termination rates) between the pricing of terminating network access on mobile networks compared to wireline local exchange networks in many foreign countries.

The purpose of the Report is fundamentally empirical. Much effort was invested in the collection, cleansing, tabulation, and presentation of a large, complex data set. It is not within the scope of the Report to develop a formal economic model that might help explain the behavior of the data reported or the important trends that the Report reveals so clearly. Yet additional economic research that begins to explain in terms useful for policy analysis just what the data reveal seems warranted. Two directions in future research appear especially useful.[4] First, additional research should be

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[2] The Report draws careful distinctions between and among *mobile termination rates, mobile settlement rates,* and *mobile settlement rate premium.* For the purposes of this Appendix, less precise terminology is used to simplify the discussion and to highlight policy issues that may warrant additional research. More specifically, this Appendix identifies several directions for future research that flow from the inefficiency and adverse welfare implications for U.S. consumers of the pricing of network terminating access service on mobile telecommunications networks in foreign countries that are documented in the body of the Report.

[3] The price, or rate data, documented in the Report are "implicit" in the sense that such price information is derived as an average revenue statistic from data on revenues and minutes of access services provided.

[4] It is not proposed that such future research should be confined to, or even a part of, the record in IB Docket No. 04-398 (*Foreign Mobile Termination Rate NOI)*. Rather, the additional research discussed in this Appendix is recommended to academic researchers and others in public policy research organizations who may be interested in contemporary issues in international telecommunications policy.

considered that calibrates in a formal way the magnitude of consumer welfare losses that are implied by above-cost mobile telecommunications network terminating access services supplied by foreign wireless carriers.[5] Second, additional research that advances hypotheses that might explain the behavior of the data presented in the Report would provide useful guidance to public policymakers on what sort of policy response may be appropriate to alleviate the consumer welfare losses implied by the inefficient pricing of mobile telecommunications network terminating access services in foreign countries. This Appendix briefly expands on what these two directions for future research might accomplish.

Mobile Network Terminating Access Service and Consumer Welfare[6]

The prices for terminating an international telecommunications service on either a mobile wireless or a fixed landline network have important implications for the economic welfare of both end-user consumers and business users. Network terminating access is a critical component in the production of international telecommunications services.[7] This cost, when passed along to end-user

[5] The Report does provide bounded estimates of the elevated revenues attributable to above-cost mobile terminating access services, but these elevated revenues reflect only a partial estimate of the total welfare losses imposed on U.S. consumers of international telecommunications services.

[6] It is important to stress the specific context that is implicit in the following discussion of mobile network access services and consumer welfare. To emphasize, the discussion is focused exclusively on the likely economic effects of above-cost terminating access services on mobile networks in *foreign* countries on *American* end-users and business entities. Thus, the possible welfare trade-offs between and among the pricing of usage on mobile networks, the pricing of terminating access services, and mobile terminating equipment are ignored. Such pricing trade-offs may have subtle implications for consumer welfare in *domestic* markets for mobile telephony and broadband data communications, where high prices for network termination services might be used to subsidize the cost of mobile terminal equipment or some quantity of usage. Whatever the net welfare effects of such pricing arrangements, it is likely that the benefits are internalized by consumers in such domestic markets. It is not clear, however, how a U.S. end-user might benefit directly from a subsidized mobile handset available to a mobile network subscriber in a *foreign country* that is financed by U.S. consumers paying an inflated cost of mobile network terminating access service that is embedded in the price of international telecommunications. It is further assumed that even the potential *indirect* benefit to U.S. consumers of subsidized terminal equipment or usage in foreign mobile telephony as ways to increase foreign network size and subscribership are negligible. In other words, the incremental value of positive network externalities to U.S. consumers of large mobile networks in foreign countries is slight, given the existing high levels of mobile network penetration in foreign markets where substantial volumes of U.S. international telecommunications are terminated today. For a formal analysis of the interdependencies existing between and among the pricing of mobile termination equipment, mobile telephone usage, and subscribership, see Peter J. Alexander, Adam Candeub, and Brendan M. Cunningham, "Network Growth: Theory and Evidence from the Mobile Telephone Industry," *Information Economics and Policy* 22 (March 2010):91-102.

[7] In simple terms, the production of an international telecommunications service, such as a voice or data transmission, involves the usage of a number of interconnected telecommunications facilities, including domestic local exchange network access and switching, transport to a cable landing station or communications satellite earth station, international long distance transmission over international cable or communications satellites, and functionally-equivalent telecommunications facilities at the foreign destination to transport and finally terminate the voice or data telecommunications services. The prices that both end-user consumers and business entities pay for international telecommunications services recover the total economic cost of the usage of all these

consumers and business customers, has a direct effect on the prices paid by all consumers of international mobile telecommunications. The economic effects of the pass-through of the costs of foreign terminating network access services are amplified in cases where international telecommunications carriers, such as AT&T and Sprint, add substantial markups to these foreign network terminating costs as shown in the Report when setting the retail rates for their international telecommunications services. All other things remaining the same, both voice and data communications are necessarily deterred by the elevated prices for such international telecommunications services.[8] These reductions in the quantity demanded of telecommunications services imply reductions in the economic welfare of end-user consumers and economic inefficiency in the usage of telecommunications facilities.[9] Although business calling may be deterred less by higher prices for voice and data communications,[10] higher prices for telecommunications must ultimately be recovered as a cost of doing business in the pricing of the output of any business entity. As a result, end-user consumers and business customers of any business enterprise ultimately bear the adverse economic effects of the inflated pricing of international telecommunications services.

As the global economy becomes larger and increasingly interdependent, it is likely that the demand for international telecommunications will to continue to grow ever larger over time. It is also

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interconnected facilities plus the non-direct or common costs of operating a telecommunications network. The cost of network terminating access services is an important cost component in the production of international telecommunications services. This cost component has a substantial effect on end-user prices, especially after a telecommunications carrier marks up such costs as described in the Report.

[8] This assertion assumes, realistically, that the own-price elasticity of demand for international telecommunications services for end-user consumers is not zero. Thus, any upward price change will reduce the quantity demanded for international telecommunications, although the effect on total revenues collected by the carriers will depend on the extent to which the own-price elasticity of demand either exceeds one or is less than one in absolute value. A recent empirical study finds that the long run own-price elasticity of demand for mobile telecommunications in Europe falls within the range of – 0.52 to – 0.61. Although demand appears to be price inelastic, the quantity demanded for mobile telecommunications increases with reductions in the unit price of minutes of mobile telecommunications. See Christian Growitsch, J. Scott Marcus, and Christian Wernick, "The Effects of Lower Mobile Termination Rates (MTRs) on Retail Price and Demand," *Communications & Strategies* 80 (2010):119-138.

[9] The formal analysis of economic welfare shows that the welfare of individual consumers depends on the quantity of goods and services consumed by the consumer. An introductory discussion of welfare economics is provided by Richard E. Just, Darrell L. Hueth, and Andrew Schmitz, *Applied Welfare Economics and Public Policy* (Englewood Cliffs, NJ: Prentice-Hall, 1982), Chapters 5 and 6.

[10] To the extent that telecommunications is virtually an indispensable input of production for any business enterprise, it is likely that business firms will not reduce their quantity demanded for telecommunications as much as an end-user consumer in response to higher prices for telecommunications services. In brief, business communications are likely, as a general matter, to be more time-sensitive or urgent than consumer communications that may involve more discretionary communications that can rely on other communications methods if telecommunications becomes more expensive. In other words, end-user consumers may have acceptable types of substitute communications that are impractical for many types of business communications.

likely that the cost of international telecommunications will become embedded in a growing array of consumer goods and services and intermediate goods purchased by business firms as international trade expands in both terms of scale and scope. Even small elevations in the cost of terminating international telecommunications on foreign mobile networks imply non-trivial welfare losses as these costs become embedded in ever larger volumes of trade. Research that begins to calibrate the full welfare losses to consumers and the economic inefficiencies borne by all business enterprises by paying above-cost termination costs on foreign mobile networks would focus the attention of policymakers on the importance of ongoing review of such charges and the need to support research on additional policy options. Although the Report documents the reduction in mobile settlement rate premiums since their peak in 2007-2008, the Report also points out that ". . . [mobile termination rate] premiums may be above cost in roughly *half of the countries of the world,* resulting in potentially hundreds of millions of dollars in above-cost payments by U.S. carriers and consumers each year as well as reduced U.S international calling volumes."[11] Such excess payments, however, represent only a fraction of the total welfare losses actually realized by end-user consumers and business entities in the United States.[12]

Models of Industry Behavior and Public Policy

The Report provides a detailed picture of the prices paid by U.S. international carriers for terminating international calls from the United States on mobile telecommunications networks around the globe. Understanding the factors that may explain the observed data requires, however, a model, or models, that clarify the underlying cause and effect forces in play. Such modeling is not within the immediate scope of the Report, although making recommendations for public policy that may be implicated by the data in the Report would benefit from such conceptual development. Fortunately, there exists a growing economic literature that addresses the efficient pricing of access to both fixed and mobile telecommunications networks.[13]

Inefficiencies in Institutional Design and Contracting

The persistence of above-cost pricing of mobile network termination in foreign countries seems puzzling at one level. Mobile telecommunications as a telecommunications sector in many, if not most, developed economies has grown steadily in recent decades. Consumers usually have a choice of mobile

[11] Report at page 5. (Emphasis supplied.)

[12] Economic research that develops estimates of the implied welfare losses attributable to above-cost prices for terminating international telecommunications on foreign mobile networks is necessarily complex as a matter of both economic theory and data collection. A detailed survey that carefully reviews both conceptual and empirical issues in measuring consumer welfare is Daniel T. Slesnick, "Empirical Approaches to the Measurement of Welfare," *Journal of Economic Literature* 36 (December 1998):2108-2165.

[13] An especially informative reference is Jean-Jacques Laffont and Jean Tirole, *Competition in Telecommunications* (Cambridge, MA: The MIT Press, 2000), especially Chapter 5. A survey describing how regulators in Europe and elsewhere around the world have responded to and applied certain economic models of the pricing of network termination is provided by S. C. Littlechild, "Mobile Termination Charges: Calling Party Pays Versus Receiving Party Pays", *Telecommunications Policy* 30 (2006):242-277.

telecommunications networks that compete vigorously for new customers and the retention of existing customers. Typically, consumers are offered a wide choice of calling plans, with differing terms and conditions of services and different lengths of contract. In addition to the mobile telecommunications services offered by facilities-based network operators, many resellers offer many other service options, including pre-paid calling cards. From a casual perspective, mobile telecommunications would appear to be a rivalrous sector of the telecommunications industries in the United States and in many foreign countries. Yet, both the reality and persistence of above-cost mobile network termination prices may suggest some inefficiency in market performance.

A number of theoretic and empirical studies of mobile telecommunications network pricing attribute the persistent economic efficiency distortions in mobile telecommunications pricing to specific attributes of the contractual terms of offer for mobile telecommunications services in certain foreign countries.[14] More specifically, one of two different pricing rules are commonly embedded in the mobile telecommunications operator's contract with its subscribers, namely, (1) *calling party pays* (CPP) and (2) *mobile party pays* (MPP).[15] A mobile or fixed telephone network that offers telecommunications service to its subscribers pursuant to the CPP rule bills the subscriber, or calling party, for the cost of originating a call on its own network plus the cost of terminating the call to a called party. The party receiving the call is not billed for the cost of terminating the call (which is paid by the caller) and pays only the monthly subscription or other fees that the mobile network operator requires its subscribers to pay for network access. Either fixed or mobile telephone networks that bill their subscribers pursuant to the mobile party pay or MPP rule bill only their own subscribers for both the cost of originating a telephone call and the cost of terminating a call originated by a caller from some other mobile or fixed network.

Mobile telephone networks compete aggressively for subscribers, since consumers in most developed economies have a good choice of competing mobile networks to choose from. This intense competition for subscribers effectively constrains the cost of *originating* access on most mobile networks. By contrast, a consumer originating a call on his or her mobile network that terminates on some *other* mobile network does not have the constraining effect of competition to keep the cost of terminating the call at approximately marginal cost. The calling party is not free to choose the mobile network to terminate the call, which would otherwise create competition for call termination and keep the price of call termination at roughly marginal cost, but must use the call terminating service of the mobile network to which the called party subscribes. In other words, the calling party faces a *monopoly*

[14] To the extent this diagnosis of market inefficiency is accurate, transaction cost economics would appear to be a fruitful framework for public policy analysis of persistent above-cost mobile termination rates. On the nature of transaction cost economics generally, see Oliver E. Williamson, *The Economic Institutions of Capitalism* (New York, NY: The Free Press, 1985).

[15] The mobile party pays principle is also described as the *receiving party pays* (RPP) principle in some policy discussions or the *wireless party pays* (WPP) principle in other contexts. In principle, terminating network access pricing may raise public policy concerns for either wireline or mobile telecommunications networks. For historical reasons, the pricing of terminating access in wireline networks in foreign countries is far less controversial, however, than the pricing of terminating access on mobile telephone networks.

supplier of terminating network access for any call that is *off-net,* i.e., a call terminated on a mobile network different from the mobile network to which the calling party subscribes. Not surprisingly, mobile network operators have long recognized that call termination service for callers originating their calls on other mobile networks or wireline networks is a monopoly service for any given call and have tended to price mobile termination service well above marginal cost or at profit-maximizing monopoly levels.[16] With the conspicuous exception of the United States and Canada, most mobile network operators around the globe tend to offer mobile telephony services pursuant to the CPP principle.[17]

Each billing rule appears to achieve different objectives. In particular, CPP appears to encourage *subscribership* to mobile telecommunications networks, while MPP appears to encourage mobile telephone *usage*. It is often observed in the emerging literature on the pricing of mobile network termination that CPP facilitates high mobile network termination rates and the realization of excess profits that are used, at least in part, to subsidize the cost of mobile telephone handsets and the cost of mobile network subscriptions.[18] While some empirical evidence tends to support the suppositions concerning the differing effects of the CPP and MPP billing rules,[19] there is also evidence that subscriber growth in countries applying the MPP billing rule is approaching penetration levels observed in countries that apply the CPP billing rule.[20] While intuitive explanations and anecdotal evidence can be cited to justify the choice of CPP or MPP as a preferred billing rule, only formal models can reliably identify the implications of each rule for purposes of designing public policies on the pricing of call termination on mobile telecommunications networks.

Application of the CPP principle in the billing of mobile telephony services appears to have had a paradoxical effect on the economic performance of the mobile telecommunications sector. As the number of mobile network operators has increased in most developed countries and competition for new subscribers has intensified, the incentive for mobile network operators to maintain network termination rates at monopoly levels has also *intensified.* The substantial markup over the marginal cost of mobile network termination provides the funds for subsidizing the cost of handsets or other terminal devices for subscribers and the cost of monthly subscription charges, providing service packages with some quantity of "free" usage, and other promotional offers that will attract new subscribers or

[16] A detailed history of the implementation of the CPP rule and the public policy response to high mobile termination rates for a number of countries is provided by Littlechild, "Mobile Termination Charges."

[17] More precisely, given the history of the development of the wireless telecommunications industry in the United States, both MPP and CPP billing principles are applied in the United States. The MPP principle applies to most mobile telecommunications services offered at the retail level, while *reciprocal compensation* sometimes applies at the wholesale level for recovering from other operators the cost of wireless network termination of local traffic.

[18] See, for example, Littlechild, "Mobile Termination Charges."

[19] See ibid.

[20] See Robert W. Crandall and J. Gregory Sidak, "Should Regulators Set Rates to Terminate Calls on Mobile Networks?" *Yale Journal on Regulation* 21 (Summer 2004): 261-314.

minimize the "churn" of existing subscribers. It is evident that mobile network operators implementing the CPP rule have a very strong incentive to oppose vigorously the efforts of national regulatory authorities to impose price caps on mobile termination rates since above-cost termination rates finance the competitive strategies intended to attract new subscribers and retain existing ones. The consumer welfare implications embedded in the trade-off of economically-inefficient mobile termination rates for subsidized terminal equipment and mobile telephony service are both complex and unclear and likely will vary from operator to operator and country to country.

A mobile or fixed telephone network that offers telecommunications services to its subscribers pursuant to the MPP rule bills only its own subscribers for both the cost of originating a telephone call *plus* the cost of terminating a call from a caller using some other telecommunications network to originate the call. In other words, a mobile network operator implementing the MPP rule does not charge callers that originate calls from competing mobile networks for terminating calls to subscribers on its own network. The MPP rule alters dramatically the mobile network operator's incentive for pricing terminating access on its network compared to the CPP rule. Since the subscriber pays both the cost of originating and terminating telephone calls, mobile networks must compete for subscribers by offering usage prices that are attractive to both new and existing subscribers. Such competition for subscribers, given a sufficient number of rival mobile networks to offer consumers a number of mobile service choices, will tend to constrain the pricing of call origination and termination on mobile networks. As a result, subscribers tend to pay very low prices (equal to marginal cost or even zero) for originating and terminating access pursuant to various mobile service plans offered by competing mobile operators.[21]

An important insight that emerges from this discussion of MPP and CPP is that institutional arrangements, or the terms of contract with customers with respect to billing in the present instance, may have significant consequences for achieving economic efficiency and promoting competition in the mobile telecommunications industry. In particular, economic literature[22] suggests that changing from a CPP rule to MPP would appear from actual experience to solve in major part the incentives for a mobile

[21] In broad terms, mobile telephone service in the United States is often priced using multipart rate designs, offering the consumer various choices of low, fixed monthly subscription rates but usage rates well in excess of marginal cost, somewhat higher fixed monthly subscription prices and somewhat lower usage charges, and even higher fixed monthly subscription charges but no usage charge for fixed "buckets of usage minutes." Such pricing is referred to *self-selecting two-part tariffs* or *nonlinear pricing* and is clearly described in Stephen J. Brown and David S. Sibley, *The Theory of Public Utility Pricing* (Cambridge, UK: Cambridge University Press, 1986). Adoption of the MPP principle in mobile telephony in the United States was the outcome of the unique history of the evolution of the American telecommunications industry and the federal legislation that shaped the organization of the industry over many decades. For a very brief synopsis of events shaping mobile termination rates and the implementation of the MPP rule in the mobile telecommunications sector in the United States, see Littlechild, "Mobile Termination Rates," Appendix, p 275.

[22] See, for example, Littlechild, "Mobile Termination Charges."

telephone operator to charge termination rates at monopoly levels.[23] As a result, the apparent need to regulate mobile termination rates where the CPP rule prevails should be substantially alleviated, avoiding the substantial costs of regulation by both mobile network operators and regulatory authorities.[24] Economic research that explores CPP and MPP as a study in comparative institutional design may provide a firm policy foundation for transitioning from CPP to MPP.[25] In particular, the substantial literature on efficient contracting should be especially relevant in this context.[26]

"Bottleneck" Monopoly

The emerging literature on the pricing of terminating access identifies several alternative models for understanding the implications and effects of CPP and MPP billing rules. One theoretical framework emphasizes that terminating access provided by mobile telecommunications networks is a "bottleneck" that mobile telecommunications operators can price at a monopoly level, notwithstanding

[23] It is unlikely, however, that the implicit mobile termination rates embedded in subscriber charges under the MPP rule will equal the marginal cost of termination. Given the substantial fixed costs of providing mobile telephony, it is likely that such charges will resemble Ramsey pricing, a second-best type of economically-efficient pricing. In practical terms, a Ramsey price is equal to marginal cost plus a markup to recover the fixed costs of production. The aggregate of Ramsey prices over all outputs produced by the firm should just equal the total economic cost of production but zero economic profit. On Ramsey pricing generally, see Kenneth E. Train, *Optimal Regulation: The Economic Theory of Natural Monopoly* (Cambridge, MA: The MIT Press, 1991), Chapter 4.

[24] Estimates of such regulatory costs are provided in Littlechild, "Mobile Termination Charges."

[25] The prolonged policy debates over the appropriate design of intercarrier compensation rules or access charges in the United States should be especially helpful. Although CPP and MPP rules pertain to the *retail* pricing of mobile telecommunications services, analogous rules are found in the history of pricing of *wholesale* access and transport between and among competing and complementary telecommunications carriers in the United States, such as incumbent local exchange carriers, competitive local exchange carriers, long distance carriers, Internet service providers, and other telecommunications firms. While the institutional arrangements that have evolved over decades for compensating one carrier by another for originating and terminating telephone calls are diverse and complex and continue to evolve as circuit-switched telephony gives way to IP-based telecommunications, there is recognition that rules for intercarrier compensation that are analogous to MPP encourage economic efficiency in production and consumption and foster competition and reduced regulation. In a major decision in WC Docket No. 10-90 et al., October, 2011, the FCC adopted comprehensive intercarrier compensation reform based on a uniform national "bill and keep" framework (that is, a regime of zero intercarrier payments) as the end state for all telecommunications traffic exchanged with local exchange carriers, to be implemented gradually over a transition period. For an overview of the history of intercarrier compensation in telecommunications at the federal level and a proposal for intercarrier compensation for circuit-switched telephony that is analogous to MPP, see Patrick DeGraba, "Bill and Keep at the Central Office As The Efficient Interconnection Regime," *Office of Plans and Policy Working Paper No. 33,* Federal Communications Commission, December, 2000.

[26] As an example, see Williamson, *The Economic Institutions of Capitalism.*

the competition for subscribers that mobile telecommunications operators face from other operators.[27] Thus, the mobile telecommunications operator has market power in the supply of network termination and is not constrained by the competitive forces that constrain the pricing of mobile handsets or monthly mobile subscription services. This model provides a conceptual foundation for regulating the price of mobile telecommunications network termination, although how much market power a mobile network operator can actually exercise in practice is controversial.[28]

Two-Sided Markets

Another conceptual framework for modelling the pricing of mobile terminating access is the theory of *two-sided markets*.[29] Firms competing in two-sided markets or, more generally, multi-sided markets face market demand from two or more distinct customer groups. Such business entities, called *platform firms*, provide a "matchmaking" or brokerage service between the two or more customer groups supplied by the firm. Moreover, there exists a *dependency* relationship between or among the customer groups of the platform firm. In particular, one customer group benefits in some way from the presence of members from one or more of the other customer groups supplied by the platform firm, i.e., there exists *network effects* such that the products or services that the platform firm supplies to the interdependent customer groups become more valuable as the number of customers served by the platform increases.

Mobile telecommunications networks can be modeled as two-sided platforms,[30] where "call receivers" and "call senders" are the two, interdependent customer groups.[31] The theory of two-sided markets shows that the prices charged by the platform to each group of customers will be interdependent and either the profit-maximizing *or* welfare-maximizing volume of transactions will depend on the *structure* of prices, i.e., the price charged one consumer group relative to the other, rather than just the *level* of prices. Thus, the optimal pricing response of a platform operator to a public

[27] A clear, succinct statement of this model is provided by Stanford L. Levin and Stephen Schmidt, "Competition, Essential Facilities, Bottlenecks and the Pricing of Mobile Phone Service," unpublished paper.

[28] For example, certain information disclosure requirements may constrain the ability of a mobile network operator applying the CPP billing rule from exercising market power. See Crandall and Sidak, "Should Regulators Set Rates to Terminate Calls on Mobile Networks?"

[29] See Jean-Charles Rochet and Jean Tirole, "Platform Competition in Two-Sided Markets," *Journal of the European Economic Association* 1 (2003): 990-1029. A less technical, intuitive discussion of two-sided markets is provided by David Evans, "The Antitrust Economics of Multi-Sided Platform Markets," *Yale Journal on Regulation* 20 (2003): 325-381.

[30] In addition to offering a way to analyze the voice calling termination issues that are the focus of the Report, two-sided market models also offer a way to analyze the somewhat distinct termination issues that arise where mobile handsets are used for sending and receiving data.

[31] See, for example, Christos Genakos and Tommaso Valletti, "Regulating Prices in Two-Sided Markets: The Waterbed Experience in Mobile Telephony," *Telecommunications Policy* 36 (June 2012): 360-368.

policy that mandates reduction in the price of mobile network termination will be an *increase* in the price of subscription, usage, or terminal equipment. [32]

Quality Competition

As penetration rates for mobile telephony approach saturation in advanced economies, the focal point of competitive rivalry for subscribers may evolve away from price competition and toward quality competition.[33] One critical aspect of such quality competition is the capacity of mobile networks to accommodate the increasing bandwidth requirements for handsets capable of high bandwidth applications. Such handsets are considerably more expensive than older generations of handsets yet subscribers today appear willing to pay substantial price premiums for higher quality performance. It is unclear at present whether this enhanced consumer willingness to pay will soften consumer concerns for above-cost mobile termination rates in countries that operate pursuant to the CPP rule in mobile telephony. Indeed, it might conceivably be the case that the relatively high cost of advanced handsets might intensify efforts of mobile telephony operators to keep mobile termination rates well above cost to provide the subsidies necessary to keep the price of advanced handsets more attractive to subscribers. If this outcome emerges as quality competition in mobile telephony markets develops in foreign countries, then the downward trend in foreign mobile termination rates documented in the Report may flatten out or even reverse unless the CPP rule is replaced by the MPP rule. Economic research that examines the extent and likely development of quality competition in mobile telephony in foreign countries may provide an early indicator of the likely effects of such new competition on the welfare of telecommunications consumers in the United States.[34]

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[32] This predicted pricing response to a regulatory requirement to reduce mobile termination rates is an example of the *waterbed effect* in mobile telephony. Some empirical evidence is consistent with the predicted waterbed effect. See, for example, Alexander, Candeub, and Cunningham, "Network Growth."

[33] Quality in the present context refers to *vertical product differentiation,* a type of product or service differentiation where all consumers agree that more of a particular attribute of product or service is preferable to less, all other things remaining the same. For example, all consumers will prefer a mobile telephone handset that permits faster rather than slower downloads from the Internet. As another example, all consumers prefer automobiles with higher fuel efficiency, all other attributes of the car remaining the same. For further discussion of vertical product differentiation, see Luis M. B. Cabral, *Introduction to Industrial Organization* (Cambridge, MA: The MIT Press, 2000), Chapter 12.

[34] A conceptual framework for understanding and calibrating the effects of quality competition in markets with substantial fixed and sunk costs, such as mobile telephony, is provided by John Sutton, *Sunk Costs and Market Structure* (Cambridge, MA: The MIT Press, 1991). An updated survey of the essential ideas is provided by John Sutton, "Market Structure: Theory and Evidence," in M. Armstrong and R. Porter, eds., *Handbook of Industrial Organization,* v. 3 (Amsterdam, Holland: North-Holland, 2007). Also see the short summary of Sutton's ideas in Paul Belleflamme and Martin Peitz, *Industrial Organization: Markets and Strategies* (Cambridge, UK: Cambridge University Press, 2010), pp. 91-97. Quality competition may intensify in response to the growth in trade in telecommunications. An analysis of the effects of international trade on quality competition is provided by J. Jaskold Gabszewscz, Avner Shaked, John Sutton, and J.-F. Thisse, "International Trade in Differentiated Products," *International Economic Review* 22 (October 1981): 527-534.

Conclusions

The Report provides an insightful, empirical overview of the behavior of mobile termination rates using a unique data base on foreign mobile termination rates from around the world. The data in the Report document trends in prices for terminating international calls from the United States on foreign mobile telecommunications networks that are favorable to the American telecommunications consumer, although it is apparent that additional welfare improvements are both possible and desirable. The directions for further research suggested here would deepen the understanding and interpretation of the results shown in the Report and provide additional guidance to policymakers both domestically and internationally on what further steps in public policy may broaden and sustain the gains in consumer welfare already achieved for the American telecommunications consumer.