Report

Economic Analysis Of Fixed-To-Mobile Call Termination Charges

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1 EXECUTIVE SUMMARY

1. Objectives and background. This report analyzes the regulation of rates for the termination of calls from subscribers of fixed networks to subscribers of mobile networks in a Calling Party Pays (CPP) regime, with special emphasis on the applicability of such regulations in Latin America. It is motivated by recent decisions in several countries that have a CPP regime, including the UK and Australia, to regulate the rates for fixed-to-mobile (FTM) call termination, and current initiatives in Latin America (especially Argentina, Peru, and Venezuela) to introduce similar regulations.

Theoretical arguments for the regulation of FTM call termination rates are made in several economics papers, some specifically written for regulatory agencies, and some regulators have based their decisions on these papers. The analysis in this report identifies gaps in the economic case for regulation made in these theoretical papers and regulatory decisions, and develops an alternative analytical approach to bridge these gaps. We consider both static efficiency and dynamic efficiency, and draw out the implications of our analysis for the optimal regulation of FTM call termination rates.

2. Allocative Efficiency and Market Power. Section 2 of the report, which analyzes economically efficient price structures and the market power of mobile network operators (MNOs), begins with a detailed review of regulatory approaches to mobile call termination in the US, the UK, and Australia, followed by a tabular summary of the regulatory status of mobile call termination elsewhere. Appendix A contains more detail on the regulatory status of mobile call termination in Europe. In almost all cases, rate regulation has been premised on a finding that the operators whose rates are to be regulated possess Significant Market Power (SMP) in a "relevant market" for call termination services. A finding of SMP in the relevant market is a desirable prerequisite for the regulation of rates in that market. In many cases, the fact that FTM call termination prices are greater than prices of outgoing mobile calls has been taken as evidence of SMP in the market for FTM call termination services. We argue, however, that an analysis of SMP should be based on the fundamental principles of market definition developed for a wide range of telecommunications services, and that a comparison of call termination prices to the corresponding incremental costs is not a substitute for such an analysis.

Using widely accepted, fundamental principles of market definition, we conclude that for a determination of SMP, the relevant market is the retail market for a basket of mobile services (handsets, access, outgoing calls, and incoming calls) rather than a more narrowly defined national market for mobile call termination, or the still narrower market for call termination on the network of each mobile operator. If the retail market for mobile services as a whole is sufficiently competitive, the regulation of mobile call termination rates is arguably unwarranted and would likely lead to reduced consumer welfare in both the short and long term.

Next, we analyze efficient prices for mobile services. Earlier analyses of static efficiency neglect (in varying degrees) three fundamental features of telephone calls: (1) telephone calls are shared goods that provide benefits to both the calling and called parties, where the benefit to the nonpaying party is a *call externality*, (2) related pairs of users can, and often do, *internalize* the

external benefits of the calls, and (3) calls between unrelated parties often result in *negative* benefits to the called party that cannot be internalized. When these features of telephone calls are accounted for, static efficiency is likely to require that FTM call termination be priced *above* marginal cost.

The economic logic for this conclusion is straightforward. If the high FTM call termination rate would inefficiently reduce the volume of calls to a mobile subscriber from a fixed subscriber with whom the mobile subscriber has some type of relationship, the mobile subscriber will have an incentive to reduce the cost to the related user using one or more *internalization mechanisms*. For example, the mobile subscriber may pay for some of the charges incurred by the fixed network caller. This arrangement is quite common in cases where both subscribers are businesses, and the fixed subscriber supplies a good or service to the mobile subscriber. In this case, the fixed subscriber can incorporate the high price of calls to the mobile subscriber in the price of its product, or even submit itemized invoices for telephone charges. Other common forms of internalization are discussed in the report.

When an internalization mechanism is used, the effective price to the fixed subscriber is generally lower than the list price and, as a result, FTM calling volumes may not be inefficiently repressed. When retail markets for mobile services are competitive and FTM rates are high, mobile subscribers will experience lower rates for other components of mobile service, including lower per minute rates for outgoing calls. Among related users, the higher rates of FTM calls will be offset (at least partially) by the lower rates for outgoing mobile-to-fixed (MTF) calls, allowing mobile users to increase the extent to which they subsidize communications with fixed subscribers. Calls from unrelated users will be repressed by a high list price, but there is considerable evidence that many of these calls are *unwanted calls*. Many subscribers to fixed and mobile networks prefer to keep their numbers private (often paying for unlisted numbers), expressing a strong preference to block calls from parties to whom they have not given their number. High rates for mobile call termination help mobile subscribers meet this objective, increasing (not reducing) economic efficiency. Finally, lower handset prices made possible by above-cost FTM call termination rates may help realize network externalities that are not easily internalized.

Economic analyses that do not fully account for the three features of telephone calls identified above are likely to lead to inefficient forms of regulation (such as cost-based regulation of call termination rates), *reducing* the welfare of consumers in the short run. Specifically, the focus of previous analyses on the relationship between the *list* price of FTM call termination and its incremental cost is not warranted when the full range of call externalities (negative and positive) are considered. The more comprehensive analysis developed in this report leads to the conclusion that simple comparisons of FTM call termination rates to other mobile rates or to incremental costs are unlikely to be a useful basis for regulations promoting static efficiency and that when the retail market for mobile services is competitive, the regulation of FTM call termination is unwarranted.

This section continues with a review of several indicia of competition in Latin American markets for retail mobile services and concludes that the market evidence is consistent with vigorous competition for mobile subscribers.

3. Dynamic efficiency. Section 3 focuses on the attainment of universal service over some future period. The main policy consideration is to promote investment in infrastructure and ensure the availability of basic telecommunications capabilities at affordable rates to all citizens. Economic analysis suggests that with significant *network externalities*, market forces may not be adequate to attain this goal. Briefly, a new subscriber joining a network obtains benefits from calling and being called by other subscribers, and takes these benefits into account when deciding to subscribe to a service. However, the new subscriber is likely to ignore benefits obtained by other subscribers who can call or be called by the new subscriber. Some subscribers with private benefits below the cost of subscription will not join the network, even though the total benefits to all subscribers exceed those costs. Networks are therefore likely to be too small. Universal service policy seeks to correct this market failure through subsidies targeted to particular consumers or through implicit cross-subsidies. The earlier economics literature observes that mobile call termination rates that exceed the corresponding costs can be used to lower handset prices, monthly access fees, and outgoing charges, thereby correcting for the network externality. Our analysis concurs with this view. However, the earlier analysis finds that the goals of static and dynamic efficiency conflict, and seeks an acceptable trade-off between these goals. In our view, static and dynamic efficiency are not necessarily in conflict because above-cost rates for FTM call termination promote the goals of both static and dynamic efficiency.

We also conclude that mobile services play a special role in efforts to meet universal service goals in Latin America. Regulators have argued that the network externality is higher when penetration rates are low, but becomes less important as penetration increases. When compared to Europe, the low penetration of both fixed and mobile networks in Latin America implies the need for higher universal service subsidies in Latin America. However, there are no external funds available to finance more rapid penetration of mobile services in Latin America. Currently, low handset prices and the supply of relatively inexpensive prepaid packages to low-income consumers are financed, in part, by high termination rates for FTM calls. Like static economic efficiency, dynamic efficiency is promoted by above-cost FTM termination rates, and where there is effective competition in the retail market for mobile services, the public policy goal of universal service is likely to be set back by unnecessary regulation of FTM call termination rates.

4. Optimal regulation. When retail markets for mobile services are sufficiently competitive, regulation of FTM call termination rates is unnecessary, whereas with insufficient competition, some regulation of mobile rates is warranted. However, an efficient price structure may require FTM call termination rates that are higher than call origination rates. With this result in mind, we critically examine five approaches to regulation, including Ramsey pricing, international benchmarks, TSLRIC-based prices, price caps, and top-down cost models. Our conclusions are as follows:

1) A traditional application of Ramsey pricing is inadequate for two reasons – it takes as its starting point marginal cost prices, which are not efficient for shared goods such as telephone calls where a mix of positive and negative externalities are present, and it imposes extreme informational requirements that can be met only after considerable expenditure of time and money.

2) International benchmarks for FTM rates are of limited use when the countries being compared are fundamentally different from one another. The differences between the high penetration rates for fixed and mobile services in Europe and the far lower rates for Latin America suggest that European benchmarks are not appropriate, and there is little detailed information from other less-developed countries that can serve as useful benchmarks.

3) TSLRIC-based approaches, especially engineering-economics cost proxy models, are extremely expensive to develop, maintain, and update, and give rise to protracted adversarial arguments in regulatory proceedings. In addition, the costs produced by these models are not related to the efficient prices in a simple way, so that simple markups of TSLRIC estimates for FTM call termination costs are unlikely to be efficient.

4) Price caps can be efficient if the operators with SMP in the retail market are given sufficient flexibility to implement the price structures for the bundle of services provided (handsets, monthly access, outgoing calls, and incoming calls). In particular, price caps should not prevent setting FTM termination charges at the economically efficient above-cost level, or above the price for outgoing mobile calls.

5) Top-down models are difficult to develop, particularly for a multinational firm that does not maintain accounts in accordance with a prescribed regulatory system. The allocation of the firm's costs across countries, products, and market segments is likely to be arbitrary.

We conclude that no regulation of FTM termination rates is warranted if the retail market is sufficiently competitive, while flexible price caps might be the best form of regulation for mobile operators found to have SMP in the relevant market for retail mobile services.

2 MARKET POWER AND ALLOCATIVE EFFICIENCY

This section begins with a review of the regulatory approaches to mobile call termination adopted in several countries, and a review of theoretical articles relied on by some regulators to justify regulating rates for FTM call termination. It identifies fundamental gaps and inconsistencies in these theoretical models, and outlines an analysis of economically efficient prices in a more complete framework. We conclude that regulations based on the logic of the earlier models are not warranted. More specifically, we conclude that, in a range of circumstances, TSLRIC-based rates for mobile call termination are likely to *reduce* economic efficiency.

The implications of our theoretical approach for the regulation of mobile call termination are then drawn. The principal conclusion of this section is that if the overall market for retail mobile services (including subscriber access, outgoing calls, incoming calls from mobile and fixed network subscribers, and vertical features) is sufficiently competitive, regulation of mobile rates (including FTM and mobile-to-mobile call terminations rates) is not warranted.

2.1 REVIEW OF REGULATORY FRAMEWORKS

Regulatory authorities around the world have taken various approaches with respect to the regulation of FTM call termination service. In this section, we review details of the approaches taken in the US, the UK, and Australia, and summarize regulatory positions from the European Union, Argentina, and Venezuela. We draw out implications of these experiences for public policy in Latin America.

2.1.1 US Regulatory Framework

Between January 2001 and December 2001, the number of US mobile subscribers grew from 109.5 million to 128.5 million, resulting in a nationwide penetration rate (number of subscribers as a percent of the population) of roughly 45 percent. In 2002, 94 percent of the US population lived in counties with access to three or more operators offering mobile telephone service, 80 percent lived in counties with five or more mobile telephone operators, and 53 percent of the population lived in counties with six mobile telephone operators.[1]

In the US, the mobile subscriber generally pays for both making and receiving telephone calls, including telephone calls that originate on fixed networks, a system that is called Receiving Party Pays (RPP). While RPP is the dominant payment system in the US, Calling Party Pays (CPP) has been offered as an optional service by several wireless operators. According to a 1997 study, CPP was offered in markets served by Ameritech, Bell Atlantic, Cincinnati Bell, GTE, and US WEST Communications (USWC).[2] At the time of the study (in 1997), US WEST had offered

[1] FCC 02-179, "Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services," Seventh Report, released 3 July 2002, p.5.

[2] CTIA Service Report. "The Who, What and Why of 'Calling Party Pays', " 4 July 1997, p.5. Henceforth, CTIA Service Report.

such a service for more than 9 years.[3] The CPP service faced several technical and regulatory obstacles, including the difficulty of collecting CPP charges for calls that originate from payphones, PBXs, and the networks of long-distance carriers.[4]

In 1999, the FCC initiated a proceeding to address the appropriate regulatory framework for CPP services.[5] The FCC sought comment on whether market conditions existed (or would develop) to discipline CPP rates. In 2001, the FCC terminated that proceeding without taking any action.[6] In denying a petition for reconsideration of its decision, the FCC argued that developments in the wireless market appeared to have "dramatically reduced the demand for a calling party pays service offering. This reduced demand for calling party pays offerings was substantially demonstrated in the record and was a key factor in determining the best way to resolve this proceeding."[7] The factors responsible for the decline in demand for a CPP service included flat rate plans, plans in which the first minute of an incoming call to a mobile subscriber was free, and the continued reduction of prices for all components of mobile service.[8]

In sum, mobile operators in a vigorously competitive US mobile market were allowed to offer a CPP service as an option to consumers. The operators did not use CPP to raise the price of FTM calls to the monopoly level (or above the monopoly level, as has been suggested in some theoretical work discussed below), while reducing the prices of handsets, monthly access, and outgoing mobile calls to attract customers. Rather, the record "substantially demonstrated" the failure of CPP services to win acceptance among mobile users given the other retail packages offered by providers. The rates for terminating FTM calls to customers who selected the CPP option were not regulated.

2.1.2 UK Regulatory Framework

Mobile penetration in the UK has reached a high level and continues to increase. In October 2000, the number of mobile subscribers exceeded the number of fixed lines for the first time. By March 2001, there were over 43 million mobile subscribers, and 15 percent of residential consumers now consider mobile handsets to be their main telephone.

In December 2001, the European Parliament issued five new directives affecting the regulation of telecommunications in the member states. UK law will be changed by May 2003 to be consistent with these directives, and Oftel's regulatory framework will be adjusted to bring it

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[3] CTIA Service Report, p.8.

[4] CTIA Service Report, Section 4.05.

[5] Declaratory Ruling and Notice of Proposed Rulemaking, WT Docket No. 97-207, *In the Matter of Calling Party Pays Service Offering in the Commercial Mobile Radio Services*, released 7 July 1999.

[6] Memorandum Opinion and Order on Reconsideration and Order Terminating Proceeding, WT Docket No. 97-207, *In the Matter of Calling Party Pays Service Offering in the Commercial Mobile Radio Services*, released 13 April 2001, at 2. Henceforth, Termination Order.

[7] Second Memorandum Opinion and Order on Reconsideration and Order Terminating Proceeding, WT Docket No. 97-207, *In the Matter of Calling Party Pays Service Offering in the Commercial Mobile Radio Services*, released 31 January 2002, at 10.

[8] Termination Order, at 24.

into compliance with the new laws. The two most significant changes are that Significant Market Power (SMP) has been redefined to make it identical to the notion of dominance in competition law, and that specific regulation can only be imposed on an operator with SMP. Market reviews must be carried out before regulations are adopted.[9] Consequently, in the UK, the regulation of call termination on mobile networks will require a prior finding that the operator whose rates are to be regulated has SMP.

In analyzing the rates charged by Mobile Network Operators (MNOs), Oftel began with an analysis of the relevant product market using the standard "hypothetical monopolist" test applied by competition authorities.[10] This test defines the market to be the smallest set of products for which, beginning from a competitive market price, a small but significant and nontransitory increase in price would be profitable, i.e., there are no close substitutes for the products included in the market definition. While the focus of its inquiry was the wholesale market for mobile call termination, Oftel began with a review of the retail market for mobile services, since the demand for the wholesale service is derived from the retail services it supports. Based on available evidence from the retail market, Oftel determined that fixed and mobile services are in different markets, prepaid and postpaid plans for mobile services are in the same market, and SMS and voice calls are likely to be in different markets.[11] Three possible wholesale market definitions were then considered:

> "(a) a separate market for call termination on the network of each MNO;
>
> (b) a market for call termination, that is part of a cluster of linked national markets for mobile services; and
>
> (c) a national market for call termination on the networks of all of the MNOs."[12]

Definition (a) leads to the most stringent regulation. Since with current technology each carrier necessarily provides 100 percent of the call terminations to its customers, each carrier necessarily possesses market power in its call termination market, and only regulation can be used to offset this power. Note that even if a mobile carrier lost significant market share because it charged high termination rates, it would continue to have 100 percent of the relevant market — calls terminated to its subscribers — and regulation would still be necessary. With definition (b), regulation of call termination services would not be justified for a carrier with very small market share in the broad mobile services market, even though such regulation would be justified under definition (a). Thus, definition (b) would imply less stringent regulation. Definition (c) is

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[9] Letter from Vincent Affleck, Oftel, to Alan Shearman, Competition Commission, "Mobile Phones Inquiry, Mobile Regulation," 17 January 2002.

[10] Competition Commission, "Reports on references under section 13 of the Telecommunications Act 1984 on the charges made by Vodafone, O2, Orange and T-Mobile for terminating calls from fixed and mobile networks," at 2.92. Henceforth, Competition Commission Report.

[11] Oftel, "Review of the charge control on calls to mobiles," 26 September 2001, at 4.7.

[12] Oftel, "Review of the charge control on calls to mobiles," 26 September 2001, at 4.4.

similar to definition (b): a firm with a small market share of FTM calls would not be regulated under (c), but would be regulated under (a).

Oftel began its analysis with the relatively narrow market definition of call termination on the network of a single operator, and considered the possibility of demand substitution. Oftel noted that call termination on a different mobile network was not a substitute for the call termination services of the mobile network to which a customer was directly connected, as the substituting network would have to purchase call termination services from the MNO serving the called customer. Furthermore, Oftel argued that other retail calls, such as on-net mobile calls, were not close substitutes for FTM calls. Oftel stated that SMS and MTF calls were not substitutes for FTM calls. It concluded that demand substitution was unlikely to discipline the call termination price set by any MNO.

UK networks use GSM technology; however, supply-side substitution using multiple SIM cards was not possible for technical reasons related to the availability of information on SIM cards. Finally, Oftel rejected the argument that because MNOs sold a bundle of mobile services, including call termination, the relevant product market was the entire bundle of mobile services.

Oftel reasoned that FTM call termination was demanded by a different group of consumers (i.e., fixed-network consumers and wholesale purchasers of call termination services) than the consumers who purchased the other services offered by MNOs. Oftel stated that mobile customers were not sensitive to the price paid by fixed subscribers who called them, and consequently, call termination was not part of the market for retail services purchased by mobile subscribers. On these assumptions, the relevant market would be call termination to each individual subscriber, as a call to another individual would not be a satisfactory substitute and would not constrain the price of call termination. But because MNOs are unable to charge different prices for terminating calls to each individual subscriber, the competitive conditions that apply to call terminations to one subscriber also apply to the other call terminations of that MNO.

In sum, Oftel concluded that call termination on the network of each mobile operator was a separate relevant market, that each MNO had significant market power in the market for call termination on its own network, and that (based on a model of the costs of a mobile network operator) the price of call termination exceeded the marginal cost of call termination.

Oftel did consider whether mobile call termination service is part of a cluster of linked national markets for mobile services. Oftel observed that termination service and other services are supplied together, and MNOs would potentially compete for customers on the overall price of the bundle. If the services are linked, an MNO would be unable to raise termination charges without customers switching to other operators in response to an increase in the price of the bundle. For this to be the case, Oftel said, it would be necessary for mobile owners to care about the cost to others of calling their mobile phone. However, Oftel rejected this market definition, stating that mobile owners are not sufficiently sensitive to the price for others to call them for the termination charge to provide a competitive constraint on the termination charge of another MNO. In a later section of this report, we critically examine the linkage of mobile services

markets that may occur as a result of the joint consumption of mobile telephone calls by the mobile subscriber and the fixed-network subscriber.[13]

Having concluded that call termination service is a separate market for each MNO, Oftel did not consider in detail the third potential market definition — a national market for call termination — and this definition was not supported by parties involved in the consultation process.

Oftel proposed to regulate charges for call termination based on its estimate of long-run incremental costs as projected for four equal-sized mobile operators in 2006. Initially, the regulation of call termination charges was in the form of a price cap for the two largest MNOs, BT Cellnet, and Vodafone. Their weighted average termination charges for 1999-2000 were set at a ceiling of 11.7 pence per minute with an X-factor of 9% for the years 2000-2001 and 2001-2002.[14] Subsequently, Oftel indicated that the call termination charges for the other two MNOs, Orange, and One2One, should be no greater than the price-capped rates with adjustments to account for cost differences among the networks.

Oftel's proposal to regulate call termination was referred to the Competition Commission in December 2001. In May 2002, the Competition Commission extended its investigation for an additional six months, and in December 2002, it released its final reports. The Commission's findings, which parallel those of Oftel, are that "each MNO has a monopoly of call termination on its own network."[15] The Commission also concluded that "competitive pressures at the retail level did not constrain termination charges"[16] and "that termination charges should, in principle, be cost-reflective and that the most appropriate method for determining the costs of termination was long-run incremental costs (LRIC)."[17]

Oftel bases its maximum FTM termination price on cost estimates developed from a LRIC model of mobile termination that it has been developing (along with its consultant, Analysys) since mid-2000. The model incorporates demand projections and an adjustment for the network externality. The first version of the model was released in September 2001, followed by a second version in April 2002. The changes in the second version had a significant effect on the costs calculated by the model, and later revisions may result in further changes. Overall, the UK experience has been that model building is a time-consuming, resource-intensive, and adversarial process, not a simple, cooperative venture to which all industry participants contribute scientifically neutral insights.

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[13] For another criticism of Oftel's market definition, see Gual, Jordi, "Market Definition in the Telecoms Industry," Final Draft prepared for the European Commission (DGCOMP), September 2002.

[14] Oftel, "Review of the charge control on calls to mobiles," 26 September 2001, p.2.

[15] Competition Commission, "Reports on references under section 13 of the Telecommunications Act 1984 on the charges made by Vodafone, O2, Orange and T-Mobile for terminating calls from fixed and mobile networks," at 1.4.

[16] Competition Commission Report, at 1.5.

[17] Competition Commission Report, at 1.6.

Jeffrey Rohlfs, a consultant to Oftel, has been developing a model of economically efficient prices.[18] His model includes a consideration of both network externalities and call externalities (the benefit to the called party of communicating with the calling party at no charge). The theoretical model supports the view that the market might not provide a sufficiently large network because some of the external benefits would not be accounted for in the prices charged by the firm. Thus, mobile termination rates that exceed the costs of call termination might promote economic efficiency by allowing other mobile rates to be lowered, leading to somewhat larger mobile penetration than would otherwise occur. We consider these arguments in greater detail in Section 3.

2.1.3 Australian Regulatory Framework

The Australian mobile telephone market is highly developed, with five major carriers. In December 2000, these carriers served 10.3 million subscribers.[19] In addition to voice telephony, Short Message Services are widely used.

In 1997, the Australian Competition and Consumer Commission (ACCC) declared[20] the GSM originating and terminating services, and in 2002, it extended the declaration to include services provided by CDMA technology as well.[21] Consequently, Australian mobile service providers are required to offer mobile termination service to other carriers on request, and a failure of carriers to reach an agreement on the terms and conditions of access can be referred by either carrier to the Commission for arbitration.

Over a three-year period, following notification of access pricing disputes, the ACCC conducted a public inquiry regarding the need to regulate prices of mobile termination services, retained economic consultants, published draft reports, held public roundtable meetings, and received industry submissions. The ACCC considered three methodologies for regulating prices: (1) forbearance, (2) cost-based regulation, and (3) retail benchmarking.

The ACCC concluded that a policy of regulatory forbearance was insufficient, given the level of competition, but noted that an increasingly competitive market can generate outcomes that cannot be replicated by regulatory pricing.

The ACCC also rejected a cost-based approach to regulation (whether TSLRIC-based or retail-minus-based), concluding that the costs of implementing the approach (both actual resource costs and the risks of incorrect implementation) outweighed the benefits, noting also the potentially transitory nature of the problem.

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[18] Rohlfs, Jeffrey H., "A Model of Prices and Costs of Mobile Network Operators," 22 May 2002. Henceforth, Rohlfs Pricing Model.

[19] ACCC, "Pricing Methodology for the GSM Termination Service," Final Report, July 2001, p.34.

[20] Once an eligible service is declared, access suppliers must provide the service to access seekers. Prices for declared services are subject to regulation.

[21] ACCC, "Pricing Methodology for GSM and CDMA Termination Services," Final Report, September 2002.

Industry submissions argued that closed user groups are of growing importance, and integrated carriers are responding with differentiated pricing for on-net and off-net calling. The ACCC recognized that closed user groups and callback behavior may provide a competitive discipline on mobile termination prices. Several industry submissions argued that there exists effective retail competition that disciplines mobile termination prices, and that the relevant issue is whether the multiproduct mobile services firm as a whole earns above-normal returns, and not the level of mobile termination prices relative to the corresponding incremental cost. The ACCC accepted that, if the overall mobile services market is effectively competitive, then the relevant issue would be whether regulated reductions in mobile termination prices would result in a net increase in economic efficiency.

In July 2001, the ACCC concluded that there were factors that would keep the price of mobile call termination above the efficient costs of provision. Two important factors that led the Commission to its decision were that (1) once a consumer connected to a particular MNO, that operator had control over mobile termination for that user, and (2) consumer ignorance of the specific mobile carrier used to terminate a call and the rates charged by different carriers meant that persons calling mobile subscribers could, at best, base their calling decision on an estimate of the average price of reaching all mobile subscribers, reducing the loss of terminating minutes to any one MNO that would result from an increase in its call termination price.[22]

The ACCC concluded that the relevant product market was mobile (GSM and CDMA) calls, and the associated functional wholesale and retail elements of the market were mobile origination service, mobile termination service, mobile access and outgoing call services. The ACCC considered the possibilities for demand substitution in the relevant product market and concluded that (1) CDMA calls were close substitutes for GSM calls, (2) 3G services were not currently close substitutes for mobile calls, (3) fixed line services are not close substitutes for mobile calls, (4) prepaid mobile services are in the same market as postpaid mobile calls, (5) Short Message Services are not effective substitutes for voice calls, and (6) e-mail, faxing, and paging services are not substitutes for mobile calls. On the supply side, the ACCC considered market shares and barriers to entry (including availability of spectrum, the ability of an entrant to offer national coverage to its subscribers, and the importance of sunk costs) in its analysis of market power, and concluded that, since the market was not contestable, actual entry would be required to constrain prices. Market growth was expected to plateau, reducing the likelihood that market power would erode. Product differentiation at the wholesale level (i.e., for call termination) was not common, increasing the likelihood of coordinated conduct.

Overall, the ACCC concluded that price regulation of FTM call termination was called for, and that *retail benchmarking* was the most appropriate approach. The price of call termination was initially set equal to the lowest call termination price then in effect, and MNOs were required to reduce the price of call termination at the same percentage rate as they reduced their retail prices for mobile services. .

[22] ACCC, "Pricing Methodology for the GSM Termination Service," Final Report, July 2001.

The ACCC also concluded that it was not necessary to regulate access prices for *mobile-to-mobile* calls, because commercial negotiations appear to link these prices to FTM termination rates. It did, however, raise the issue of potential price discrimination by integrated fixed and mobile carriers.

When the ACCC released its final report, "all access disputes that were current at the time were withdrawn."[23] The report does not provide any information on the prices in the negotiated agreements. The arguments on market definition are the ones that are most likely to be relevant to policy-making in Latin America, since market definition is an important determinant of the necessity for regulating call termination rates.

2.1.4 European Union Regulatory Framework

The European Union recommendations and directives to national regulatory authorities (NRAs)[24] indicate that interconnection and terminating access rates should be cost-based. Long-run average incremental costs should be used to assess tariffs for terminating access.[25] Also, charges for interconnection should be based on a price 'closely linked' to long-run incremental cost.[26]

Table 1 contains a summary of the regulation of FTM termination rates, which is based on the European Union's most recent Implementation Report.[27] More detail is contained in Appendix A of this report. The NRA of each member country generally distinguishes between an operator with significant market power (SMP) and other operators. This appears to be the only point on which there is wide agreement. At a greater level of detail, there is no common European experience. At one extreme, the German regulator does not supervise mobile termination rates. Similarly, Danish, Greek, and Dutch regulators have not determined that any mobile operator has SMP, and therefore, they do not regulate FTM call termination rates. At the other extreme, as discussed above, Oftel in the UK has determined that all mobile operators have SMP in the FTM call termination market, and proposes using an engineering economics model to calculate forward-looking costs for call termination on mobile networks. In between, the Portuguese regulator is negotiating lower rates with Portuguese mobile operators, Austria is developing "appropriate" rates for operators without SMP, and Greece is using "best practice" to set rates.

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[23] ACCC, "GSM Final Pricing Principles," Addendum, Appendix E.

[24] European Union, Seventh Implementation Report, Annex 3, at http://www.europa.eu.int/information_society/topics/telecoms/implementation/annual_report/7report/documents/finalannex3.pdf.

[25] *Recommendation 98/195/EC*, 8 January 1998, Annex 3, at http://europa.eu.int/abc/off/index_en.htm.

[26] *Directive 97/33/EC of the European Parliament and Council*, 30 June 1997, recital 10, at http://europa.eu.int/abc/off/index_en.htm.

[27] European Union, Seventh Implementation Report, Annex 3, at http://www.europa.eu.int/information_society/topics/telecoms/implementation/annual_report/7report/documents/finalannex3.pdf.

Table 1. Regulation of Mobile Sector for Selected European Countries

Country	Penetration rate	Number of operators	Regulatory Framework
Austria	82%	6	Cost oriented price for SMP mobile operators, appropriateness for others. No mobile operators currently have SMP.
Belgium	75% [a]	3	Incumbent's mobile arm has SMP, termination rates are being reduced. International benchmarks used as proxy for cost oriented rates
Denmark	74%	4	No mobile operator has SMP in national market for interconnection. Rates not regulated.
Finland		4+	Sonera's termination rates determined to be non cost-oriented. Radiolinjia under investigation. Rulings appealed, but companies have reduced rates.
France	58%	3	SMP operators required to set cost oriented rates; 20% rate reduction mandated in December 2000 for Orange, second SMP operator followed suit..
Germany	35% [b]	6	The regulator (RegTP) does not regulate mobile rates. No mobile operator has been found to have SMP.
Greece	68%	6	While call termination rates are high, no mobile operator has been found to have SMP in the national market for interconnection. In the absence of cost models, "best practice" to be used for regulating SMP operators.
Ireland	73%	3	Eircell and ESAT determined to have SMP in the national market for interconnection. Cost oriented rates required.
Italy	82%	6	Regulator set an upper benchmark for the termination rates of mobile operators that were determined to have SMP.
Luxemburg	41%	2	SMP operators must set cost-oriented rates. No additional operators were determined to have SMP since the last review.
The Netherlands	70% [c]	5	Regulator still considering SMP designations for mobile providers. Fixed operators argue for lower mobile termination rates by *all* mobile operators.
Portugal		4	Regulator negotiating with mobile operators for lower call termination rates.
Spain	62%	3	2 mobile operators found to have SMP. Cost accounts submitted to the regulator who is working on a cost model.
Sweden			In 1999, 2000 and 2001, Telia was required to lower its mobile termination rates. All decisions were appealed.

Source: Unless otherwise specified, EC, Overview of Implementation in the Member States, Annex 3.

a. Mobistar, Nico Daminet, Delta Lloyd Securities, 29 July 2002.

b. http://www.ericsson.com/about/publications/kon_con/contact/cont16_00/c16_19.shtml

c. Libertel, Jorn van Breukelen, Friesland Bank Securities, 15 June 2000.

Note: "Number of operators" is a count of UMTS, 2G, and 3G operators.

Since Latin American telecommunications markets differ in significant ways from European markets (in particular, fixed and mobile penetration rates are considerably lower in Latin America than in Europe), it may well be that the Latin American policy goals may be quite different from European policy goals. These policy differences may, in themselves, result in Latin American solutions that vary considerably from European solutions. At a more specific level, in Europe, almost all regulators justify intervention by first establishing that a mobile operator has SMP, and then attempting to develop "cost-oriented rates." In Latin America, too, the identification of fixed and mobile operators with SMP may be a useful first step to take in formulating regulations. Specific regulations adopted in different European countries vary considerably, suggesting that one solution does not fit all countries. The lesson for Latin America may well be that no regulator should attempt to regulate mobile rates without first establishing that existing rates reflect the exercise of SMP, and that each country should develop specific regulations (if regulation is warranted) that best address the policy goals of that country. It may be that the economic analysis would support a conclusion that MTF call termination rates should not be regulated (as was the case in Germany, Greece, Denmark, and the Netherlands).

2.2 Summary of the Theoretical Literature

This section briefly summarizes major findings from theoretical economic analyses of call termination pricing. More detail is contained in Appendix B.

2.2.1 Competitive Behavior

With a CPP regime, a mobile carrier obtains revenues from handset sales, monthly recurring charges, charges for calls originated by its subscribers, and call-termination charges paid by other carriers. It has been argued that if mobile subscribers are indifferent to the prices paid by fixed subscribers who call them, then mobile carriers will compete for subscribers by reducing handset rates, rentals, and call-origination charges, while raising call-termination charges in order to maintain their revenues and break even; as a result, call-termination charges will be above cost and monthly recurring charges below cost. If there is no coordination among carriers, and if consumers can only observe the average charge for mobile call termination, then call-termination charges may escalate to levels in excess of the monopoly price.

2.2.2 Efficient Prices in a Simple Case

The simplest case considered in the literature[28] is that in which (1) each mobile carrier has a monopoly over the termination of calls to its subscribers, (2) only the calling parties obtain utility from calls, and (3) there are no network externalities.[29] With these assumptions, it can be shown that the mobile carrier sets the FTM termination price above cost. This is considered

[28] Armstrong, Mark, "Call Termination on Mobile Networks," 11 April 2002, at http://www.oftel.gov.uk/publications/mobile/ctm_2002/armstrong110402.pdf.

[29] Network externalities refer to the additional benefits each subscriber gets from the addition of new subscribers to the network. The addition of the new subscribers increases the value of the network to existing subscribers, who may call or be called by the new subscribers. Since the new subscribers may not factor the benefits to existing subscribers into their subscription decision, it is sometimes argued that subsidies may be required in order to reach the socially optimal network size.

inefficient.[30] As in any single market with a bottleneck resource, regulation that reduces price to cost increases economic efficiency. This theoretical argument is offered as justification for regulating FTM call termination. Indeed, this result (and results obtained in more general versions of the simplest case) suggests that cost-oriented rates (such as those obtained from LRIC models) are necessary to promote the long-term interests of consumers, while allowing the firm to earn an "adequate" return on its investment.

However, FTM call termination is not a bottleneck in the usual sense—when there are multiple firms in a market, they compete for mobile subscribers (by lowering retail prices paid by their customers) in order to earn the profits on calls terminated to the new subscribers. Consequently, above-cost call-termination prices make possible lower subscription prices and an increase in penetration and consumer welfare, offsetting the welfare loss from the higher call-termination prices.

Because of *network externalities* (the increase in utility of existing subscribers when new subscribers are added to the network), an increase in mobile penetration generates some additional welfare to *existing* fixed-network and mobile-network subscribers. These considerations suggest that, even for the simple model and its generalizations, when call termination charges are somewhat greater than the corresponding costs, regulation of call termination may not be warranted.

While the traditional models do provide some conditions under which optimal FTM call termination rates exceed the corresponding incremental costs, we believe that these models are incomplete because they neglect the most important characteristic of telephone calls: every call is shared by at least two parties. As analyzed in section 2.3, because a FTM telephone call benefits both the caller *and the called mobile subscriber,* the optimal call-termination price cannot be determined without considering the extent to which the two parties to a call may (directly or indirectly) share the charge for a FTM call. When a high proportion of mobile traffic is between members of closed user groups, such that the total value of any call is recognized and its costs can be shared across the group, it can be efficient for the call-termination charge to exceed cost for reasons not considered by the traditional model. As we show in section 2.3, consideration of call externalities reveals additional reasons for keeping FTM call termination charges above cost.

2.3 Efficient Pricing and Competitive Effects

This section analyzes efficient prices when the benefits of a call to both the called and calling parties are explicitly considered. Most of the countries reviewed in Section 2.1 act to regulate call termination rates only after establishing that the mobile operator(s) in question possess(es) SMP. An analysis of SMP consists of two important steps: the definition of the relevant market, and the calculation of market shares in that market. Our analysis of the market definition

[30] Economically efficient prices are defined to be prices that maximize the sum of consumer benefits and benefits to the firm. In markets for typical privately supplied goods, setting price equal to marginal cost maximizes welfare (i.e., it is efficient).

appropriate to call termination service begins with a discussion of optimal prices and competitive effects. The discussion leads to a market definition that follows from the analysis of competitive effects. To bring out the key factors affecting market definition, we begin our analysis of efficient pricing and competitive pricing in the simplest context, and then add complexity incrementally to this initial case.

2.3.1 The Simplest Case

The efficiency of FTM call termination pricing has been examined largely in models in which only one party—the fixed-network calling party—benefits from a FTM call. In the basic model, it is assumed that mobile services are produced competitively, all calls made by mobile subscribers terminate on the fixed network (there are no mobile-to-mobile calls), and that mobile subscribers gain no benefit from receiving calls and do not care about the welfare of fixed subscribers who call them.[31] In such a model, each mobile operator will set the termination charge at the monopoly price level, which exceeds the marginal cost of call termination.[32] On these assumptions, FTM prices above cost are economically inefficient.

However, this conclusion can be questioned, because once it is assumed that mobile subscribers do not value calls from fixed subscribers or care about the welfare of fixed subscribers, there is no reason for mobile subscribers to engage in conversations with fixed subscribers. Rather, mobile subscribers will endeavor to economize on their time and the battery life of their handsets by (1) not sharing their mobile numbers with subscribers to the fixed network, (2) leaving their handsets turned off when they are not originating calls, (3) checking the caller-ID and not answering an incoming call from the fixed network, and (4) hanging up immediately if, for some reason, they answer a call from a fixed subscriber. As a result, the actual volume of FTM calls will be nearly equal to zero, not the volume of FTM calls demanded by subscribers to the fixed network.

Since mobile networks are only compensated for FTM minutes when FTM calls are actually terminated on their networks, they will receive little revenue from FTM calls, and will be unable to subsidize other mobile rates. The "usual" monopoly price predicted by the basic model will not, in fact, be realized. Effectively, the relevant market for mobile call termination will not exist and the need for regulating mobile call termination will not arise.

Thus, a realistic analysis of FTM termination pricing must make provision for benefits to *both* parties to a call. While the calling party initiates any specific call, it is the called party who decides whether to accept or decline the call. The decision to engage in communication is therefore a joint decision made by both parties. Furthermore, once the call is established, the parties jointly decide to continue the call until one or both parties agree to terminate the call. It is misleading to assume (even implicitly) that the volume of calling is solely determined by the originator of the call, i.e., that FTM call minutes are demanded and determined by the fixed

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[31] See, for example, Armstrong, Mark, "Call Termination on Mobile Networks," 11 April 2002, at http://www.oftel.gov.uk/publications/mobile/ctm_2002/armstrong110402.pdf. See Assumptions 1–3, p.2.

[32] Armstrong, p.4.

subscriber alone, while the volume of MTF calling is demanded and determined by the mobile subscriber alone. Nevertheless, this assumption is made in most theoretical models of telephone demand, including papers relied on by regulators to justify regulating mobile call termination. A more realistic model of demand would recognize that the calling volume *in each direction* is determined jointly by the calling and called parties—with caller ID, neither party need accept a call from another party, neither party can prolong a call without the consent of the other party, and either party can terminate the call at any time.

Moreover, the price of a minute of FTM calling does not generally measure the marginal value (or willingness to pay) of the fixed subscriber. When an FTM call is terminated because the mobile subscriber disconnects, the value of the marginal minute to the fixed subscriber may be higher than the price he pays.

For yet another reason, the distinction between the calling and called party may not be meaningful for economically efficient pricing. More than 80 percent of telephone calls do not reach the intended party.[33] Many calls reach assistants, voice mail systems, or answering machines. In some instances, a message left by the calling party substitutes for a conversation. In other cases, the calls are returned by the called party, presumably because they are considered valuable.[34] Often, these returned calls do not reach the intended party, but are part of the common experience of "phone tag." When calls reach a subscriber on a multi-line system or a subscriber with call waiting service, the called party often places an existing call on hold, answers the new call, and offers to return that call later. In many of these cases, the party initiating a particular call may not be the party initiating the particular communication, and may not be the party that obtains greater value from the call.

Models that assume that mobile subscribers obtain *no* benefit from calls made to them by fixed-network subscribers are, therefore, of limited value, and the use of traditional demand functions and the measure of consumer welfare derived from such models can be quite misleading when applied to telephone calls. It is therefore important to analyze the total volume of calling in both directions and the utility obtained by both parties to a call.

2.3.2 Joint Consumption of Telephone Calls

As observed above, a telephone call is a good that is *jointly* consumed by the calling and the called parties. In economic terms each telephone call is a particular *public good* that is consumed by two subscribers, although its cost is most often paid by only one of them. Analysis of efficient FTM telephone pricing must, therefore, take into account (1) the utility to both the called and calling parties call, and (2) the prices and opportunity costs facing both parties to the call. An analysis that considers only the price paid by the fixed subscriber will necessarily be incomplete.

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[33] Naik, Gautam, "Voice Messaging: Efficient And Cheap But Still Too Limited," *Wall Street Journal*, 28 October 1995.

[34] "Recent industry survey results show that a North American employee typically spends 50 minutes a day returning an average of 11 pages, and spends an additional 36 minutes a day reviewing voice mail." http://www.nortelnetworks.com/products/01/companion/ibc/biz.html.

Consider, first, consumers whose purchasing and consumption behavior is determined only by their own utility and expenditure. The fixed-network consumer will initiate a call to a mobile subscriber when she expects a successful call to provide utility at least equal to the cost to her of making the call, where the cost includes both the monetary cost of the call and the opportunity cost of her time. The mobile subscriber will accept the incoming call when he expects his utility of the call to exceed his (monetary and time) cost of answering it. The relevant costs include both the charge (typically to the caller) for placing the call and the opportunity costs of the time of answering and conversing for both called and calling parties.

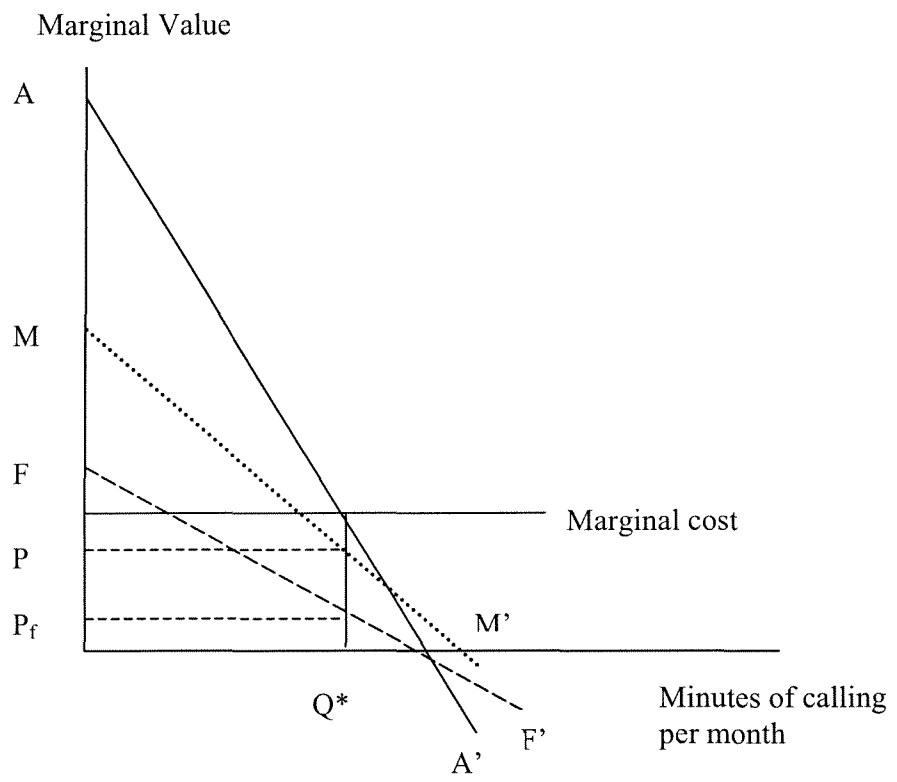
Once a call has been initiated, the duration of the call will be determined by the utilities of both parties and the costs they incur. The fixed-network caller will wish to converse until the additional utility she receives from an additional minute is less than the charge for an additional minute plus the opportunity cost of a minute of her time. The mobile subscriber will wish to converse until his additional utility is less than the opportunity cost of a minute of his time. The call will terminate when the first of these conditions occurs. An alternative representation of this condition is that each party will wish to prolong the call as long as the *net* marginal benefit (the value of the call less the opportunity cost of time) is greater than the price paid by that party.

By placing a call and paying for it, the fixed-network caller confers an *external* benefit (or imposes an external cost if the call is considered a nuisance by the called party) on the mobile subscriber. The *total* benefit of a call consists of the utility to the caller *plus* the utility to the called party. To determine efficient prices and quantities, it is the *sum* of the utilities of both parties that must be compared to the total end-to-end cost of the call. If we assume a constant marginal cost per minute, the maximum net benefit will be achieved at the calling volume (or duration) where the net marginal utility per minute of the caller (i.e., the marginal benefit of the call net of the opportunity cost of time) plus the net marginal utility per minute of the called party is equal to the marginal cost of an additional minute. This volume of calling is economically efficient for this pair of subscribers. By summing up the economically efficient volume of calling for each such subscriber pair, we obtain the economically efficient aggregate volume of calling. Since many unanswered calls from a fixed to a mobile subscriber may be calls that are returned as MTF calls, and vice versa, the efficient calling volume does not distinguish between types of calls, but consists of the total calling volume *in both directions* between each pair of subscribers.

2.3.3 The Optimal Price Structure

For pairs of subscribers who are in a personal or business relationship with each other, calls typically provide utility to both the caller and the called party. Like a public good, both parties consume the same quantity of the good: a 10-minute call requires 10 minutes of the caller's time and also 10 minutes of the called party's time. When the call is paid for by one party (typically the caller) the other party receives a positive external benefit, or, in public good parlance, a "free ride." As with other public goods, the optimal pricing of shared goods like telephone calls requires "personalized" prices charged to both parties to a call. These are illustrated in the diagram on the following page.

The line *FF'* represents the (expected) net value to the fixed subscriber of each additional minute of telephone conversation with the mobile subscriber per month, i.e., the marginal value of the call less the opportunity cost of time. As indicated in the diagram, the marginal value to a party can be negative – this occurs when the opportunity cost of time exceeds the benefit from the call. *MM'* is the corresponding line for the mobile subscriber. *AA'*, the vertical summation of these two lines, represents the aggregate net value to both subscribers of each additional minute of telephone calling. The efficient volume of calling, Q^*, is given by the intersection of the aggregate net value line and marginal cost. Beyond this volume, an additional minute of calling does not generate sufficient benefit to the two parties to cover the costs of supplying the additional minute. The fixed subscriber will demand Q^* minutes if he is charged a uniform price of P_f per minute for both incoming and outgoing calls, and the mobile subscriber will demand Q^* minutes at a corresponding price of P_m. Also, $P_f + P_m = MC$. In this setting, economic efficiency therefore requires *personalized pricing* – a specific price for each party to a call.



The personalized prices that are efficient for one pair of subscribers will not, in general be economically efficient for other subscriber pairs because the value to one subscriber of calling (or being called by) other subscribers can vary significantly with the identity of the other party. For example the value to a parent of calling a child can be a large and positive number, whereas the value to that parent of receiving a telemarketing call during dinner can be a large negative number. It follows that one "efficient price" does not fit all cases. In particular, a TSLRIC-based price for all calls is not necessarily efficient.

Despite the great variability in efficient prices across subscriber pairs, some general properties of efficient pricing and the implications for regulation can be obtained.

2.3.3.1 Internalization

Because most calls are valued by both parties, it is in the parties' mutual interest to arrange matters so that the full net benefits of each potential call are obtained. When consumers are able to consume the volume of calls that maximizes the sum of their net benefits less the sum of their costs, in spite of charges levied on only one party, they have successfully *internalized* the external effects of the FTM termination charge.

The ability of consumers to internalize the external effects varies with the relationship of the calling and called parties. Consumers who may be termed *related users* are those who have some sort of ongoing relationship—based on family, friendship, or business interest—that enables the called mobile subscriber to reciprocate or otherwise mitigate the expense incurred by the calling fixed-network subscriber. Such groupings of consumers are also sometimes termed "closed user groups."

In many instances, each party to the call obtains roughly equal net benefits, and an explicit mechanism for compensating the fixed-network party may not be necessary in order to sustain the optimal volume of calling between the two parties. All that is needed is that the parties implicitly agree on a pattern of call origination that allocates the ongoing costs of communication in a manner that is mutually agreeable (i.e., the internalized prices are roughly equal to the optimal "personalized prices").

In other instances, two parties who communicate regularly with one another have numerous opportunities to affect the balance of charges they incur.[35] For example, one party can attempt to shift charges to the other party by leaving a short voice mail asking for a return call; or attempt to assume a larger share of the costs by repeatedly calling the other party instead of leaving a message for a return call. When these internalization strategies are used, FTM and MTF calls can be close substitutes for one another.

When one party obtains significant benefits from calls with a second party, while the latter's benefits are less than the costs that party would incur, then the party obtaining the greater

[35] Rohlfs, Jeffrey H., "Annex A: Network Externalities and their Internalization with respect to the UK Mobile Market Network," 19 April 2002, Annex A, p. 2. Henceforth, Rohlfs, Annex A.

benefits has an incentive to internalize the external benefits. Parties in family relationships provide numerous examples of this internalization. Many parents call their children significantly more often than their children call them, because the parents' benefits from the call exceed their costs, while the children are constrained by limited budgets. With CPP, two people who communicate regularly with one another can, over a series of calls, split the total telephone charges to both parties in any desired proportion by varying the frequency and duration of calls in each direction. Some parents go further and obtain a personal 800 (toll-free) number at which their children call them, accept collect calls from their children, or reimburse their children for their expenses on telephone calls. Businesses can internalize the costs of originating calls by charging their clients for phone calls made to the clients, either directly or as part of the overhead cost built into their prices. Additionally, parties in a long-term relationship can find other indirect means (such as asymmetric gift-giving) to make up for any asymmetric payments that arise from differences in the telephone charges they face. Given the range of internalization techniques available, it is not surprising that Oftel has concluded that consumers can internalize a large portion of calling externalities.[36]

2.3.3.2 Related Pairs of Users

Since the ability or inability to internalize call externalities is a central determinant of the relationship of optimal prices to marginal costs, we examine an alternative description of internalization. Let P_f be the price per minute of FTM calls, and let P_m be the price per minute of MTF calls. Let $V_f(Q)$ be the willingness to pay (or inverse demand) function of the fixed subscriber for Q minutes of conversation with the mobile subscriber. Here, Q represents the total volume of calling initiated by both the mobile and the fixed subscribers. Let Q_f be the inverse of the willingness to pay function. For the mobile subscriber, let $V_m(Q)$ be the corresponding willingness to pay function and Q_m its inverse.

Q_f is the volume of calling that the fixed subscriber would like to consume if he had to pay P_f for all calls to and from the mobile subscriber, and Q_m is the corresponding demand of the mobile subscriber. Since either party can (politely) terminate a call at any time, the actual volume of calls between the two parties will be the minimum of Q_f and Q_m. Suppose, for concreteness, that Q_m exceeds Q_f. In this case, the actual volume of calls will be Q_f. The prices P_f and P_m are not optimal because they do not satisfy the conditions for efficient personalized pricing shown in diagram 1. In particular, it is unlike the optimum displayed in Figure 1, $Q_m \neq Q_f$.

For this example, the mobile subscriber's net benefit from an additional minute will exceed the price that he must pay. However, he cannot realize the gains from additional minutes of conversation because the fixed subscriber does not wish to spend more time on the phone. The mobile subscriber has an incentive to use one of the internalization mechanisms described above to induce the fixed subscriber to participate in an increased volume of calling. Internalization increases the cost to the mobile subscriber of conversations with the fixed subscriber, reducing Q_m. At the same time, it reduces the corresponding cost to the fixed subscriber, increasing Q_f.

[36] Rohlfs, Annex A, p.3.

When the internalization process is costless, subscribers will engage in internalization until the desired volume of calling is the same for both parties as shown in Figure 1: $Q_m = Q_f = Q^*$. [37]

Optimal prices for calls between any one pair of users will, in general, be different from the optimal prices for other pairs of users. As was pointed out earlier, a mobile subscriber may be willing to reimburse a fixed-line residential user for calls to the mobile telephone, but quite unwilling to reimburse a telemarketer who calls him. Of course, telephone companies and regulators do not have either the information or the flexibility required to implement optimal prices for each pair of subscribers. However, when related pairs of users can internalize externalities due to list prices that deviate from the optimal personalized prices, efficient calling volumes for these user pairs will be realized.[38] When externalities are internalized, the effective prices facing the subscribers are not the same as the tariffed prices set by the telephone company or the regulator. Demand will be governed by effective (internalized) prices, not list prices.

If mobile subscribers provide assistance to fixed subscribers who call them, the (monetary or in-kind) "subsidy" that mobile subscribers may transfer to fixed subscribers will not impose an undue burden on the mobile subscribers *so long as the retail market for mobile services generally (i.e., access, outgoing and incoming calls) is vigorously competitive*. The profits from above-cost call termination charges will be competed away as providers seek to attract customers through lower charges for other components of service, such as monthly access and outgoing calls. If reductions in mobile charges for outgoing calls exactly offset increases in FTM call termination rates, the internalization mechanisms used by related users will be adjusted to maintain the previously optimal calling volume, and no loss of efficiency will result. To the extent that competition results in somewhat lower monthly charges or lower handset prices, the sum of the outgoing price per minute and the FTM rate per minute may increase. In this case, the higher total price of calls both to and from mobile subscribers to fixed subscribers will reduce the volume of calling of related pairs of users below the optimal amount.[39]

For closed user groups and other parties in long term-relationships that resemble the related pairs of users in the example described above, the system will resemble a money pump: mobile providers charge high prices for termination, pass on the profits to mobile subscribers in the form of lower prices for outgoing calls, and mobile subscribers in turn reward related fixed subscribers (if necessary) by internalizing the call externality, using the savings in outgoing call charges to cross-subsidize calls to them from related users in the fixed network.

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[37] The mobile subscriber need not, in all circumstances, subsidize the fixed subscriber. The example depends on the specific demand curves of the two parties—for some related pairs with different demand curves, the internalization costs might be borne by the fixed-network subscriber.

[38] "Where externalities are internalized in such fashion, corrective pricing (via an externality factor) is unnecessary." Rohlfs, Annex A, p.3. By corrective pricing, Rohlfs means an attempt by regulators to set the price at the economically efficient level when the market fails to do so.

[39] This reduction in welfare from calls between related users may nevertheless be efficient if it is more than offset by other increases in welfare, including a reduction in the number of unwanted calls to mobile subscribers and an increase in the number of mobile subscribers. Both these effects are discussed later in this report.

2.3.3.3 Unrelated Pairs of Users

For pairs of users who are not part of the same community of interest, a different analysis of efficient prices is required. Lacking an established relationship, these user pairs are likely to incur high transaction costs for internalizing call externalities. Since internalization may not be feasible, each party will respond to the tariffed rates it must pay for these calls. If the tariffs result in charges to the calling party only, it will pay a price equal to the tariffed rate, while the called party will pay nothing. This pair of prices will not, in general, equal the personalized prices shown in Figure 1. Consequently, calling volumes between unrelated parties are likely to be economically inefficiently low. For these users, it is important that list prices be appropriately set, since internalization cannot correct for the call externality.

Some calls between unrelated pairs of users are likely to generate positive benefits for both parties. Examples might include pairs of business subscribers where one business calls another to establish a new business relationship. However, other calls between unrelated parties are likely to create small (expected) positive benefits for the calling party but large negative benefits for the called party. Calls from telemarketers and other salesmen fall in this category.[40] The annoyance caused by such calls is not trivial, and in several countries laws have been passed to limit the incidence of unwanted calls. In the US, the Telephone Consumer Protection Act of 1991 was enacted in response to consumers' concerns about the growing number of unsolicited telephone marketing calls to their homes and the increasing use of automated and prerecorded messages. The Act allows consumers to "opt out" of receiving telemarketing calls by registering in an industry-maintained database and prohibits automatically dialed calls to mobile telephones.[41] An opt-out arrangement is available to telephone subscribers in Australia.[42] In the UK, Oftel has implemented regulations aimed at reducing the incidence of unwanted calls to subscribers from automated calling equipment and unsolicited telephone sales calls.[43]

Despite such regulations, callers continue to receive a significant volume of unwanted calls. Although the 1991 US act prohibited automatically dialed commercial calls to mobile phones, mobile consumers have increasingly complained about receiving telemarketing calls. As a result, a marketing trade group will identify 280 million existing and prospective mobile numbers and seek to have members remove those numbers from dialing lists.[44] Examples of attempts to filter out unwanted calls include the following:

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[40] Rohlfs points out that telemarketing calls, which have become "increasingly important in recent years," are "often a nuisance (source of disutility) to the called party." He also points out that this negative externality cannot be easily internalized by the called party. Rohlfs, Annex A, footnotes 1 and 2. However, the formal model developed by Rohlfs does not include a consideration of this type of call.

[41] FCC, "Unwanted Telephone Marketing Calls," 21 May 2002, at http://www.fcc.gov/cgb/consumerfacts/tcpa.html.

[42] Australian Communications Authority, "Privacy and Your Telephone Service," at http://www.aca.gov.au/consumer/fsheets/consumer/fsc16.pdf.

[43] See http://www.oftel.gov.uk/consumer/advice/faqs/prvfaq5.htm and http://www.oftel.gov.uk/consumer/advice/faqs/prvfaq1.htm.

[44] "Mobile Telemarketing," *International Herald Tribune*, 22 October 2002, at http://www.iht.com/cgi-bin/generic.cgi?template=articleprint.tmplh&ArticleId=74453.

- Between 1985 and 1998, the proportion of unlisted telephone numbers in the Netherlands increased from 17% to about 27%.[45] By 1998, more than 50 percent of Californians had unlisted numbers, with the main reason being to avoid solicitations.[46] Most cellular numbers are unlisted.

- Between 1998 and 2001, the proportion of households owning an answering machine increased from 69 percent to 77 percent.[47] Many owners of answering machines use the device to screen out unwanted calls.[48] Voice mail is increasingly used for the same purpose. And business executives rely on secretaries to filter out unwanted calls.

- Caller ID services were used by 40 percent of BellSouth's residential customers in 1998, and penetration was growing at 23 percent per year. It is a standard feature of mobile telephone service in the US. Related services, such as selected call blocking, are also quite popular.

The filtering devices in use are imperfect: they do not successfully block all unwanted calls, and the unwanted calls that come through are often considered quite intrusive. This is particularly true of mobile subscribers, who may be operating a vehicle when they receive a call that distracts them. In the absence of perfect blocking solutions, a high list price on FTM calls[49] can augment the range of filtering strategies employed by mobile subscribers to discourage calls that the mobile subscriber does not value. If a high price of FTM calls reduces unwanted calls substantially while reducing desired calls slightly, an above-cost price of call termination will internalize the (on average) *negative* call externality, and therefore increase consumer welfare.

2.3.3.4 Both Related and Unrelated Pairs of Users

In a market in which each subscriber has long-term relationships with some subscribers but no relationship with others, a fully efficient price structure will likely require discriminatory pricing of call termination. Users are likely to prefer a price structure in which related users call them at low cost while unrelated users are charged a sufficiently high price to filter out unwanted calls. Since different callers have different calling communities, such optimal prices will vary from one caller to another.

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[45] Netherlands Official Statistics, Volume 14, Autumn 1999. Available at http://www.cbs.nl/nl/publicaties/publicaties/algemeen/a-125/1999/nos-99-3.pdf.

[46] Testimony before the House Judiciary Committee, Oversight Hearing on "The Effects of Consolidation on the State of Competition in the Telecommunications Industry", Deborah A. Howard, MPH, Executive Director, Internet Service Providers' Consortium.

[47] Miller, Paul, "Market Sector Report: Tuning in to Electronics," *Catalog Age*, 1 July 2001, at http://catalogagemag.com/ar/marketing_market_sector_report_2/.

[48] Gates, Bill, "Looking forward to a listed telephone number," 28 January 1997, at http://www.microsoft.com/billgates/columns/1997essay/essay970128.asp.

[49] Rohlfs points out that "telemarketing calls are seldom if ever originated in mobile networks." Rohlfs, Annex A, footnote 1.

FTM prices that charge a high price when the fixed caller calls a mobile subscriber who did not designate him a member of his calling community, and a low price otherwise, would likely be important. However, the effects of an optimal price structure can be approximated by setting a high price on all FTM calls and relying on each mobile subscriber to lower the price selectively to members of his calling community using one of the internalization techniques listed earlier. The subscriber has the ability and the incentive to implement such a scheme. On the other hand, if a MNO charges a low price for terminating FTM calls, the mobile subscriber cannot implement the desired discriminatory price, since he has no means of collecting high prices from callers with whom he has no long-term relationship.[50]

In practical settings, high call termination prices charged by a MNO coupled with internalization by related pairs of users most closely approximate a fully efficient price structure when each subscriber tends to communicate with relatively few users, and when calls from strangers tend to have little, or even negative, value. It is likely that the calling patterns of most users are not uniform. In his pioneering analysis of interdependent demand in 1974, Rohlfs noted that a "uniform calling pattern may not be very realistic. People typically belong to groups, each of which has a strong community of interest within itself. And they typically have a few principal contacts who alone account for a substantial part of their communication."[51]

In the decades that have passed since Rohlfs' observations, many callers continue to have a few principal contacts, but unwanted calls appear to have become a far more serious problem.[52] When these conditions occur, efficient price structures for mobile services might well consist of above-cost mobile FTM call termination rates and below-cost handset prices, monthly access fees and outgoing charges, with overall economic profit being zero.

2.3.4 Efficiency of Competitive Prices

The analysis developed above suggests that an efficient price structure for mobile services is likely to be achieved when there is vigorous competition in the retail market for mobile services. When MNOs compete for subscribers, increases in FTM call termination rates are likely to result in offsetting reductions in other charges for mobile services. Closed user groups, which take into account all of the charges for call termination and all of the benefits to parties to a call, and may account for a large proportion of non-nuisance calls, have incentives to subscribe to the network with the lowest FTM call termination charges (other things equal). Competition in the retail

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[50] "...a mobile subscriber under RPP is unlikely to be able to recover the cost of an unwanted call from a telemarketer." Rohlfs, Annex A, p.3. Indeed, the telemarketing industry has taken steps to render ineffective some call blocking strategies adopted by subscribers seeking to reduce unwanted calls. For one example, see Krane, Jim, "Telemarketing Tool Trumps Telezapper," *AP News*, 25 February 2003. For a related discussion of mobile subscribers, see "You've got my number," *The Economist,* 3 October 2002.

[51] Rohlfs, Jeffrey H., "A theory of interdependent demand for telecommunications service," *Bell Journal of Economics and Management Science*, 5 (Spring 1974): 16–37. Rohlfs notes that "the value of the service to others would probably be lessened if a large number of life insurance salesmen subscribed to the service to solicit other subscribers."

[52] The growth of "spam" (or unsolicited broadcasts of e-mail) on the Internet is one example of the problems that arise when message origination charges are low.

market is therefore a key factor in determining whether prices for retail *and* wholesale services provided by MNOs are economically efficient.

Customer ignorance or unawareness of the retail price for FTM calls is unlikely to be a major cause of inefficiency. Related-user pairs are likely to call one another frequently, and the fixed-network subscriber has several opportunities to observe the prices paid for FTM calls he makes. If high FTM prices inefficiently reduce the volume of calling between the parties, the mobile subscriber will have the incentive and ability to internalize the inefficiency. For unrelated user pairs, the high FTM price may serve to augment filtering mechanisms that are valued by the mobile subscriber.

This analysis suggests that price structures in which the FTM call termination rate exceeds the marginal cost of MTF call termination are likely to be economically efficient when the market for retail mobile services is sufficiently competitive and increases in FTM rates are offset by reductions in MTF rates. This analysis also requires a fresh examination of the definition of the relevant market for call termination services.

2.4 Market Definition

In this section, we use our analysis of efficient prices to examine issues related to market definition and SMP. Since most regulators (correctly, in our view) consider a finding of SMP as a prerequisite for regulating mobile termination rates, this section can be viewed as an analysis of conditions under which regulation is justified.

2.4.1 Analysis of Competitive Effects

Market definition includes listing the product(s) in the market and determining the geographic extent of the market. In the analysis of an antitrust or merger proceeding, the process of defining a market typically begins by considering the extent of demand substitution in response to a small but significant and sustained increase in price above the competitive level. The *relevant market* is defined as the smallest set of products for which such a price increase would be profitable. However, for the regulation of telecommunications services, this approach to market definition has not always been useful, and authorities have instead relied on a broader consideration of competitive effects. For example, in examining a proposed merger of two US long-distance carriers, the Federal Communications Commission stated that:

> The geographic market is more accurately defined as a series of point-to-point markets. A telephone call in one point-to-point market usually is a poor substitute for another. For example, if one wants to call a relative or business associate in Denver, it is generally inconsequential if rates to San Francisco are lower. Nevertheless, for purposes of our competitive analysis of this merger, we analyze a single national market for long distance services—both mass market and advanced business services—because we believe that geographic rate averaging and rate integration, price regulation of exchange access services, and the availability of interstate transport capacity cause carriers to behave similarly in each domestic point-to-point market. Equally important, most substantial competitors in the long distance services market are national in scope,

> advertise nationally, and exert the same competitive effect in all regions. There is no credible evidence suggesting that there is, or could be, different competitive conditions in a particular point-to-point market, or groups of point-to-point markets.[53]

Similarly, in Australia, the ACCC determined that:

> The Commission's report on Local Telecommunications Services noted that substitutability tests tend to be of limited use when delineating the geographical dimensions of telecommunications markets. For example, a local call made in Perth is unlikely to be a substitute for a local call made in Melbourne. Rather, in delineating the geographic dimension of the telecommunications markets, factors such as the area over which major suppliers operate (supply-side) are considered to ensure that the relevant arena of competition is described.[54]

In the UK, Oftel determined that while it may be possible to define different markets for different types of retail calls offered by MNOs, a single market for outgoing mobile services was appropriate:

> ...[S]ince the competitive conditions for different outgoing retail services are likely to be the same as they are purchased as part of a bundle with subscriptions, Oftel has carried out its competition analysis using a single retail market for all outgoing mobile services including subscriptions, MTF, mobile-to-off-net mobile and on-net-mobile calls.[55]

In Argentina, the Commission for Competition examined the possibilities for demand substitution, including calls to fixed telephones, use of fax or e-mail, callback, and "tromboning" that would route calls internationally before terminating them on a mobile network. It "conclude[d] that, at present, it is not possible to substitute the calls to a mobile telephone for any of the alternatives considered."[56] However, the Commission's conclusion was apparently incorrect with respect to rerouting of calls via an international carrier—we understand that tromboning has allowed termination of calls to mobile subscribers with no termination payment and that such calls will now be charged the FTM termination rate.[57]

The Commission also took the view that (fixed-line) consumers have limited information about termination charges, which vary by operator and rate plan, and that the fixed-network caller is a "captive" user of the mobile network of the called party. Thus, it rejected defining the relevant

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[53] Order, MCI-WorldCom merger, at 30.

[54] ACCC, "Pricing Methodology For The GSM Termination Service," Final Report, July 2001, p.31. Footnotes omitted.

[55] Oftel's views on market definitions for fixed and mobile services, at 2. Available at http://www.oftel.gov.uk/publications/mobile/ctm_2002/definitions0502.pdf.

[56] Ministry of Production – Competition, Deregulation and Consumer Protection Secretariat – Argentine Anti-Trust Commission, Note CNDC No. 736/2002, File 064-006233/2001 (C.660), letter, 8 May 2002, at 106.

[57] Secretaria de Comunicaciones, Servicia Telefonica, Resolucion 124/2002.

market as part of a basket of mobile services. It also rejected as a relevant market the termination charges of the network of each operating company, largely because of the lack of a uniform termination price and the great variety of retail plans. The Commission "believes that the most adequate definition of relevant market is the termination charges of the destination market."

The Commission recognized the importance of closed user groups in the determination of mobile termination rates:

> On the other hand, and due to the fact that the called person is not the one paying the charge for call termination, it is slightly probable that in case of an increase in this charge he decides to change the termination service provider. An exception may occur in the families that must frequently contact their members through a cellular telephone; or the companies contracting packages for task forces, because the person or customer called is interested on the amount that the member calling him must pay for termination, given that the origination and termination charges are paid, finally, by the same family or work group. However, this does not seem sufficiently general so as to turn, in practice, into a demand side substitution axis.[58]

The Commission offers no empirical evidence for this conclusion, which is not consistent with Rohlfs' observation that each subscriber has a relatively small calling circle to which most calls are made, or with the incentives a business has to keep its customers' and suppliers' costs low. The Commission also does not consider the negative externalities that arise from unwanted calls. In view of these shortcomings and our earlier analysis of these factors, we do not believe that the regulations following from the Commission's conclusions are likely to increase economic efficiency.

CPP rates in Argentina are regulated by the government using a "retail-minus approach," whereby the CPP rate is equal to a weighted average of outbound mobile prices. Resolution 630/2002 introduced the retail-minus approach to determine the CPP rate in local currency.[59]

US, UK, and Australian regulators have relied on competitive analysis to define the market, rather than narrow tests based on demand or supply substitutability. The analysis of this report finds that in the mobile markets of most countries, MNOs compete by offering a bundle of retail services to their subscribers, including handset prices, monthly access, outgoing calls, and incoming calls. When customers choose an operator, they will recognize that a high call termination rate may require them to undertake greater efforts to internalize call externalities among related users, and will factor this into their subscription choice. Competition among providers will involve *all* elements of the bundle, not just handset prices, monthly access, and

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[58] Ministry of Production–Competition, Deregulation and Consumer Protection Secretariat–Argentine Anti-Trust Commission, Note CNDC No. 736/2002, File 064-006233/2001 (C.660), letter, 8 May 2002, at 107.

[59] Resolucion 630/2002, "Mecanismo para la Fijación del Valor de Referencia de la Terminación de Llamada en Red de Destino en la Modalidad Abonado Llamante Paga (CPP).

outgoing charges. As a result, the relevant market is *all* retail services, including MTF calls, offered by the MNO.

In addition, several other developments serve to discipline mobile operators. For example, it is reported that the incumbent local fixed network operator in Peru has offered its subscribers the ability to block FTM calls from their telephones. Also, in Latin America business subscribers with PBXs often use a scheme referred to as "*telulars*" in which FTM calls are routed through a fixed wireless loop network and presented to a mobile network as though they were mobile-to-mobile calls. The FTM call termination charge does not apply to these calls.

2.4.2 Competitiveness of Retail Markets in Latin America

This section reviews data on some common indicia of competition in Latin America: market shares and the Herfindahl-Hirschman Index (HHI)[60], rates of growth, and churn for several mobile services markets.

Because economies of scope and scale are important in the production of many telecommunications services, telecommunications markets are often highly concentrated. Nevertheless, the markets may be vigorously competitive. The market for long distance competition in the US is one relevant example. In its order approving the merger of WorldCom and MCI, the FCC stated that:

> Although there can be no dispute that the merger will increase concentration in the short run, we disagree that anticompetitive effects are likely to result. Recent market trends indicate that the long distance market has become progressively less concentrated over the past decade. Moreover, the record indicates that there will be significant increases in the amount of long distance transmission capacity over the next two years. We further conclude that, once a carrier has access to this fiber capacity, any remaining barriers to deploying this capacity in the retail long distance market are low.[61]

In a more recent analysis of the US mobile market, the FCC used measures other than HHIs to gauge the extent of competition in the mobile market:

> Some of the key metrics reported by mobile telephone operators, such as subscriber growth, average monthly usage per subscriber, and average revenue per subscriber, while not indicative of competition *per se*, demonstrate the increased demand for and reliance placed on mobile telephony services. In addition, continued downward price trends and continued expansion of mobile networks into new and existing markets are

[60] The HHI is a widely used measure of market concentration. When a single firm controls an industry, the HHI is 10,000. In a perfectly competitive market, the HHI is approximately zero. HHI's in the range of 2,000 to 5,000 are not uncommon in telecommunications markets.

[61] Order, MCI-Worldcom merger, at 36.

> related in different ways to the level of competition for mobile telephony customers. These metrics generally demonstrate a high level of competition for most consumers.[62]

Thus, there is a sound basis for examining the competitiveness of telecommunications markets in terms of several metrics, including (1) changes in the level of concentration, (2) the elasticity of supply and the expansion of networks, (3) churn, (4) and trends in the average revenue per subscriber, usage per subscriber and number of subscribers.

Data for Latin America show that

(1) concentration (as measured by the HHI) has fallen for almost all countries over the period 1997–2001 (Table 2 below),

(2) that MNOs have had sufficient capacity to grow rapidly (Table 3); and

(3) that customers have churned among MNOs at a rapid rate, indicating that firms with capacity do not face remaining barriers to entry (Table 4).

These data, taken together, do not support the view that retail markets for mobile services are characterized by a low level of competition. Trends in the average revenue per subscriber (presented subsequently in Table 6) are consistent with this view.

[62] Seventh CMRS Report, p.19.

Concentration and HHI

Table 2: Change in Concentration (HHI) for Selected Latin American Countries, 1997–2001

	1997	2001	% change
Argentina	2,618	2,522	-4%
Chile	4,069	2,866	-30%
Colombia	4,507	4,541	1%
Ecuador	5,200	5,129	-1%
Guatemala	10,000	3,027	-70%
Panama	10,000	5,132	-49%
Peru	5,890	4,949	-16%
Venezuela	5,380	4,210	-22%

Source: CRA calculation using data from *Pyramid Wireless Quarterly Forecast: Fourth Quarter 2001*. Data for Argentina provided by BellSouth International.

Table 2 shows that for the period 1997–2001, in 8 of the 9 countries for which data were available, concentration as measured by the HHI corresponding to market shares of subscriptions decreased substantially in all but two cases. The exception is Columbia, where BellSouth's share decreased from 53 percent to 41 percent while Comcel's share increased from 43 percent to 53 percent. In Columbia, the leading MNO was displaced by smaller rivals, suggesting that competition was vigorous even though the HHI increased. In sum, the evidence on changes in the HHI is not inconsistent with vigorous and increasing competition among MNOs in all nine countries.

Growth Rates

Table 3 contains information on the annual rates of growth of mobile subscribers in the period 1997–2001. The rate of growth is high, indicating the availability of sufficient capacity (and a high elasticity of supply) with the MNOs.

Table 3: Annual Growth Rate of Mobile Subscribers in Selected Latin American Countries 1997–2001

Argentina	39%
Chile	84%
Columbia	26%
Ecuador	43%
Guatemala	103%
Panama	141%
Peru	39%
Venezuela	60%

Source: CRA calculation using data from *Pyramid Wireless Quarterly Forecast: Fourth Quarter 2001.*

Churn

In the US, the FCC reports that "most carriers report churn rates between 1.5 percent and 3 percent per month. At current rates, more than 30 percent of subscribers change service providers each year."[63] Table 4 contains data on churn in Latin America. With the exception of Venezuela, churn rates in Latin America in 2001 are in the range reported for the US by the FCC.

Table 4: Annual Churn Rates in Selected Latin American Countries, 1997-2001

	1997	1998	1999	2000	2001
Argentina	15%	16%	17%	32%	33%
Chile	27%	35%	40%	44%	36%
Colombia	18%	28%	25%	23%	28%
Ecuador	15%	15%	25%	25%	26%
Guatemala	10%	10%	18%	26%	25%
Panama	8%	14%	13%	17%	27%
Peru	26%	36%	42%	45%	41%
Venezuela	18%	31%	25%	18%	18%

Source: *Pyramid Wireless Quarterly Forecast: Fourth Quarter 2001.*

[63] FCC, Seventh Annual CMRS Report, p.22.

In sum, data on market shares, growth rates and churn for several Latin American countries suggest that the markets for retail mobile services are increasingly characterized by vigorous competition. Given our analysis of economic efficiency, market definition and SMP, we conclude that the case for regulating mobile termination rates is not supported by the data.

3 DYNAMIC EFFICIENCY

The static analysis of mobile call termination charges analyzed in Section 2.3 took the communities of interest as given and described price structures that facilitated communication between related pairs of users and discouraged communication between unrelated pairs. In a dynamic context, investment in telecommunications and the structure of prices for telecommunications services can help facilitate the formation of new communities of interest, promoting important social goals. In societies with relatively low teledensity, personal communities of interest are often limited to groups who can easily communicate with one another using older methods and less efficient technologies, such as face-to-face communication (perhaps with travel) and the postal system. Business communities (the chain of supply running from raw materials to finished goods and services offered to end users) are similarly circumscribed, as easy access for many businesses is linked to a relatively small number of suppliers and customers.

Investment in a telecommunications infrastructure is a prerequisite for the evolution and expansion of the relatively small and local communities that characterize an economy with low teledensity. Communications services are used by residence subscribers to form and maintain new social relationships and maintain them, and used by business subscribers to extend their markets. The development of a modern telecommunications infrastructure can expand the web of personal relationships, and enlarge the markets in which business subscribers participate, hastening the pace of social and economic development.

Private investment in the telecommunications infrastructure is recovered through revenues generated from services offered to subscribers. The assets used to build a mobile telephone network's infrastructure (cell sites and switches) are long-lived and modular: most network elements come in minimum sizes with more capacity than necessary to meet demand in the medium term. These investment costs are typically recovered over several years, increasing the risks and uncertainties of the recovery of the investment. Some of these risks can be reduced by encouraging subscribers to join the network earlier rather than later. The increased value of the network to those who communicate with the new subscribers, and the increased calling volume can generate greater revenues for the network provider, thus facilitating the recovery of its investment in infrastructure over a shorter period.

Price structures that encourage businesses and residences to subscribe earlier than they would at cost-based prices are beneficial both because they help internalize network externalities, and because they reduce the risks of investing in infrastructure.

This network externality is not as readily internalized by individual subscribers as the positive call externalities discussed in the static analysis.[64] At the time he subscribes to a telephone network, a consumer typically incurs a nonrecurring charge, which can be quite substantial. For mobile networks, the charge includes the price of the handset. In addition, the subscriber typically pays a fixed charge per month, irrespective of usage. Even if the subscriber knows that the usage charges for calls to each person in his calling circle will be pair-wise internalized, it may be difficult to apportion the cost of nonrecurring and monthly charges among all the parties in his calling circle. The transactions costs of such multilateral sharing decisions are often higher than the corresponding costs when only two parties are involved, or when the decision maker represents a closed user group, such as the employees of a company. These transactions costs are magnified if the future communities of interest are not well defined at the time the subscription decision is made.

When the network externality is unlikely to be fully internalized by subscribers, corrective pricing can increase welfare. Under the rubric of "Universal Service Policy," regulatory authorities have attempted to correct for this market failure, and simultaneously, to promote other social goals while allowing network operators to recover their investments. The next sections address some of the implications for FTM call prices of Universal Service goals, with specific reference to countries with relatively low teledensity.

3.1 The Network Externality and Universal Service

Prior to the US Telecommunications Act of 1996, policymakers relied on implicit and explicit subsidies to promote the goal of universal service. Cross-subsidies from interstate services regulated by the FCC and intrastate services regulated by state commissions were used to promote access to basic telephone service at reasonable rates to residential consumers. The effect of these policies was to establish lower rates for residential than for business subscribers, and to keep rates in high-cost areas below the costs of serving those areas. With the passage of the 1996 Act, the US began the transition to a competitively neutral system of explicit subsidies that will allow high-cost firms to recover the forward-looking cost of providing universal service.

In the UK, Oftel has adopted different policies for advancing universal service through fixed and mobile networks. For fixed networks, Oftel relies primarily on geographically uniform pricing, a rebate to "light users," and the Contact Plus program. For mobile networks, Oftel has undertaken to calculate the optimal price structure, making an allowance for the network externality.[65] The starting point for this approach is the demand curve for subscription to the network as a function of the price of subscription. At each subscription price, the demand curve specifies the number of individuals who will subscribe to the network. At any subscription level, the height of the curve is the willingness to pay of the marginal subscriber, i.e., the marginal private benefit. Because other subscribers obtain value from both calling, and being called by, the marginal subscriber, the social benefit to all subscribers exceeds the private benefit.

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[64] See, e.g., Rohlfs, Annex A, p.3.

[65] "Oftel's Response to the Competition Commission's Letter on Externalities of 28 March," 15 April 2002.

The Rohlfs-Griffin factor[66] is one way of quantifying the social benefit of an individual's decision to subscribe to the network. It is defined as the ratio of the marginal social benefit of an additional subscriber to the marginal private benefit enjoyed by that subscriber. When there are no social benefits (i.e., existing subscribers do not expect to call or be called by a new subscriber), the Rohlfs-Griffin factor is 1. When the total social benefit to existing subscribers is equal to the private benefit of the additional subscriber, the Rohlfs-Griffin factor is 2. In its analyses, Oftel assumes that the factor is greater than 1 but less than 2. That is, the additional subscriber obtains a higher value communicating with existing subscribers than those subscribers in total obtain from communicating with him.

In the context of business subscribers, it is likely that the Rohlfs-Griffin factor will decline as penetration increases. For example, the first pizza parlor in a neighborhood that subscribes to telephone service and takes orders over the phone creates relatively large externality value for existing subscribers in a neighborhood. However, the twentieth pizza parlor to install a telephone line creates less additional value to the existing subscribers. To the extent that some subscribers (especially business subscribers) are substitutes for other subscribers, one might expect that the Rohlfs-Griffin factor will decline as penetration of telephone service increases. It follows that in economies with relatively low penetration rates (especially among businesses) telephone service will have relatively high network externalities compared with economies with high penetration rates. The network externality is therefore likely to be more important in less developed countries with low penetration rates than in developed countries, such as the UK and the US. Consequently, the Rohlfs-Griffin factor is likely to be higher in any Latin American country than it is in the UK.

The ability of networks to increase penetration through policies, such as handset subsidies is likely to promote the goal of universal service.[67] As was argued in Section 2.3.3.4, such price structures (i.e., above-cost FTM call termination rates coupled with below-cost rates for outgoing calls) are likely to increase economic efficiency in a static framework. In countries with low penetration where the external benefits of subscription are relatively high, the regulation of FTM call termination rates can decrease both static and dynamic measures of economic efficiency.

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[66] See Rohlfs Pricing Model, p.3. See also "Oftel's Response to the Competition Commission's Letter on Externalities of 28 March," 15 April 2002, pp.2,5-6.

[67] "In practice, MNOs often subsidize new subscribers. Such behavior is consistent with the exploitation of network externalities, but it can alternatively be explained on the basis of other considerations, e.g., the prospect of keeping new customers long enough to get compensatory profits from them. In any event, MNOs are doing precisely what is called for to promote economic efficiency." Rohlfs, Annex A, p.4.

3.2 Penetration Rates and Market Maturity

Almost all of the telecommunications markets in which regulation of FTM termination rates has been extensively considered are mature markets with nearly-complete fixed-line penetration and also extensive mobile penetration. In sharp contrast, in nearly all of the Latin American markets, fixed-line telephones are far less ubiquitous and the incumbent carriers are a considerable distance from providing universal service. Table 5 reports on penetration rates (the number of subscribers as a proportion of the population) for mobile services in several European and Latin American countries. In the less-extensively penetrated Latin American markets, mobile service frequently extends telephone penetration to new subscribers who do not have a fixed telephone and mobile service has continued to grow rapidly (Table 3). Unlike the situation in mature markets, where mobile service primarily provides mobility to consumers who have fixed-line service, in the Latin American markets, mobile service serves to advance the goal of universal service.

Table 5: Mobile Penetration Rates in Selected Latin American and European Countries

Latin America		Europe	
Country	**Penetration Rate [1]**	**Country**	**Penetration Rate [2]**
Argentina	20%	Austria	82%
Chile	32%	Belgium	75%
Columbia	7%	Denmark	74%
Ecuador	6%	France	58%
Guatemala	9%	Germany	35%
Nicaragua	3%	Greece	68%
Panama	20%	Ireland	73%
Peru	6%	Italy	82%
Venezuela	28%	Luxemburg	41%
		The Netherlands	70%
		Spain	62%

Sources: 1. *Pyramid Wireless Quarterly Forecast: Fourth Quarter 2001*. 2. Table 1, this report.

3.3 Low Income Subscribers and the Role of Prepaid Services

A notable feature of Latin American mobile markets is the rapid growth of prepaid services. Table 6 presents data on the number of prepaid and postpaid subscribers in several Latin American countries. In 1997, prepaid services were purchased by relatively few subscribers. By 2001, prepaid service subscriptions exceeded postpaid subscriptions in every country, often by large margins. The annual rate of growth of prepaid subscriptions from 1998 to 2001 varied from 54 percent in Peru to 230 percent in Nicaragua. In contrast, postpaid subscriptions declines in Columbia, Ecuador, Peru and Venezuela. In 2001, the majority of mobile telephone users subscribed to prepaid services, and the share of prepaid services varied from 62 percent in Argentina to 88 percent in Panama.

Table 6: Subscribers by Type of Plan, 1997-2001 (000s)

	1997	1998	1999	2000	2001
Argentina Prepaid	58	361	1,810	3,712	4,615
Argentina Postpaid	1,947	2,311	2,542	2,749	2,881
Chile Prepaid	53	306	1,334	2,459	3,787
Chile Postpaid	381	650	906	975	1,217
Colombia Prepaid	47	278	895	1,480	2,402
Colombia Postpaid	1,214	1,522	1,031	618	776
Ecuador Prepaid	61	138	221	376	608
Ecuador Postpaid	114	138	123	104	125
Guatemala Prepaid	3	39	149	426	721
Guatemala Postpaid	61	72	195	284	372
Nicaragua Prepaid	0	3	22	67	108
Nicaragua Postpaid	7	14	23	37	61
Panama Prepaid	0	22	92	274	495
Panama Postpaid	17	64	102	107	68
Peru Prepaid	136	390	645	992	1,427
Peru Postpaid	314	353	370	267	233
Venezuela Prepaid	261	735	2,422	4,226	5,818
Venezuela Postpaid	774	1,088	1,021	1,012	1,012

Source: *Pyramid Wireless Quarterly Forecast: Fourth Quarter 2001.*

A postpaid subscriber pays for service under a two-part tariff plan: a monthly rental plus a per-minute price for his or her outgoing calls. In contrast, a prepaid subscriber purchases a fixed number of minutes for a lump-sum. The per-minute price paid by a prepaid subscriber is, however, much higher than a postpaid subscriber's per-minute price.

Prepaid subscribers use mobile service mainly to receive calls because: (i) the prepaid subscriber's per-minute rates on outgoing calls are high, and (ii) prepaid services are mainly marketed to low-income subscribers and households who cannot afford to make many calls at the high per-minute rates. In contrast, postpaid subscribers generate more outbound traffic than incoming traffic and have substantially higher calling volumes. Table 7 shows that in Latin America a postpaid subscriber generates, on average, nearly four times more traffic than a prepaid subscriber.

Table 7: Monthly Minutes of Use by Subscriber

	Postpaid	Prepaid	Blended
Mexico	291	46	63
Venezuela	287	62	80
Brazil	158	67	105
Chile	190	70	100
Average	232	61	87

Source: Morgan Stanley. "The Wireless Connection - Pricing: Understanding Yields."

Under CPP, neither type of mobile subscriber pays for incoming calls. However, the MNO receives a termination fee for incoming traffic from the originating carrier. Table 8 lists the Average Revenue per User for prepaid and postpaid subscriptions in several Latin American Countries.

Table 8: Average Monthly Revenue per Subscriber in Selected Latin American Countries Prepaid vs. Postpaid Subscriptions, 1997–2001

	1997	1998	1999	2000	2001
Argentina Prepaid	$ 26.40	$ 30.36	$ 28.58	$ 24.02	$ 26.85
Argentina Postpaid	$ 79.19	$ 91.08	$ 85.73	$ 72.07	$ 53.69
Chile Prepaid	$ 26.50	$ 17.96	$ 15.32	$ 14.11	$ 14.16
Chile Postpaid	$ 55.64	$ 43.31	$ 41.75	$ 40.89	$ 41.48
Colombia Prepaid	$ 32.43	$ 19.53	$ 17.95	$ 14.29	$ 14.21
Colombia Postpaid	$ 72.96	$ 43.95	$ 38.72	$ 31.94	$ 32.88
Ecuador Prepaid	$ 22.97	$ 15.17	$ 10.40	$ 8.18	$ 10.28
Ecuador Postpaid	$ 93.31	$ 78.86	$ 62.36	$ 40.53	$ 45.16
Guatemala Prepaid	$ 31.22	$ 21.84	$ 17.95	$ 13.51	$ 12.05
Guatemala Postpaid	$ 74.78	$ 55.97	$ 50.56	$ 47.38	$ 42.40
Nicaragua Prepaid	$ 22.06	$ 21.07	$ 20.14	$ 17.42	$ 16.55
Nicaragua Postpaid	$ 62.16	$ 56.08	$ 60.11	$ 62.02	$ 64.09
Panama Prepaid	$ -	$ 57.15	$ 48.89	$ 41.79	$ 39.75
Panama Postpaid	$ 83.34	$ 75.43	$ 72.36	$ 71.88	$ 71.05
Peru Prepaid	$ 35.96	$ 25.03	$ 20.47	$ 15.94	$ 16.52
Peru Postpaid	$ 79.29	$ 59.07	$ 50.90	$ 41.76	$ 42.62
Venezuela Prepaid	$ 21.05	$ 22.40	$ 24.48	$ 29.17	$ 29.51
Venezuela Postpaid	$ 73.68	$ 78.40	$ 85.67	$ 102.10	$ 103.29

Source: *Pyramid Wireless Quarterly Forecast: Fourth Quarter 2001.*

For many low-income consumers and small businesses, prepaid mobile service provides an affordable and attractive alternative to obtaining fixed telephone service.[68] The availability of this alternative to unserved segments of the population has been achieved without government subsidies. Regulations that reduce the price of FTM calls are likely to result in price increases in the other components of mobile service, making the service less affordable for low-income households and small businesses. Higher rates for prepaid services would then impair the attainment of universal service goals. Although, in principle, governmental funding of subsidies to the target population could offset these impacts, public funding of universal service is unlikely in Latin American economies today.

[68] With Receiving Party Pays, prepaid mobile service plans would not necessarily be a low-cost means of obtaining connectivity.

4 REGULATION OF FTM CALL TERMINATION

The analysis in section 2.3 above established that high charges for FTM calls are not necessarily inefficient or "monopoly" prices. Rather, economic efficiency may require that charges for FTM calls be set above cost in order to decrease the number of unwanted calls. The above-cost price paid by a calling party will not appreciably reduce total calling (in both directions) between related parties when the retail market for mobile services is competitive because the high price of call termination will be accompanied by lower prices for the other components of mobile service. When the called and calling parties both benefit from a call (and belong to a community of interest), they have the incentive and ability to internalize call externalities. For these calls, the total calling volume in both directions is unlikely to be significantly affected by increased charges for FTM calls so long as the price for calls originated by mobile subscribers is reduced. At the same time, nuisance calls will be discouraged, increasing the welfare of mobile subscribers.

The observation that FTM prices exceed some measure of cost or that FTM prices exceed outgoing prices is not by itself sufficient to trigger the regulation of mobile call termination. Indeed, if the market for (retail) mobile services is competitive, regulations reducing or limiting the call termination charges of MNOs may be counterproductive. The regulation of MNOs' call termination charges reduces the ability of mobile subscribers to filter incoming calls, thus decreasing the attractiveness of the service and slowing the growth of the mobile market. The reduced growth of the market will delay the achievement of universal service goals, and may further reduce the incentive of operators to invest in telecommunications infrastructure at a time when the investment climate is already depressed. However, if the market for retail mobile services is not competitive, appropriate regulatory intervention can lead to more efficient outcomes. In the following sections, we analyze several approaches to regulating call termination.

4.1 RAMSEY PRICING

Ramsey prices are typically used to obtain economically efficient prices for a multiproduct monopoly whose revenues must cover its costs. A recent example of the application of Ramsey pricing to mobile services is a study by Rohlfs.[69] That study assumes that the firm provides four services: (1) subscription, (2) minutes of mobile-originated usage excluding off-net use, (3) minutes of FTM usage, and (4) minutes of mobile-originated, off-net usage. Demand curves are calibrated for each service, and *ad hoc* factors are used to account for call and network externalities. The model does not address the issue of unwanted calls.[70] By maximizing the sum of consumer and producer surplus, a Ramsey price for each service, which relates the price to the marginal cost of that service, is obtained.

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[69] Rohlfs, "Annex C: Mathematical Economic Analysis," p.1.

[70] Equations 40-43 assume that the value placed on calls by the calling party is always positive. The model assumes that the called party obtains a fraction of this value – this call externality is represented by a "factor" *en*. Annex C, pp.7-9.

We have argued that a comprehensive analysis of efficient prices must take into account both calls between related users that have value to both parties, and *also* calls that have negative value to one party. Rohlfs' model, however, recognizes only some "average" *positive* value of the call externality that is represented through several *ad hoc,* cross-elasticity adjustments and usage externality factors. This approach does not permit FTM call termination rates to perform the critical filtering function of discouraging unwanted calls with negative values to mobile subscribers, while permitting the volume of desirable calls to be sustained through commonly used internalization mechanisms. Since high FTM call termination rates serve to supplement other efforts by mobile subscribers to block unwanted calls, a model that does not account for unwanted calls is unlikely to provide an accurate account of efficient prices.[71] In such a model, a price for FTM call termination that is high relative to some measure of marginal cost but which is efficient in deterring calls with negative call externalities will incorrectly be determined to be inefficient and high, and may lead to an unwarranted finding of SMP.

Even within the limited context of private goods, the computation of Ramsey prices requires a great deal of information on both demand and costs, including demand elasticities, cross-elasticities and cost functions for all the services in question. Rohlfs relies on fourteen inputs provided by Oftel for the level of demand, prices, and parameters of the cost functions.[72] The input values are projections for 2005-2006. The model uses assumed values for 16 elasticities and cross-elasticities, a gross (network) externality factor and three (call) externality factors, and several detailed assumptions, such as the ratio of the marginal subscriber's usage to the average usage per subscriber. Despite the large number of assumptions regarding subscriber preferences, no account is taken of unwanted calls. The computation of Ramsey prices involves a significant amount of data collection, or the adoption of assumptions that seem reasonable to the modeler. The calculation of Ramsey prices is likely to be difficult and costly, and the results of the exercise will be only as reliable as the data on which they are based. To the extent that the shared nature of telephone calls (especially unwanted calls) is neglected, the resulting prices might well be less efficient than the prices produced in a competitive market for retail mobile services.

Even if Ramsey prices can be accurately calculated, they may not be appropriate in a dynamic and competitive environment. It has long been known that Ramsey prices may not be sustainable when economies of scope and scale are present.[73] That is, Ramsey prices may not be equilibrium prices in markets where competitors are free to compete for customers by offering different prices. One economist concluded that "the Ramsey rule is primarily a tool that is useful in the context of centralized planning in a well-defined industry, where competitive entry is not a serious policy question."[74] Since mobile markets are served by more than one provider, and new

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[71] For one account of the unwanted FTM calls, see "You've got my number," *The Economist*, 3 October 2002.

[72] Rohlfs Pricing Model, Tables 1-2.

[73] Faulhaber, Gerald R., "Cross-Subsidization: Pricing in Public Enterprise." *American Economic Review*, 65 (December 1975): 966–977.

[74] Sharkey, William W., *The Theory of Natural Monopoly*, Cambridge University Press, 1982, p.102.

providers may enter as additional spectrum is made available for traditional and 3G services, prices derived by the Ramsey rule may not be appropriate for mobile markets.

4.2 International Benchmarks

In setting rates for one company, regulators frequently rely on rates charged by other companies as benchmarks. Key issues in benchmarking include the selection of comparator companies and adjustments to the benchmarks to account for differences between the regulated company and its comparators. Benchmarking works best when the comparators are very similar to the regulated company, so that few adjustments are necessary.

International benchmarks obtained from developed countries are difficult to use for evaluating and setting rates in developing countries, given the differences in fundamental aspects of demand and supply across countries. Differences for which suitable adjustments are necessary include:

Differences in teledensity. Developing countries have serving areas with lower teledensity (subscribers per square mile) than developed countries. It is well known that even within a country, unit costs are higher in areas with low teledensity than in areas with high teledensity. Since unit costs are driven by the teledensity of individual serving areas (i.e., area served by a switch or cell site), adjustments for differences in teledensity should be made on the basis of teledensity in each serving area (or cell), not on the basis of national population divided by national land area. These adjustments are difficult to make.

Differences in peak/off-peak traffic ratios. Networks are typically designed to offer acceptable service during peak periods. When the offered load is more sharply peaked, the cost per unit of the traffic is higher. Differences in the peak to off-peak traffic ratio between countries should be accounted for in international comparisons. These adjustments are also difficult.

Differences in call duration. Differences in call duration across countries (including differences resulting from the use of wireless data services and the technologies used to support data services; differences in the use of vertical services, such as voice mail and conference calling; and other differences in the mix of services offered) can lead to differences in the per-minute cost of switched services across countries.

Differences in usage volume. The cost-volume elasticity of providing many telecommunications services is quite low. That is, the percentage increase in costs corresponding to a 1 percent increase in usage tends to be quite close to zero. Therefore, the unit cost of a company serving customers with lower usage is likely to be higher than the unit cost of a company serving customers with higher usage.

Differences in input prices. For mobile networks, important inputs include interconnection to fixed networks, telecommunications equipment (handsets and network equipment), capital, labor, and the costs of collection and fraud. The prices corresponding to these inputs can vary significantly from one country to another and also from one period to another. In some cases, the required data (for example, prices for major items of telecommunications equipment

purchased by telecommunications companies in developed countries) may not be publicly available. Taxes and regulations (including license fees and rollout requirements) may also vary significantly from one country to another. Adjustments for these differences are not likely to be straightforward.

While call termination rates in other countries might be easy to obtain, the adjustments required to obtain comparable rates as benchmarks are likely to be complicated, limited by the availability of necessary data, and costly to undertake.

4.3 Total Service Long Run Incremental Cost (TSLRIC)

The TSLRIC approach estimates the forward-looking economic cost of providing designated services using the most efficient technology currently available. A hypothetical network is designed from the ground up to provide the designated services. The quantity of each network element is determined using best-practice engineering rules, investments are calculated at current input prices and converted to monthly costs using economic depreciation and a forward-looking cost of capital, and operations and maintenance expenses are estimated (e.g., using the ratio of such expenses to investment for the most current vintage of equipment). Overhead costs are typically calculated as a markup to total costs.

The TSLRIC approach has most often been used to regulate the prices of wholesale services offered by incumbent fixed-network carriers to competitors. In the US, cost proxy models were built to estimate the TSLRIC of providing basic services over fixed networks, and to calculate the prices of unbundled network elements (such as local loops, switching, and transport). When the Telecommunications Act of 1996 was passed, there were at least three cost proxy models under development: the Hatfield Model, the Cost Proxy Model and the Benchmark Cost Proxy Model. Over the years, the models were refined to address criticisms and to take advantage of more powerful computational tools. In October 1998, after more than two years of intense effort by interested parties, the FCC adopted a hybrid cost proxy model that was based on two models developed by telephone companies and a third model developed by FCC staff.[75] After another year of intense effort, inputs for the FCC's TSLRIC model were selected.[76] The effort to implement the TSLRIC approach was enormously expensive and only partly successful – only the networks of the larger local carriers were modeled, omitting the networks of the smaller local carriers (of which there are more than 1,300).

While significant effort has been devoted to developing TSLRIC models of fixed networks, modeling of mobile networks is far less advanced. In the US, at least one attempt to produce a TSLRIC model of wireless networks was undertaken, but has since apparently been abandoned.[77]

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[75] FCC, *In the Matter of Federal-State Joint Board Universal Service*, CC Docket 96-45, Fifth Report & Order, released 28 October 1998.

[76] FCC, *In the Matter of Federal-State Joint Board Universal Service*, CC Docket 96-45, Tenth Report & Order, released 2 November 1999.

[77] HAI Consulting, Inc., Wireless Model, Version 4.0 Documentation, prepared for Western Wireless Corporation.

SprintPCS has submitted a proprietary network model in state proceedings.[78] Unlike the models of fixed networks, which use engineering economics to determine the optimal network configuration, the SprintPCS model was based on the network that was actually deployed. Since the network had been in existence for only a few years, the deployed network was arguably a close approximation to the hypothetical network required in a TSLRIC study.

In the UK, Oftel commissioned a consultant to develop its LRIC model of the mobile sector, based on the fixed-network model developed for Oftel earlier. Oftel established an industry/regulatory working group in June 2000 to test the robustness of the model. Following publication in February 2001 of its consultation document on the model, a year of consultation with industry ensued. Oftel responded to 80 industry-submitted criticisms of the amended model in July 2002. The Analysys/Oftel model is considerably less complex than the US models of fixed networks—its treatment of customer locations, for example, is quite rudimentary when compared with the detailed geo-coded data used in US models of fixed networks.[79]

TSLRIC modeling of mobile networks raises important issues that have not arisen in models developed for fixed networks—the treatment of the costs of marketing activities and spectrum resources. Unlike incumbent fixed-network operators, mobile operators face several vigorous direct competitors in most national markets. Marketing expenditures, product differentiation, and price structure competition are critically important factors affecting the costs of an efficient operator. Customer acquisition costs, including handset subsidies, must be recovered rapidly in the face of high "churn."

Long-run costs in a mobile network will also include spectrum costs. The capacity of the network can be expanded directly by using additional spectrum to provide more channels. Alternatively, to some degree, capacity can be increased through cell-splitting, sectorization, and more efficient access technologies. These alternatives incur higher infrastructure costs that indicate the opportunity cost of available spectrum.

The effort and expense required to produce a reliable TSLRIC model are very substantial, and the expertise required to produce and update such a model is not always available to carriers or to regulators. In the US and the UK, the use of outside consultants with the required expertise has been the rule. In the absence of a clear showing that alternative "light-handed" regulations (such as price caps) are insufficient to address problems identified by the regulator, the expense and effort of producing dueling TSLRIC studies may not be justified.

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[78] A broad description of the cost methodology used by the model can be found in Mitchell, Bridger and Padmanabhan Srinagesh, "Transport And Termination Costs In PCS Networks: An Economic Analysis," 4 April 2000. The model itself is not publicly available.

[79] The FCC's Hybrid Cost Proxy Model is described in some detail in: Bush, C. A., D. M. Kennet, J. Prisbrey, W. W. Sharkey (FCC) and Vaikunth Gupta (Panum Telecom, LLC), "Computer Modeling of the Local Telephone Network," October 1999.

4.4 Price Caps

Price caps have been used, and continue to be used, to regulate the prices of monopoly telecommunications services. Two important components of a traditional price cap are the initial level of the cap and the "X-factor," which represents the expected increase in productivity and the rate at which prices are required to fall over time. Other components include the definitions of baskets (each of which is separately subject to the cap), the inflation rate, the sharing of rules that apply if the realized rate of return falls outside an established range, and the treatment of exogenous cost changes. The effort required to determine each element of a comprehensive price cap can be quite substantial, and may be hard to justify in the absence of a clear showing that market power is being abused.

Recently, a less-intrusive form of price cap has been used to regulate mobile call termination rates in Australia. MNOs were required to set their charges for call termination equal to the lowest rate then in effect, and then to reduce that charge at the same rate as other prices for mobile services. In Argentina, Resolution 630/2002 introduced the CPP rate adjustment mechanism which caps the CPP rate using a weighted average of outbound mobile prices.

While this form of price cap is administratively simpler than the traditional price cap, it is not without its cost. The analysis in section 2.3 suggests that if the number of unwanted calls to mobile telephones grows rapidly, mobile subscribers might benefit from an increase in the FTM call termination rate balanced by a decline in the other rates they pay. The Australian form of the price cap might rule out such an adjustment to the price structure.

4.5 Top-Down Modeling

Top-down models are used to estimate the costs of individual services sold by a firm. First, costs that can be allocated uniquely to a service (or subset of services) are allocated to that service (or subset of services). Next, costs that are shared among services are allocated to them using an allocation factor, such as direct cost, revenue, or output. In many jurisdictions, top-down models were used to set regulated prices that allowed the firm to recover its booked costs and a fair rate of return on its asset base. This form of regulation has been replaced by price caps (or incentive regulation) in many jurisdictions because it did not offer the firm sufficient incentives to reduce cost, improve service, or innovate.

For regulated firms that book their costs in accordance with prescribed accounting rules (such as the Uniform System of Accounts in the US), the development of service-specific costs is time-consuming, arbitrary, and costly, and prices based on these calculated costs are not economically efficient from either a static or a dynamic viewpoint. For unregulated multinational firms, the need to allocate costs across markets in different countries raises additional complications.

4.6 Summary

If, in the context of Latin American mobile telephone markets, it is determined that the mobile sector is not sufficiently competitive and that price regulation is necessary, then the most attractive mechanism would be a price cap that preserves sufficient flexibility for setting MTF

call termination rates. Other forms of regulations, such as Ramsey pricing, TSLRIC-based rates, top-down models, and international pricing benchmarks, are less desirable alternatives that require extensive amounts of information, can be costly to implement, and are subject to considerable uncertainty.

APPENDIX A—SUMMARY OF EUROPEAN UNION REGULATORY FRAMEWORK

The European Union recommendations and directives to national regulatory authorities (NRAs)[80] indicate that interconnection and terminating access rates should be cost based. Long-run average incremental costs should be used to assess tariffs for terminating access.[81] Also, charges for interconnection should be based on a price "closely linked" to long-run incremental cost.[82]

The following summary of the regulation of FTM termination rates is taken from the European Union's most recent Implementation Report. [83] The NRA of each member country generally distinguishes between an operator with significant market power (SMP) and other operators.

AUSTRIA

In June 2001, the penetration rate for mobile services was nearly 82 percent. There are currently four mobile operators offering services on their own network. The Austrian regulator (RTR) was one of the first authorities to impose cost-based mobile termination rates on MNOs, but has recently stepped back from that determination. The costs of an efficient network operator were calculated using a bottom-up LRIC methodology. This bottom-up model was calibrated using top-down cost information submitted by the regulated MNO, Mobilkom. All operators, including new entrants, have been subject to charge controls, calculated using different parameters depending on the size of each operator.

After the NRA's intervention in FTM tariffs by regulating charges either on the basis of cost-orientation (for SMP operators) or "appropriateness" (for non-SMP operators), prices have fallen significantly and became some of the lowest in the EU. In 2001, the NRA removed the designation of mobile network as having significant market power in either the interconnection or mobile markets, and determined new and different interconnection charges for *Mobilkom Austria* and *max.mobil* on the basis only of "appropriateness." Consequently, the incumbent's mobile subsidiary no longer needs to apply the principle of cost-orientation. Tariffs for FTM call termination have been highly disputed.

BELGIUM

The Belgian regulator (BIPT) currently sets mobile termination charges based on benchmarking information in order to proxy cost orientation, and has stated an intention to continue to do so in the foreseeable future.

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[80] European Union, Seventh Implementation Report, Annex 3, at http://www.europa.eu.int/information_society/topics/telecoms/implementation/annual_report/7report/documents/finalannex2.pdf.

[81] *Recommendation 98/195/EC*, 8 January 1998, Annex 3, at http://europa.eu.int/abc/off/index_en.htm.

[82] *Directive 97/33/EC of the European Parliament and Council*, 30 June 1997, recital 10, at http://europa.eu.int/abc/off/index_en.htm.

[83] European Union, Seventh Implementation Report, Annex 3, at http://www.europa.eu.int/information_society/topics/telecoms/implementation/annual_report/7report/documents/finalannex2.pdf.

The incumbent fixed-network operator, Belgacom, charges retention rates for FTM calls that are significantly higher than its equivalent termination rates. The NRA is currently in discussions with Belgacom in order to review those retention rates.

DENMARK

No mobile network operator has been designated as having SMP on the national market for interconnection, and there is no requirement for cost orientation of these charges.

FINLAND

In April 2001, the NRA reported the results of its investigation of Sonera's mobile interconnection charges, which were found not to be cost oriented. Even though Sonera has appealed this decision, it has reduced its access charges by some 12 percent and FTM termination charges by 20 percent (these are average figures). The NRA is also investigating the interconnection charges of Radiolinja, the second mobile operator with SMP. During this investigation, Radiolinja has reduced its termination charges by around 20 percent.

The new entrants are particularly concerned that the absence of an obligation for mobile operators with SMP to offer fixed operators an interconnection tariff for call termination on mobile networks (as opposed to charging an end-user price) is a major barrier to competition. They further claim that the end-user price system perpetuates high mobile call termination charges, as the mobile operators have no incentive to reduce the end-user charges that will ultimately be paid by the customers of the fixed operators who originate the calls. Service providers stress that they should be able to buy call origination and termination services at wholesale interconnection prices from any fixed and mobile operator.

The Finnish authorities claim that the end-user charge regime is sound because each operator only prices that part of the service that it actually provides, and that consumers benefit from this transparency. They also note that the argument that mobile operators have no incentive to reduce prices is not valid, given that in many households, there is both a fixed and mobile telephone connection and that users look for packages with low FTM charges.

FRANCE

In mobile telephony, market penetration and traffic have continued to grow impressively. By the end of September 2001, the penetration rate for mobile was 57.6 percent of the population, which brings France closer to the EU average. For the first time the number of active mobile lines exceeds the number of fixed lines.

The French regulator (ART) has chosen to cap FTM call termination rates by means of a step-by-step reduction in average termination rates of 15 percent in March 2002, 15 percent in 2003, and 12.5 percent in 2004.

There have been problems in the mobile sector (is one of the following supposed to be deleted?) with regard to tariffs, with continuing difficulties in bringing about FTM call termination rates that are perceived as equitable by new entrants. The new France Telecom cost-accounting system

is in place, and it is hoped that the data available from the new system will be used in developing regulated tariffs for mobile call termination.

GERMANY

RegTP does not regulate mobile termination rates. Indeed, no mobile operator has been notified as having significant market power.

GREECE

The regulator, EETT, is planning to review call termination charges in mobile networks. OTE is the only operator designated as having significant market power. In a recent study on SMP, the EETT concluded that no mobile operator has significant market power in the national market for interconnection.

IRELAND

According to the new determination, operators with SMP are: Eircom in the fixed public telecommunications networks and services and leased lines services markets; Eircell & ESAT Digifone in the market for public mobile telecommunications networks and services; and Eircell & ESAT Digifone in the national market for interconnection. These last designations require the mobile operators to offer cost-based interconnection charges.

In the context of mobile telecommunications in Ireland, the national regulator (ODTR) plans to issue a consultation paper seeking the opinions of interested parties as to mobile accounting separation and costing methodologies for call termination interconnection services on mobile telecommunication networks.

All mobile operators with SMP on the mobile market are obliged to negotiate interconnection with appropriately qualified organizations, and operators designated as having SMP on the national market for interconnection are obliged to apply cost-oriented methodology to interconnection rates. Similar provisions apply also for Mobile Virtual Network Operators (MVNOs) since they also require interconnection, although a form of roaming might be necessary since MVNOs must have access to the mobile network air interface.

ITALY

Mobile termination rates are still among the highest in the EU, and they are the cause of disagreement between fixed operators and their subscribers on the one hand and mobile operators on the other.

In the first part of 2001, the mobile operators determined to possess SMP in the national interconnection market reduced their termination rates by 4.2 percent, to a maximum average of €0.178 per minute, below the upper benchmark set by the NRA. New entrants in the fixed market claim that retail prices for on-net mobile calls are much lower than termination rates of calls coming from fixed networks. Moreover, in their view, the Italian mobile termination rates are higher than those of most EU countries. Users have complained about the failure to observe the principle of cost-orientation. Flat rate pricing plans for fixed-to-fixed calls have per-call rates that are 10 times lower than from the corresponding rate for FTM calls. The mobile operators contend that the competitive model set by the NRA has been delivering positive results since the main mobile operators have reduced their termination tariffs. However, the fixed operators have not used the reduction in mobile termination rates to reduce the prices to their fixed-line customers.

LUXEMBOURG

There are two operators offering mobile services, one of them being the incumbent. The mobile penetration rate reached 41 percent at the end of 2000.

THE NETHERLANDS

The relatively high mobile call-termination tariffs in the Netherlands affect the competitive market position of fixed network operators and have resulted in relatively high list prices for FTM calls. New entrants in the fixed market also complain that integrated fixed/mobile operators still make bundled offers to business customers which cannot be matched by fixed operators who cannot easily provide discounts on FTM termination charges.

The regulator, OPTA, is still considering to designate operators with SMP on the national market for interconnection. Fixed entrants request that the SMP designation(s) be accompanied by the obligation to lower the mobile termination tariffs of the SMP operators with immediate effect, together with parallel action regarding non-SMP operators. In June 2000, KPN mobile decreased its FTM termination rates. Given that the other mobile operators did not follow this trend, KPN mobile increased the tariffs again after four months, but kept them 17 percent lower than those of its competitors. KPN mobile has recently filed a request for dispute resolution with OPTA regarding one of the other (non-SMP) mobile operators charging significantly higher termination rates. KPN mobile argues that the principle of reciprocity should apply as should the principle of reasonable tariffs. OPTA has not yet ruled on this dispute.

PORTUGAL

Three operators were declared as having significant market power in August 2000: PT (domestic interconnection, fixed telephone networks and/or services, leased lines); TMN, a mobile subsidiary of PT; and Telecel-Vodafone (which provides mobile telephone networks and services).

As a whole, Portugal's mobile tariffs are considered competitive, because MTF calls are relatively cheap. However, FTM termination charges remain among the highest in the EU, despite the regulator's (ICP's) intervention in 2000. New discussions, which might lead to a 20 percent to 25 percent cut in termination rates, are under way between the ICP and mobile operators. On the one hand, mobile operators explain that these cuts would have a negative impact on their business development and insist that the overall prices are in line with the European average. On the other hand, ICP has taken the position that mobile termination prices do not reflect cost and advocates a tariff "rebalancing" between MTF and FTM calls. At one time, "on-net" and "off-net" calls (i.e., calls to PT's network and to OLO's networks) were tariffed differently: it was up to three times more expensive to call a competitor's subscriber. This was due to the fact that operators had chosen different rates of interconnection, leading to different prices and creating a lack of transparency for the consumers. ICP made four consecutive decisions from September 2000 onward to resolve the differences, but changes were implemented slowly. PT customers are now being retroactively refunded the extra amount they were unduly charged.

SPAIN

Telefónica Móviles and Airtel-Vodafone have been designated as having significant market power in the mobile telephony market and the national market for interconnection. These operators presented their cost accounts to the regulator at the end of April 2001. The CMT is working on a cost model that was expected to be finalized by the end of 2002.

Telefónica is concerned about the strictness of the obligations imposed on the mobile operators. It stresses that mobile termination prices are subject to double regulation , in that mobile operators with SMP must comply with the cost orientation requirement, but at the same time, its FTM calls are subject to a price cap. The following price decreases for mobile call termination are foreseen in this framework: 13 percent in 2001 and 13 percent in 2002.

The new entrants, on their part, consider that the mobile termination prices are excessive and expect them to decrease substantially after the CMT has scrutinized the cost accounts of mobile operators with SMP.

SWEDEN

Because the incumbent has significant market power in the Swedish interconnection market, the NRA determined that all its interconnection charges should be cost-oriented (including charges for FTM calls). After examining the most recent cost-accounting information available, in May 2000, the regulator required the incumbent to lower mobile interconnection charges to what the

regulator considered to be a cost-oriented interconnection charge. Both parties appealed this ruling, and in the interim, the proposed new interconnection charges could not be applied.

The interconnection charges of other mobile operators are not subject to control by the NRA. The NRA assesses whether the level of compensation demanded by the new entrant is reasonable. In August 2000, in an interconnection dispute between the incumbent and a large new entrant, the regulator decided that the new entrant's mobile call termination rate was unreasonable and considered that a reasonable compensation would be 10 percent higher than the cost-oriented price. This PTS decision has also been appealed.

APPENDIX B—ECONOMIC THEORY OF CALL TERMINATION

The economic theory of the market for mobile telephone service can be helpful in understanding the structure of economically efficient prices for the services provided by mobile operators. The theory provides an analytical basis for comparing the outcome in unregulated markets and the outcome under ideal regulation under very specific simplifying assumptions. The articles relied on by regulatory authorities (especially by Oftel in the UK), are overly simple, however, and their results are not directly applicable in more realistic circumstances. As shown in section 2.3, efficient pricing should account for the ability of related users to internalize prices, and for the fact that many calls generate negative benefits for the called party. When these factors are considered, efficient price structures are very different from the cost-based prices that result from the standard approach. Specifically, the standard approach suggests that (absent network externalities) prices above marginal cost reduce economic efficiency, whereas an analysis that accounts for both positive and negative externalities and the ability of subscribers to internalize positive externalities suggests that mobile call termination prices above marginal cost can increase economic efficiency.

This appendix provides a brief overview of the relevant theoretical papers and identifies several important shortcomings of these articles.

ARMSTRONG, M. "CALL TERMINATION ON MOBILE NETWORKS."

A benchmark model and extensions of that benchmark were developed for Oftel by its consultant, Mark Armstrong.[84] The principal assumptions of the benchmark model are that mobile subscribers gain no utility from receiving calls, and that mobile subscribers do not care about the welfare of fixed subscribers who calls them (Assumptions 2 and 3 of the model). Calling Party Pays (CPP) applies, and that consumers have identical preferences. Also, there is no network externality – subscribers gain no utility when new customers are added to a network. The mobile sector is competitive, earning zero economic profits. There are no mobile-to-mobile calls, so all calls are off-net, either MTF or FTM. The price of FTM calls is regulated at the perceived cost of termination.

On these assumptions, the welfare-optimal rate structure is marginal-cost pricing for each mobile service: subscription, call origination, and call termination. Absent regulation, each mobile carrier has market power over call termination. It therefore sets the call termination charge ("access charge") at the monopoly-price level, the price that maximizes net revenue from termination charges.

Competition for subscribers causes mobile carriers to set call origination charges at marginal cost of call origination, and to set subscription/handset charges sufficiently below cost that each mobile carrier earns zero profits. Thus, the unregulated outcome is a distortion of the welfare-optimal rate structure, with excessive termination charges and subsidized subscription/handset charges. As a result, the mobile sector is too large, and this expansion is funded by high FTM charges.

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[84] Armstrong, Mark, "Call Termination on Mobile Networks," 11 April 2002, at http://www.oftel.gov.uk/publications/mobile/ctm_2002/armstrong110402.pdf.

From this basic model, the effects of alternatives to the principal assumptions are as follows:

- If there are network externalities, so that consumers gain utility from a larger network, it is optimal to set the termination charge above marginal cost, but below the monopoly price, and to set the subscription charge below marginal cost in order to subsidize mobile subscriptions and increase the size of mobile networks.
- If there are positive call externalities, but no network externalities, so that mobile subscribers value receiving calls, the termination charge should be reduced and set *below* marginal cost to encourage more fixed-mobile calls.
- If calls to a mobile phone and calls to a fixed-line phone are partial substitutes, then a mobile termination charge above costs will increase demand for fixed-to-fixed service. If this increases the profit of the fixed carrier, then a mobile termination charge above cost is optimal.
- If caller welfare is fully internalized by mobile subscribers and there are no network externalities, mobile carriers will set price equal to marginal cost for each rate element.

The major shortcomings of the Armstrong model are as follows:

- The benchmark model and all its extensions assume that mobile subscribers do not value calls from fixed subscribers. Mobile subscribers have no incentive to continue participating in calls from fixed subscribers, and will terminate the calls as soon as possible. The model does not allow for this behavior, even though it follows logically from the assumptions. Indeed, given the assumptions of the model it is not clear that the market for FTM calls would even exist. The model is, therefore, particularly ill-suited to analyze the regulation of FTM calls.
- The model does not explicitly consider the shared nature of calls or the possibility of internalization, ignoring important factors that determine efficient prices.
- The model does not address the issue of unwanted calls, even though several countries have found these calls to be of considerable importance in formulating public policy, laws, and regulations.

GANS, J. AND S. KING. "USING 'BILL AND KEEP' INTERCONNECT ARRANGEMENTS TO SOFTEN NETWORK COMPETITION."

Some further theoretical results regarding the competitive behavior of mobile carriers are provided by Gans and King.[85] Unlike Armstrong, they allow for on-net (mobile-to-mobile) calling, and allow for reverse-direction substitution. Like Armstrong, they assume that mobile subscribers obtain no utility from receiving calls.

Gans and King assume that (fixed-line) consumers are ignorant of the price of calling a subscriber of any particular mobile carrier, and thus their demand for calls to mobile subscribers depends only on the average termination price. Generally speaking, when mobile carriers do not

[85] Gans, J. and S. King. "Using 'Bill and Keep' Interconnect Arrangements to Soften Network Competition." *Economic Letters*, 71(3), 413-420.

have unique dialing codes or if number portability has been implemented, callers will be unable to determine, from the telephone number alone, the identity of the terminating network. On these assumptions, an increase in one mobile carrier's fixed-mobile termination charge has only a diluted effect on the average termination charge. The competitive termination rate is then *above* the monopoly price, and the less concentrated the mobile sector, the higher the termination price. Mobile carriers could therefore increase joint profits if a suitably coordinated common termination price were set.

Mobile networks may use low *mobile-to-mobile* termination charges to soften price competition for mobile service. In particular, a 'bill and keep' arrangement between mobile networks exposes a carrier to the (incremental?) costs of terminating mobile-to-mobile traffic, and hence softens competition on the subscription price.

The paper does not treat telephone calls as shared goods, and it does not examine the effect of unwanted calls on efficient prices. The model also ignores the observation that most subscribers have fairly small calling communities, and are therefore more likely to observe the average price of FTM calls to the cellular customers they call. If many of these calls are to subscribers served by the same network, the average FTM prices observed by fixed subscribers are likely to be close to the price charged by that network, blunting the "averaging" effect at the heart of the model. For all these reasons, the model is of limited relevance to the analysis of regulating call termination on mobile networks.

WRIGHT, J. "ACCESS PRICING UNDER COMPETITION: AN APPLICATION TO CELLULAR NETWORKS."

Wright assumes that callers know the price of calling and that fixed networks charge the same price to call any cellular network. Calls generate utility only to the caller. Firms offer a differentiated-product, competing on features as well as on price.

Cellular termination is not a bottleneck in the usual sense—firms compete for cellular subscribers (lowering subscription prices) in order to offer termination service. When penetration is less than 100 percent, a cellular firm does not (fully) take into account the network externality of an increase in subscribers. Therefore, a subsidy of cellular subscription through above-cost, fixed-mobile termination can increase efficiency.

Without coordination among cellular carriers of their termination charges, competition leads to a game of escalating termination charges; each carrier seeks higher termination charges in order to lower subscription price and increase market share. With partial cellular penetration, optimal termination charges are two to five times the termination cost in a model calibrated with a plausible values for a range of parameters. Benefits to cellular customers of lower rentals can outweigh the loss in surplus to fixed network subscribers. As penetration approaches 100 percent, optimal termination charges fall to cost. The model is consistent with high mobile terminating charges in Latin America where mobile penetration rates are low.

If the industry consisted of an integrated (fixed-network and cellular-network) operator with monopoly pricing power over the FTM price, the optimal cellular termination rate would be higher. Competition in the mobile sector therefore reduces mobile termination rates.

If the called party's utility from receiving calls (not modeled by Wright) were included, and internalization were ignored, the model would provide lower FTM termination charges. However, the consideration of unwanted calls would tend to increase mobile termination rates.

ROHLFS, J. "NETWORK EXTERNALITIES AND THEIR INTERNALIZATION WITH RESPECT TO THE UK MOBILE MARKET NETWORK," ANNEX A.

Rohlfs provides a computable model of welfare-optimal mobile termination rates.[86] The model considers four goods: number of mobile subscriptions, minutes of mobile-originated usage excluding off-net calls, minutes of FTM usage, and minutes of mobile-originated off-net usage. Demand functions for each good include cross-elasticities and allow for the effects of network and call externalities. The demand functions are calibrated to be consistent with stylized data on demand. Traditional measures of consumer surplus are obtained for the calibrated demand functions. The cost function is assumed to consist of a constant incremental cost for each service, and a fixed cost is included to account for economies of scope and scale. The cost function is calibrated to fit estimates of the fixed and incremental costs provided by Oftel. Network and call externalities that were not captured by cross-elasticities are accounted for using "externality factors."

Based on simulations of the model with linear demand curves, Rohlfs concludes that "the welfare loss associated with unregulated charges compared with Ramsey pricing is about £303 million per quarter."[87]

The limitations of this model are extensively discussed in Section 4.1 of this report.

[86] Rohlfs, Jeffrey H., "Annex A: Network Externalities and their Internalization with respect to the UK Mobile Market Network", 19 April 2002.

[87] Rohlf, Pricing Model, p.20.