Assessing the impact of lowering mobile termination rates

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Purpose of the report

There has been significant recent interest in the possibility of a drastic reduction in the level of mobile termination rates (MTRs) for interconnection of calls between mobile operators, as a means of achieving lower prices and higher usage of mobile services in Europe. This consideration is motivated by the US market experience, where mobile subscribers consume significantly higher levels of minutes compared to European subscribers, and where the interconnection mechanism between mobile operators involves low MTRs.[1] The EC has published recently a recommendation on the appropriate methodology for the setting of mobile termination rates, which also proposes that interconnection rates between mobile operators should be reduced drastically.

In this context, a group of European operators (Deutsche Telekom, Orange, Telecom Italia, Telefónica and Vodafone), have commissioned Frontier Economics to examine the merits of moving to a system of very low mobile interconnection payments (2 and 1 € cents per minute). This report provides our assessment of the impact of moving to such a system. In particular, we:

○ Review what economic theory says about the relationship between MTRs and mobile retail prices and the efficient level of MTRs.

○ Develop a simulation model to assess, based on the theory above, the impact on consumers' welfare of setting very low MTRs.

○ Study the performance of the US mobile market, examining a series of key indicators affecting consumer welfare, in order to know whether US customers are better off than their European counterparts.

We also comment on the recent EU draft recommendation on the appropriate approach to the setting of MTRs, as one way to set inefficiently low MTRs is by underestimating the costs of termination.

Lower MTRs do not imply lower prices

The economic analysis shows that it is flawed to assume that lower mobile termination rates will automatically lead to lower overall retail prices and to higher consumer welfare.

The tariffs in the mobile sector include call prices, connection charges, handset subsidies, and monthly rentals. In this context, reductions in MTRs will lower call prices but other tariffs are expected to increase, (e.g. subscription charges). The reduction in MTRs will not allow operators to recover their costs, unless some retail prices are increased.

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[1]   MTRs are generally on a bill and keep basis for mobile to mobile interconnection, and at the level of fixed termination rates for fixed to mobile calls (see Markus 2004).

This "waterbed effect", as predicted by the economic theory, has been acknowledged by Ofcom and other regulators. Recently it has also been confirmed empirically. Genakos and Valletti (2008) found for a set of 24 countries, all European with the exception of New Zealand, Australia, Japan and Turkey that this effect exists and is strong, although is not full[2]. In particular they find that 10% reduction in MTRs leads to 10% increase in mobile retail prices. Therefore, policy makers should not assume that the lower MTRs the better for consumers, in particular when the MTR level is set below costs.

There is no market evidence indicating that below costs MTRs are economically efficient

There is a level of MTRs which maximizes market efficiency and welfare and should inform the regulatory decision regarding termination rates. The general economic result is that cost-oriented termination rates maximize efficiency. Departures from this standard are justified on the presence of network and call externalities.

The EC draft recommendation justifies below costs termination rates on the existence of call externalities and ignores the existence of network externalities. Economic theory indicates that in the presence of call externalities market efficiency requires both parties to be charged, in other words, the introduction of RPP (Receiving Party Pays). To achieve this pricing structure in the retail market, MTRs should be set below costs.[3]

There is no public market evidence showing that call externalities are large, in fact, indirect evidence points to the contrary. A study by Ofcom in 2005 showed that in their decision on network subscription, only 2% of respondents considered the price of others to call them in their choice of the network. This evidence suggests a low call externality. Also, as calls do not take place in isolation but form part of a communication process in which callers and receivers interact repeatedly, call externalities may be totally or partially internalized through call reciprocity between the parties. In addition, charging for receiving calls could give rise to other problems, such as undesirable calls and SPAM which would increase the time when mobile phones are switched off, reducing thus the welfare of consumers.[4] These problems are not hypothetical: customers in the US have recently filed a lawsuit against mobile carriers for the imposition of charges for unsolicited messages.

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[2]   The authors find that a reduction in MTRs also reduce profits, "thus mobile firms suffer from cuts in termination rates" (Source: Genakos and Valletti (2008))

[3]   Reciprocally the existence of network externalities call for above cost termination prices.

[4]   The words *welfare* and *surplus*, when referred to consumers and subscribers are used interchangeably throughout the document.

The reduction in consumer welfare of drastically reducing MTRs can be substantial

We have quantified the impact on consumers of drastically reducing MTRs to 2 and 1 € cents. The quantification is based on a model of competition between mobile operators used in most of the economic literature on this subject. This model assumes that operators compete for their share of the customer base by offering prices intended to maximize the value that consumers obtain from using mobile telephony. Thus, the results we report do not depend on competition between operators being weak.

Without charging for incoming calls (i.e. under CPP) in the more realistic scenario of low call externalities, the loss in consumers welfare of reducing MTRs to 2 € cents is 11% in Western European (WE) countries and 10% in Central and Eastern European countries (CEE). This loss comes from a reduction in penetration (9% reduction in either area, which represents around 42 and 10 million subscribers in WE and CEE countries, respectively) following the price increase in the fixed subscription charges in order to recover the losses made on calls (the waterbed effect). Even in the unlikely case of high call externalities consumers' welfare would also be reduced.

Assuming charges for incoming calls (i.e. RPP is introduced) the results are more dependant on the assumptions of the size of call externalities. In what we consider the more likely case of relatively low call externalities, losses in consumers' welfare could be as high as 45% for WE and CEE countries when MTRs are reduced to 2€ cents.

It is important to note that, in general, the reduction in MTRs will increase the minutes of usage[5] however the welfare of consumers is reduced following two effects: the increase in subscription charges under CPP (the waterbed effect) and the charges for incoming calls in an RPP system, which will increase as the MTRs are reduced, lowering the value for customers of mobile telephony and hence, penetration. Thus, by drastically reducing MTRs, actual subscribers would generally tend to speak more but there will be fewer subscribers. This is exactly the situation in the US.

The evidence used to support the interconnection model in the US is flawed

It is sometimes argued that the US mobile market truly reflects the benefits accruing to consumers from low MTRs. Thus, advocates of the US model stress that customers enjoy lower retail prices and more minutes of use, without any significant negative impact on penetration.

We find that this analysis is too simplistic to be used in drawing inferences for regulatory policy. It also fails to address the key question: the extent to which consumers are overall better off under the US system.

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[5]   We find that a reduction in MTRs reduce the traffic per user only when reception charges and low call externalities are assumed.

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Lower penetration and coverage in the US reduces the welfare of consumers, and is often ignored or underweighted

Penetration in the US is 85%, significantly lower that in Europe, with examples of rates well above 100% in Spain, Germany, the UK or Latvia, even after controlling for inactive subscribers (i.e. those having but not using a SIM card). US penetration levels applied to Europe would imply 154 million less of mobile phones, which would reduce significantly European consumers' welfare. This lower penetration is confirmed by other sources, including consumers' surveys, reflecting that in the US 25% of households do not have a mobile phone being the figure in Europe much lower (17%). In fact, for the EU-27 countries, only Romania and Bulgaria are behind the US levels. Eventually, if in the long term US reaches similar penetration levels than in Europe, customers are also harmed by the 3-4 years delay in service adoption (see next figure).
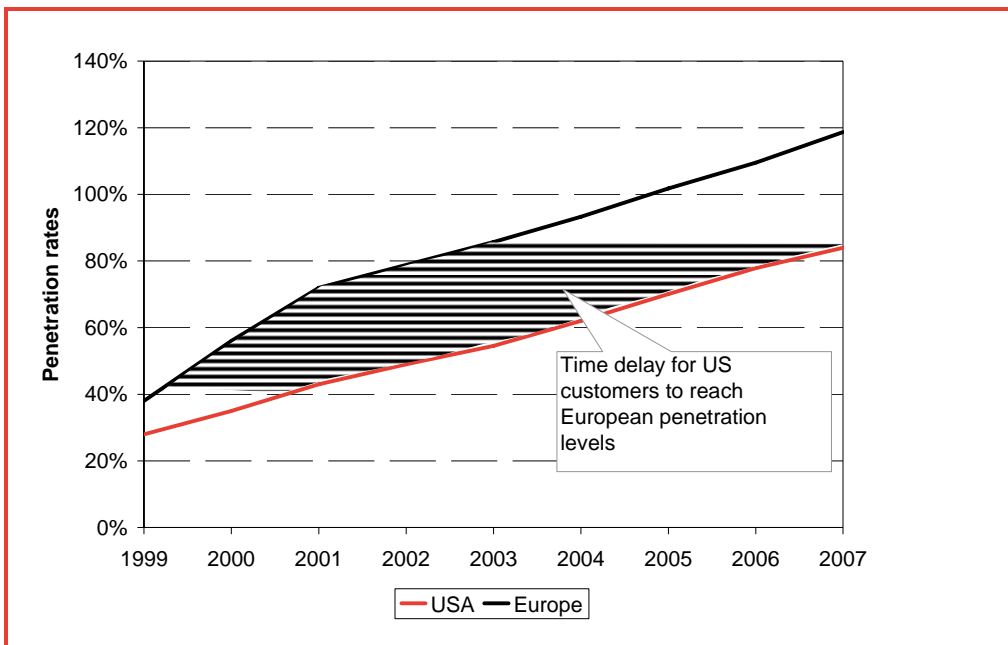
Figure 1: Evolution in penetration (US vs. Europe)

Source: Global Wireless Matrix, Merrill Lynch, 4Q 07

The same is true of population and geographic coverage levels as shown in the next figure. The gap in coverage occurs even when US wireless operators received in 2007 $1.18 billion to provide the service in high costs areas. The difference in geographic coverage may be reflecting that population density is lower in the US than in the EU, however:

- it is in less populated and remote areas where the utility of mobile telephony is likely to be high, as it allows people living or travelling through these areas, to be contactable; and

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- these remote areas are less developed economically, so lower coverage would also reflect that mobile service offers in the US are targeted to high usage consumers, who possibly are not located there.

Evidence from Sweden supports this point: it has lower population density and yet significantly higher population and geographic coverage than the US.
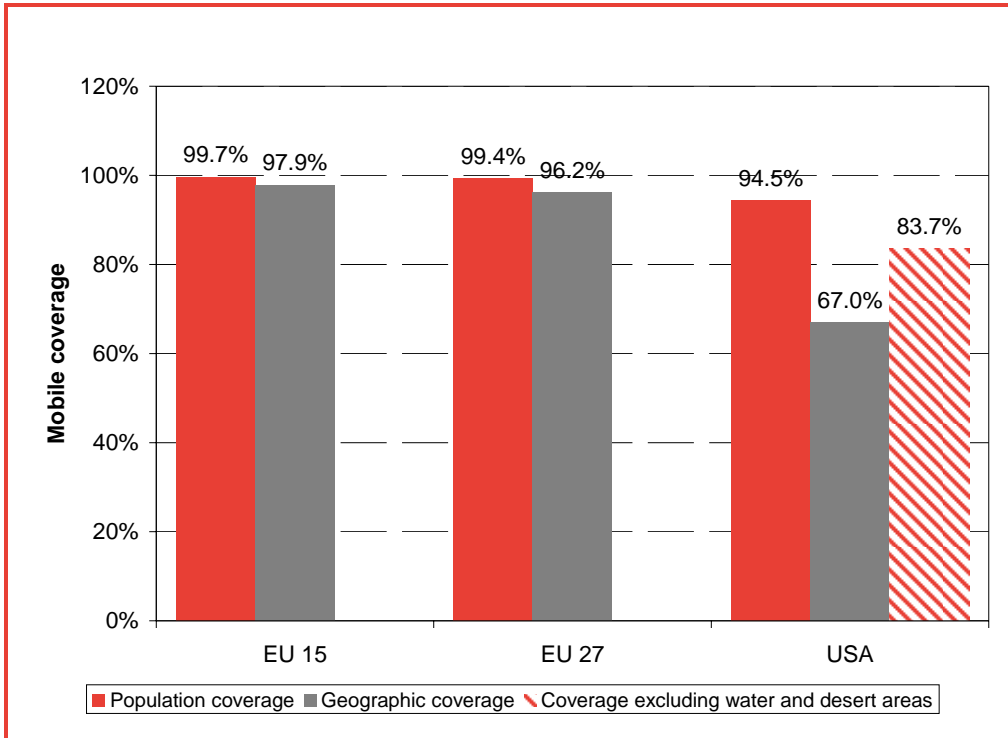
Figure 2: Population and geographic coverage in the US

Source: GSM Association and FCC

Higher usage and lower prices do not imply that US customers are better off than their European counterparts, as their monthly expenditure is higher

The higher minutes of use (MoU) and the lower prices as measured by the Revenues per Minute (RPM) cannot be interpreted as evidence of consumers being better off in the US. This would only be the case if US customers had the option to choose European type of plans and they refused it. In other words, US customers would be better off under the US offers if they could reduce their expenditure (which currently is 11.73€ higher a month than in Europe) by reducing the number of conversation minutes but decided not to do it.

But this is clearly not the case. We show in the report that US pricing plans – compared to European- offer the option of talking many minutes in exchange for a high monthly fee. Other plans like paying lower line rentals and getting higher price per minute for each call are not available. The options left for a customer who does not want to talk as much as, say, 500 minutes a month, unlimited on-

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net calls, etc. in exchange for a smaller monthly bill are either taking an expensive prepaid plan[6] or not subscribing at all.

The available evidence indicates that only European heavy users will be better off under US plans

In fact, the available evidence suggests that the majority of European consumers would be worse off under the US plans. If we use the OECD telecommunications consumption basket, (which is a reasonable approximation as the OECD basket is used in the EU's Implementation reports) we can compare how much a European customer would spend with US and European plans (see next Figure)[7].

The OECD comparison highlights the effect of the US pricing plans, namely that they offer a good deal for high consumers of mobile minutes/services. As the usage intensity decreases, the US price plans score worse. This is clearly observed for medium users, where the US minimum expenditure is 13 and 17 US$ higher per month, than those in Western and Central and Eastern European countries. Put differently, according to these calculations, a medium user in a European country would pay more than an additional $200/per year if only US plans were available.

Cost of OECD baskets (International US$)

Low user: Western Europe 15.8, Central & Eastern Europe 19.3, US 19.6*
Medium user: Western Europe 35.5, Central & Eastern Europe 39.7, US 52.4
High user: Western Europe 55.6, Central & Eastern Europe 71.5, US 53.1

(*) Includes the costs of incoming calls

■ Western Europe ■ Central & Eastern Europe ■ US
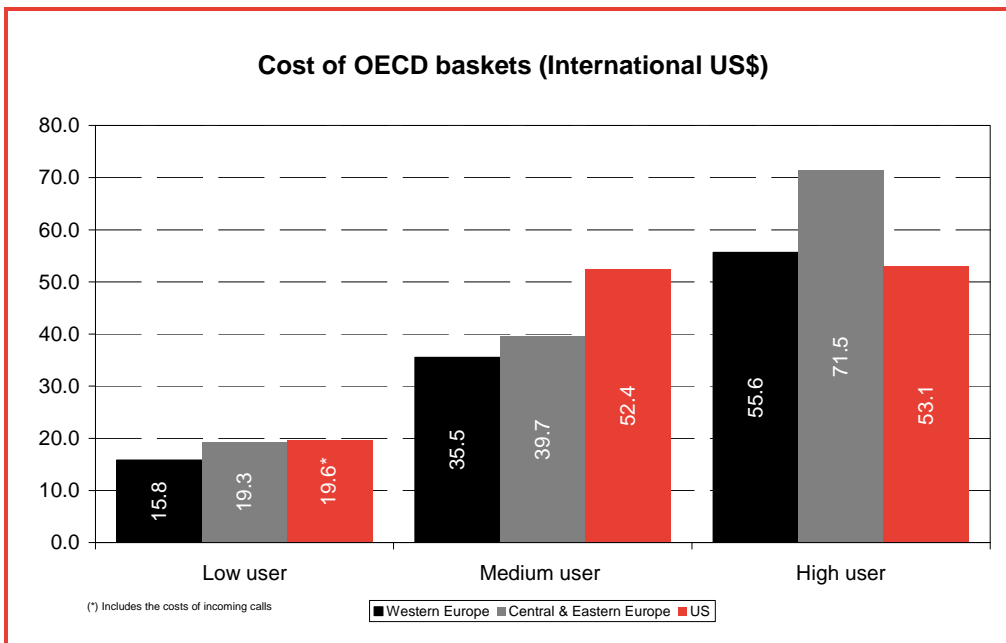
Figure 3: Mobile expenditure for OECD countries: low, medium and high user

Source: OECD Communications Outlook, pages 216-218

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6   European-type prepaid plans are not offered by all operators. They imply charges for incoming calls, a price per minute ranging from 10 to 33 US$ cents and 90 days for the expiration of the prepaid card. To get the 10 US$ cents per minute, customers have to buy a 100$ prepaid card.

7   Similar results are obtained from other sources: Analysys (2007) and GSMA (2008)

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We expect that, overall, European consumers would be worse off under US-type price plans, as we reckon that the proportion of medium and low usage subscribers is much higher than high usage subscribers[8]. From a distributional point of view if US type plans were applied, low and medium users would be net losers while high users would gain. The same is also of application for prepaid users, who tend to be low intensive users.

The EC draft Recommendation, as it stands now, underestimates termination costs

One way to set inefficiently low mobile termination rates is by underestimating the true costs of providing termination services. As currently drafted, the Commission Recommendation on the regulatory treatment of fixed and mobile termination rates, if applied, will likely lead to below costs termination prices:

○ By excluding the coverage costs from termination prices, the draft proposal is introducing a distortion in the allocation of resources, as there is no reason based on cost causality principles why outbound mobile calls should be treated differently from inbound calls.

○ The exclusion of common costs and of indirect costs are not justified on the grounds of economic analysis, which clearly indicates that, in order to achieve economic efficiency, the price of all services should contribute to the recovery of all these costs.

○ The consideration of NGN technologies in the modelling, when such technology is now beginning to be deployed, risks to produce inaccurate estimates.

Conclusion

The economic and the empirical evidence indicate that drastic reductions of MTRs are likely to reduce the welfare of European customers. In addition, relying on the US experience as support of regulatory policies that, in practice, lead to below cost MTRs, is not advisable. Analysis of usage patterns shows that only European heavy users would benefit from such an approach. The current version of the EC draft recommendation on fixed and mobile termination rates contains aspects that are expected to lead to an underestimate of the costs of terminating calls.

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[8]   Because the MoU for high users is more than 300 minutes a month, well above the average MoU of European customers, around 160 minutes, as reported by Merril Lynch

1 Introduction

This report provides an economic analysis and modelling of the impact of lowering mobile termination rates (MTR) for interconnection of calls between mobile operators below efficient levels. By efficiency we mean the level that maximizes companies' and consumers welfare.

We have based the analysis on three main sources:

 The existing economic literature on MTRs and its impact on market outcomes and consumer welfare (section 2).

 A modelling exercise, based upon the findings of the economic literature, aimed at quantifying the impact on consumer welfare of setting inefficiently low termination rates (see Section 3).

 We have also reviewed the international experience, mainly that of the US. MTRs in this country can be considered below mobile termination costs, which is the basic efficiency benchmark. However it is sometimes argued that this has led to a good deal for customers, who enjoy relatively high mobile usage and lower prices per minute. In section 4 we analyze to what extent it can be argued that US customers are better off than European mobile users.

We have finally considered the recent EU recommendation on the appropriate approach to the setting of mobile termination rates – our assessment of this is found in Section 5. The conclusions are presented in Section 6

In addition we have included several Annexes. Annex 1 explains the adjustments made in the variables used for comparison between the US and the European markets. Annex 2 presents detailed results of the quantitative modelling. Annex 3 briefly reviews some basic cost modelling concepts and, finally, Annex 4 includes tables offering further details of some figures included in Section 4.

2 Economic analysis of termination rates

2.1 INTRODUCTION

In competitive retail mobile markets the level and structure of call charges and subscriptions (and hence consumer welfare) are influenced by the level and structure of termination rates.

The economic analysis shows that it is flawed to assume that lower mobile termination rates will automatically lead to lower overall retail prices and to higher consumer welfare. A reasoning of this kind implicitly assumes that there is only one retail price in the market (call prices) therefore ignores the potential effect that termination rates may exert on other prices - such as monthly and connection charges and handset subsidies- and the effect of the level of termination rates on the way operators compete with each other. This is not to say that the level of mobile termination rates (MTRs) does not matter or that high MTRs are necessarily good, as there is a level of termination rates, usually cost based, which maximizes total (consumer plus producer) welfare.

In this section we use the existing economic literature to explain:

○ How retail prices are influenced by MTRs, showing that the idea of lower MTRs leading to lower retail prices holds under specific assumptions. Here we draw on Armstrong (2002) and Gans and King (2001).

○ The desirable (optimal in the sense of maximising welfare) level of MTRs, focusing on the assumptions where below cost termination rates are optimal. In this part we use the works of Armstrong and Wright (2007), DeGraba (2003) and Jeon, Laffont and Tirole (2004).

The general conclusions are as follows:

○ The presumption that lower MTRs will help reduce overall retail prices for mobile services and therefore benefit customers can only be held under very specific circumstances.

○ Efficient termination rates are usually cost oriented. Network and call externalities would support departures from this benchmark, requiring detailed information for their implementation. B&K (Bill and Keep) is an optimal wholesale price mechanism only under very specific assumptions and gives rise to other practical problems, including the need for additional regulation.

2.2 ON THE RELATIONSHIP BETWEEN MTRS AND MOBILE RETAIL PRICES

The majority of the economic literature on the relationship between retail pricing and wholesale charges assumes that operators compete for their share of the customer base. They compete by offering prices intended to maximise the welfare that customers would get from subscribing to their network. Customers choose the network that they believe will provide them with the highest level of

value, measured as the difference between the value that the consumer gets for the product less any charges made by the supplier.

The direct relationship between MTRs and retail prices, by which lower MTRs will produce lower retail prices and higher consumer welfare, comes from a simplified scenario where mobile operators sell only call services, setting a common price, denoted by p, for on/off net prices.[9] Under this scenario call charges and profits increase as the MTR increases and so operators have an incentive to set high MTRs, which explains why lower MTRs would lead to lower prices and higher consumer welfare.[10]

If we modify this setting by introducing the kind of tariff structure that is observed in the real world, the results are quite different as we will see in the next two sections. What we do not modify, however, is the assumption that operators compete by trying to offer the best value to subscribers and that subscribers choose the network that best match their preferences.

2.2.1 The effect of introducing fixed tariffs for handsets and/or line rentals

Let us consider a scenario in which mobile operators do not only sell traffic, but also charge monthly fees and/or sell handsets (which can be subsidized). In the remaining of the section and for the sake of simplicity, we focus on the fixed subscription charge only. Thus, operators charge a per minute price p, common for on and off-net calls, and a subscription charge F.[11]

As in the case above, there is a direct relationship between call prices and MTRs which implies that lower MTRs lead to lower call prices. However, now the termination rate has an additional effect: it exerts a negative impact on the fixed subscription charge. Thus, a lower MTR leads to lower call prices but to higher charges for subscription.

This effect is commonly known as the "waterbed effect", reflecting the idea that the regulation of termination rates affects the retail prices of other mobile services.

> "*A waterbed effect is shown to arise when demands and/or marginal costs are interdependent, firms use nonlinear pricing, or there is a zero-profit constraint or global price cap*"[12]

The theoretical existence of the waterbed effect have also been recognized by regulators such as Ofcom and the New Zealand Commerce Commission, but sometimes it has been questioned is empirical relevance.

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9   Allowing for on/off-net price discrimination does not alter the results of the discussion.

10   Armstrong (1998).

11   "Two-part tariffs" in the economic jargon.

12   Schiff (2007), page 1.

However, in a recent study Genakos and Valletti (2008)[13] has tested empirically the existence of the waterbed effect and have found that it exists and it is strong (although not "full" [14]). In particular:

> *"Our estimates suggest that although regulation reduced termination rates by about ten percent, this also led to a ten percent increase in mobile outgoing prices"[15]*

Analyzing a wide set of countries[16] and using econometric techniques to isolate the effect of fixed-to-mobile (FTM) termination rates on retail prices, they find that over the period considered[17] regulators decreased MTRs by 10%, which led to an overall increase in mobile bills to customers of 10%.[18] In other words, the 10% reduction in FTM termination rates had caused a 10% increase in consumers' expenditure in mobile services.[19] Interestingly, they show that the waterbed effect exists under quite general market conditions. In particular it would not occur only in a monopoly saturated market, a situation that does not happen in Europe.

Thus, both economic theory and empirical research suggest that a reduction of MTRs is likely to have a "waterbed" effect, and lead to increases in some retail prices for mobile services. In the absence of externalities, it can be shown that MTRs below costs lead to higher retail prices and lower consumer welfare. In this case consumer welfare is maximised by cost-based MTRs.

Note that the existence of a waterbed effect does not depend on competition between operators being weak, nor that the *mode* of competition is altered as a consequence of a change in the termination rate. It simply reflects that, given the competition in the retail market, a change in the termination rate does not affect solely the price of traffic services, it also influences equilibrium prices of other related services such as fixed subscription charges.

In the presence of off-net/on-net pricing, the waterbed effect is still operating. MTRs below cost in this context would be expected to reduce the difference

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13   Up to our knowledge this is the only study that isolates the effect of MTRs on mobile retail prices. Hausman (2004) provides some additional evidence of an increase in mobile prices in the UK after the reduction of MTRs in July of 2003. [

14   The authors find that a reduction in MTRs also reduce profits, "thus mobile firms suffer from cuts in termination rates" (Source: Genakos and Valletti (2008))

15   Genakos and Valletti (2008), page 2.

16   Poland, UK, Belgium, Austria, Italy, Japan, Spain, Norway, Sweden, Denmark, Hungary, Portugal, France, Australia, Czech Republic, Germany, Slovak Republic, Switzerland, Ireland, Luxembourg, New Zealand, Turkey, Netherlands and Greece.

17   1999-2006.

18   Genakos and Valletti use price information from Teligen, which provides the best possible deals for each user profile among all contracts available (post-paid and pre-paid).

19   In the Section 3 we include the modelling results of the impact of lowering MTRs on subscription prices, penetration and consumer welfare.

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between on and off-net prices. This softens competition for subscribers, resulting in lower consumer welfare.[20]

2.2.2 Conclusion

The presumption that lower MTRs will help reduce retail prices for mobile services and benefit customers, can only be held under very specific circumstances.

In particular, if the price structure observed at the retail level is different to a uniform per minute charge, which is rather usual in the industry, then economic theory predicts that MTRs below cost may reduce the welfare of consumers. Furthermore, in the presence of on-net/off-net prices, reductions in above-costs-MTRs could also be detrimental for customers.

Existing empirical evidence[21] provides support for the existence of strong waterbed effects, confirming the prediction of economic models.

2.3 EFFICIENT MOBILE TERMINATION RATES

The previous section has shown that the relationship between MTRs and prices is complex and, in particular, depends on the structure of pricing in the retail market. The purpose was to show that regulators should not assume that the lower the MTR the better for the customer.

However, this is not to say that the higher the MTRs the better for the market and for the customer. There is a level of MTRs which maximizes market efficiency and welfare. This optimal level is the one which should inform regulatory decisions in dealing with mobile termination rates.

The purpose of this section is to show what current economic literature says about optimal termination rates. In general terms the results reflect the principles of price regulation, with departures from cost based pricing justified by the existence of some types of externality. If there are call externalities, which means called parties attach some value to being called - and this benefit is not internalized in other ways - sharing the total costs of the call between the called and the calling party (i.e. RPP[22]) becomes desirable. In this case, optimal call termination rates could be below cost in order to induce operators to reflect the externality in their retail prices.[23] In this context, Bill and Keep (B&K), will be optimal only if very specific conditions are satisfied.

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[20] This effect is formalized in Gans and King (2001). The basic idea is that with below costs MTRs, operators are incentivized to reduce the size of any related termination losses, which they achieve by raising their subscription prices.

[21] Genakos and Valletti (2008).

[22] Note that RPP does not necessarily imply that the whole cost is borne by the called party.

[23] It is important to note that the optimality of an access charge below cost is a consequence of the presence of call externalities, not of the existence of RPP.

2.3.1 Optimal MTRs with no externalities

Under this setting[24] operators provide subscription and call services to consumers and the latter choose the supplier on the basis of which provides them with the highest level of value (consumer welfare), measured as the difference between the value that the customer gets from the product less any charges made by the supplier. In this simple framework, it can be demonstrated that termination rates should be cost oriented. Both above and below cost MTRs can be shown to damage welfare. This general solution changes as we introduce call and network externalities.

2.3.2 Optimal MTRs with network externalities

Network externalities arise when existing subscribers of a network benefit from new subscribers joining the network. In mobile markets the presence of additional subscribers generates a positive externality on existing ones since it gives the possibility of calling additional people.

The literature shows that in the presence of network externalities the efficient termination rate should be above cost.[25] A higher termination rate induces operators to lower their subscription prices promoting network participation at a level consistent with the social interest. Thus, in line with the waterbed effect commented above, MTRs are used as an instrument to internalize the network externality.

2.3.3 The impact of call externalities on MTRs

Under the presence of call externalities individual calls generate value to both, caller and receiver. In this case, efficient retail prices require that the total cost of the call (including origination and termination) to be allocated to both parties in proportion to their valuation.[26] This means that with call externalities, efficient retail prices require charging both the called and the calling party, i.e. RPP (Receiving Party Pays) but it is not necessarily the case that the called party recovers the costs of termination and the calling party the costs of origination, as it is the total cost of the call that is shared.

If operators set call prices at costs, the efficient MTR will be below costs and will *decrease* as the size of the call externality increases. As the benefit to the receiver increases, the called party should bear a larger fraction of the total cost of the call and this is managed by setting a lower MTR, which reduces the retail charge to the calling party. However the exact expression of the optimal tariffs can be complex, depending on a number of factors, such as the way in which operators compete, the presence of reception charges and the existence of on/off-net price discrimination. Thus although MTRs below costs may be efficient, determining

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[24]   This basic model is developed in Armstrong (1998) and Laffont, Rey and Tirole (1998a, 1998b)

[25]   Wright (2002b) and Armstrong and Wright (2007).

[26]   See DeGraba (2003).

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the exact amount by which termination rates should be below termination costs is likely to be complex.

For example, in the simple scenario[27] with two symmetric mobile operators that do not price discriminate between on-net and off-net calls; reception charges are regulated at cost[28], and receivers are assumed not to hang up, then the efficient termination charge equals the cost of termination minus a fraction of the total cost of the call that is determined by the size of the call externality. More formally, if we denote by C and C_T the overall cost of the call and the cost of termination respectively, and by b the size of the call externality then efficient requires $MTR = C_T - b*C$. Notice that the estimation of the efficient charge requires information not only on termination costs but also on the size of the call externality.[29]

On top of this, the introduction of RPP in order to allocate in an efficient manner the cost of the call may create other problems. Jeon, Laffont and Tirole (2004) show that in a context with call externalities and differentiated price competition for customers through non-linear tariffs there is a risk of connectivity breakdown (i.e. operators set prices in such a way that calls to rival networks become prohibitively costly). If the call externality is sufficiently large networks could set excessive off-net prices in order to reduce off-net call volumes (thus taking advantage of its size) and, in the limit, avoid off-net calls in order to make rival networks less attractive (connectivity breaks down). If the call externality is small, operators could set very high off-net reception charges in order to damage rivals' customers.

Thus, even if the termination charge is regulated below cost to account for call externalities and if RPP is introduced, the equilibrium outcome may be highly inefficient since operators will have incentives to avoid off-net traffic by increasing off-net call prices (incoming or outgoing depending on the size of the call externality). This will result in a distorted pattern of traffic.

Although connectivity breakdown may seem to be an extreme outcome, mobile offers in the USA point in this direction, with large differences between on-net and off-net prices. At present, most of the plans in the US offer on-net traffic for free (both incoming and outgoing calls) while off-net calls (incoming and outgoing) have a positive price.

Factoring in call externalities in the termination price requires controlling for several factors:

○ In the first place, the size of the externality. There is not much public information regarding the importance of call externalities. A study by Ofcom in 2005[30] showed that in their decision on network subscription consumers

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27   See Jeon, Laffont and Tirole (2004).

28   i.e. the reception charge equals the cost of termination minus the MTR.

29   According to this formula the loss in efficiency that may arise from not considering call externalities decreases with termination costs.

30   Ofcom (2005), Annex F.

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do not assign much value to the possibility of being called. Only 2% of responders considered the price of others to call them in their choice of the network. This evidence suggests a low call externality.

○ Second, the extent to which tariff offers already reflect call externalities. Low termination rates in this context are set to encourage the appearance of retail prices reflecting the call externality so that the called part bears part of the costs. Current pricing mechanisms observed in CPP countries, such as special arrangements for consumer to business calls such as 8XX calls, allocate part of the costs to the called party.

○ Third, calls do not take place in isolation, rather they are part of a broader communication process in which senders and receivers interact repeatedly and behave reciprocally. Taylor (2002), analyzing the long distance telephony market, found that "a call in one direction stimulates something like one-half to two-thirds of a call in return." Therefore, outbound calls generate inbound calls and in this way the call externality is internalized to some extent.[31]

○ Fourth, low termination rates and low off net call prices help proliferation of certain type of calls which consumers do not value (for instance marketing calls or SPAM[32]). In this respect, mobile customers in the US have recently filed a lawsuit against 6 mobile-phone carriers and a top mobile virtual operator in Mississippi federal court due to the imposition of charges for unsolicited messages received by subscribers.[33]

Bill and keep (B&K)

The presence of call externalities is usually used as an argument to support B&K, which corresponds to a situation in which the MTR is set to zero. However, if we look at the previous expression for the optimal termination rate (MTR = C_T - b*C), B&K (which corresponds to MTR = 0) is appropriate only under very specific conditions. In particular, the ratio of the cost of termination to the cost of originating the call must equal the ratio between the recipient and the caller's valuation of a call. A particular case is when the cost of origination equals the cost of termination and the value of calls is shared evenly among senders and receivers.

Thus, the optimality of B&K requires information on origination and termination costs and on the relative valuation of the call of calling and called parties, and cannot be based solely on the existence of call externalities.

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[31] Motivated by this evidence, Cambini and Valletti (2008) consider a model with call externalities and "reciprocal" communication patterns. They find that under this broader setting the risk of connectivity breakdown previously commented and the off/on-net price differential induced by the MTR are much reduced. They also show that a light-touch policy such as the imposition of reciprocity, allowing operators to negotiate over the level of the MTR, may be sufficient to induce an efficient market outcome.

[32] A study by Ofcom carried out in 2003 found that 36% of mobile subscribers at least occasionally chose not to answer calls from an unrecognized or unidentified source (Ofcom, 2003. Page 10).

[33] See RCRWireless News. May 16, 2008.

Economic analysis of termination rates

Even assuming that B&K may reduce some transaction costs[34] it is not obvious that it will diminish or eliminate the need for regulatory intervention in termination. For instance, in order to avoid the "hot potato" problem (i.e. the incentive of the initiating network to deliver the call at the point of interconnection –PoI- closest to the originating customer) the regulator may need to specify these points and set a regulated termination price (possibly cost oriented) for the remaining interconnection points.

2.3.4 Co-existence of network and call externalities and implications on optimal tariffs

We have seen that the existence of network externalities asks for an above cost termination charge (in order to incentivise subscription) whereas the internalization of call externalities requires a MTR below cost.

In reality, both types of externalities will be present to some extent and the regulator will have to weigh the importance of each. An interesting result emphasized by Armstrong and Wright (2007) is that:

> "*the presence of call externalities will amplify the impact of network externalities, since users will receive more calls when there are more mobile subscribers*". [35]

The implication is that the combination of both, network and call externalities, could result in above-cost MTRs. In other words, despite the fact that call externalities, when considered alone, lead to below cost MTRs, these widen the importance of network externalities, which require a higher MTR.

2.3.5 Conclusion

Efficient termination rates are usually cost oriented. Network and call externalities would support departures from this benchmark, requiring detailed information for their implementation. Bill and Keep is efficient only in a scenario where there are network externalities, and the costs of termination and origination are equal to the ratio of the recipient and the caller's valuation of a call. In setting termination rates, regulators should consider the extent to which any call externality is not already internalized in the bilateral relationship between the called and the calling party, and the undesirable effects in the form of retail prices aimed to leverage network size or the making of undesired calls and SPAM.

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[34] Although interconnection billing would not be necessary, counting equipment will still be in place, for instance to bill special numbers. In addition, traffic will need to be classified according to whether the interconnecting network operator fulfils the B&K conditions (e.g. points of interconnection, international traffic, etc.). For these purposes, technical equipment at the interconnection points similar to today's equipment is necessary (source: T-Mobile).

[35] Armstrong and Wright (2007), page 19.

3 Quantitative impact of lowering MTRs

3.1 INTRODUCTION

In this chapter we summarise the findings on modelling the potential impact of drastically reducing MTRs from current levels. The impact is measured on a typical Western European (WE) and a Central and Eastern European (CEE) markets on the following variables:

- overall average prices paid;

- mobile market penetration; and

- the total value obtained by consumers from using mobile telephony (consumer welfare in economists' jargon).

These results are based on a simulation model of competition between mobile operators adopted in most of the academic literature on the topic.[36] This model assumes that operators compete for their share of the customer base by offering prices intended to maximize the value that consumers obtain from using mobile telephony. Thus the results we report do not depend on competition between operators being weak.

Annex 2 offers more details on the modelling assumptions. In the following sections we report the main highlights.

3.2 RESULTS

In this section we present the results of lowering MTRs on consumers. We differentiate between two scenarios: the impact under the existing Calling Party Pays arrangements (CPP) and with the introduction of payments for incoming calls or Receiving Party Pays (RPP).

In each of these two scenarios we report the results for low and high call externalities. The scenario of low call externalities implies that the ratio between the benefit received by the called party and that of the calling party is 0.1. In the high call externality, this value is 0.7 which is at the highest end of the range advocated for those claiming for the existence of call externalities. As discussed in the previous chapter, call externalities not already internalised within particular user groups are likely to be small. We therefore expect that the scenario under low call externalities to be the more plausible, in the absence of any evidence to the contrary. We have decided not to model network externalities explicitly, in the interest of keeping the simulation and results more transparent (and

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[36] More specifically, the model is a "Hotelling type" differentiated Bertrand model. It allows for subscribers to choose between competing networks, based on the relative value that each network offers to its subscribers. This value, the per capita consumer surplus, is measured as the difference between the value that a consumer gets for the product he/she consumes, in this case the value of making and receiving calls, less any charges made by the mobile operator to which he/she is subscribed. The model also simulates the impact of changes in the level and structure of prices on the likely levels of mobile penetration.

tractable). This implies that the results do *not include* the negative impact on welfare from setting a termination charge below cost, in the presence of network externalities.

3.2.1 Impact of lowering MTRs under CPP

Without reception charges the effect of reducing MTRs is to increase the average volumes of calls made per subscriber. In our modelling, we find that the Average Minutes of Use (AMoU) could increase significantly, by up to 1.6 times in the case with MTRs equal to 2€ cents (see Table 1).

In isolation, this is obviously beneficial to subscribers. However, in the absence of reception charges, reducing MTRs *also* causes competing networks to increase their fixed subscription charges to subscribers so as to recover the losses made on calls. This has a negative impact on penetration. For instance, if we assume that MTRs are equal to 2€ cents, mobile penetration is estimated to fall by 9% in either WE or CEE countries (1% if call externalities are assumed to be high). If MTRs are lowered to 1 € cent the reduction in mobile penetration can be as high as 16% (4% reduction if call externalities are high) for either WE or CEE countries (see Table 1 and Table 2)[37].

We find that the net balance on consumers of these two effects (the positive of the traffic increase against the negative effect of lower penetration) is in most cases negative, thus reducing the benefit that consumers get from mobile services:

○ In WE countries, if MTRs are equal to 2€ cents total consumer welfare is reduced by 11% when call externalities are low and by 1% if call externalities are high. If MTRs are set to 1 € cents, total consumer welfare is reduced by 19% and 6% for low and high call externalities, respectively (see Table 1).

Western Europe CPP		Average Minutes of Use (% of AMoU with MTR at cost)	Penetration		Total Consumer Surplus (% of CS with MTR at cost)	
			Low Call Externality	High Call Externality	Low Call Externality	High Call Externality
MTR (€cents)	2	162%	91%	99%	89%	99%
	1	198%	84%	96%	81%	94%

Table 1: Average Minutes of Use, Penetration and Total Consumer Surplus. Western Europe - Without reception charges

Source: Frontier Economics

○ In CEE countries, only under the assumption of high call externalities and MTRs set at 2 € cents, the total consumer surplus remains invariant. With low

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[37]   These are reductions compared to what penetration would be absent the reduction in MTRs

call externalities, MTRs set at 2 € cent reduce total consumer welfare by 10%. Consumers experience 19% reduction in their welfare (4% reduction when call externalities are high) when MTRs are set to 1 € cent (see Table 2).

Central and Eastern Europe CPP		Average Minutes of Use (% of AMoU with MTR at cost)	Penetration		Total Consumer Surplus (% of CS with MTR at cost)	
			Low Call Externality	High Call Externality	Low Call Externality	High Call Externality
MTR (€ cents)	2	167%	91%	100%	90%	100%
	1	206%	84%	97%	81%	96%

Table 2: Average Minutes of Use, Penetration and Total Consumer Surplus. Central and Eastern Europe - Without reception charges

Source: Frontier Economics

3.2.2 Impact of lowering MTRs under RPP

If operators charge for incoming calls networks do not make losses on calls (on average) so the pressure to increase fixed subscription charges is alleviated. However, the introduction of reception charges has a mixed effect on traffic levels. If the reception charge is small, (or the value of the call externality is large), reception charges will not have a material effect on call volumes, while the reduction in MTRs, and consequently lower call charges, will result in increased average volumes of calls made per subscriber. In our modelling, we find that the volume of calls might increase by 50% in WE countries and by 53% in CEE countries, with MTR equal to 2€ cents. This makes consumers better off (see Table 3 and Table 4).

However, if reception charges become large (or the value of the call externality is small), high reception charges cause subscribers to refuse to accept calls, which will reduce the average volume of calls made. We find that this could reduce calls up to 70% in WE and CEE countries (see Table 3 and Table 4). This is estimated to reduce the welfare of consumers.

The impact of the introduction of reception charges on penetration depends on the size of call externalities. If call externalities are assumed to be high, penetration in CEE and WE countries slightly increases or remains constant when MTRs are set to 2 and 1 € cent respectively. If call externalities are low, the negative effect on penetration of introducing reception charges is quite large. Our modelling suggests that if MTRs are equal to 2 € cent penetration in WE and CEE countries could be reduced by 37% (see Table 3 and Table 4).

In our modelling the overall impact on consumer welfare of these two factors is marginally positive if call externalities are large, with MTRs equal to 2€ cents. With low call externalities, the reduction on consumer welfare is much larger: 45% for WE and CEE countries. This negative effect comes from the impact on mobile penetration following the introduction of incoming charges to recover the cost of calls (see Table 3 and Table 4).

Quantitative impact of lowering MTRs

Western Europe RPP		Average Minutes of Use (% of AMoU with MTR at cost)		Penetration		Total Consumer Surplus (% of CS with MTR at cost)	
		Low Call Externality	High Call Externality	Low Call Externality	High Call Externality	Low Call Externality	High Call Externality
MTR (€cents)	2	32%	150%	63%	102%	55%	103%
	1	30%	143%	60%	100%	52%	100%

Table 3: Average Minutes of Use, Penetration and Total Consumer Surplus. Western Europe - With reception charges

Source: Frontier Economics

Central and Eastern Europe RPP		Average Minutes of Use (% of AMoU with MTR at cost)		Penetration		Total Consumer Surplus (% of CS with MTR at cost)	
		Low Call Externality	High Call Externality	Low Call Externality	High Call Externality	Low Call Externality	High Call Externality
MTR (€cents)	2	33%	153%	63%	103%	55%	103%
	1	31%	146%	59%	100%	51%	101%

Table 4: Average Minutes of Use, Penetration and Total Consumer Surplus. Central and Eastern Europe - With reception charges

Source: Frontier Economics

3.3   THE US EXPERIENCE

We provide a detailed assessment of the US experience in the next chapter. However, it is useful at this stage to provide a brief description of the US system, in order to assess the relevance of the different results presented in this section. In summary, the US operates a B&K interconnection system between mobile operators, with reception charges at the retail level. The majority of US subscribers purchase packages that come in the form of bundles of incoming and outgoing minutes, for a periodic fee. In practice therefore, the US system is a hybrid between the CPP and RPP scenarios presented in this section. To the extent that the majority of US subscribers do not consume significant minutes outside their bundles, the US system would be more closely represented by the results presented under the CPP scenario.

3.4 CONCLUSIONS

In this section we have quantified the impact on consumers from lowering MTRs below cost levels. The welfare of consumers can be seriously reduced from this policy, even when call externalities are taken into account.

These results indicate that, given the lack of evidence on the size of call externalities, and the potentially very material effect on consumer welfare from below cost termination charges, it would be advisable to err on the side of caution and set cost based MTRs. Any policy aimed at setting below costs MTRs should be supported by strong factual evidence on the size of the externalities not internalized by the parties and consider extremely carefully a significant deviation below costs.

4 Analysis of the US experience

4.1 INTRODUCTION

From the analysis of the relevant economic literature in section 2 we concluded that:

○ The presumption that lower MTRs will help reduce overall retail prices for mobile services and therefore benefit customers is flawed and can only be held under very specific circumstances.

○ There is an optimal level of MTRs, which is generally cost oriented unless call and network externalities are present. In particular, termination rates equal to zero are optimal only under very specific circumstances and gives rise to other practical problems, including the need for additional regulation. In addition if RPP is followed after the introduction of B&K (which does not necessarily need to happen but could arise as termination costs are greater than zero), other problems coming from strategic pricing in the form of leveraging network size, could arise.

In spite of this, it is sometimes argued that the experience of markets with low (meaning below costs) termination rates clearly shows that customers are better off, as they tend to talk more and get cheaper prices, without any significant effect on mobile penetration.

The purpose of this section is to analyze whether, on the basis of the available information, such statement can be maintained. To comply with this aim we took the US example as reference. Although there are some other countries with low or zero mobile termination rates, the US is, in many instances, especially with regard to the socio economic environment, the more relevant benchmark.

We have structured this section as follows:

○ First, we review and comment on the arguments generally used by the advocates of low or zero termination rates / RPP systems.

○ Second, we expand on some of our challenges to these arguments, which covers two aspects

  • the use of a limited set of metrics to compare US and EU market performance, thereby underweighting or just ignoring others, mainly penetration and coverage; and

  • the omission of the fact that, even for a limited set of metrics, variables with the same name measure different things so that adjustments are necessary to compare like with like.

○ Third, after adjusting the metrics to ensure an "apples with apples" comparison, we answer the key relevant question: if on the basis of these indicators of the US and European markets, it can be said that US customers are better off than European users.

On this basis we conclude the following:

○ The evidence based on the international experience presented for the advocates of below costs or zero MTR is weak and cannot be used as presented to date as a basis for regulatory policy.

○ US wireless users are not on the whole better off than their European counterparts:

- There is a gap in mobile penetration and coverage, which even if it narrows over time, harms consumers with delays in service adoption.

- After adjusting MoU (Minutes of Use), ARPU and RPM (Revenue Per Minute) figures in the US with respect to Europe, to ensure that the comparison is meaningful, US customers consume more minutes but spend more money: we cannot therefore conclude that they are better off.

- Using the OECD telecommunications usage, which is representative of EU mobile consumption, US price plans could benefit high usage consumers, but would be likely to harm medium and low usage customers. As the proportion of low and medium users is higher, more European users would be expected to be worse off under the US offers, and they would be the low users.

4.2   THE CASE FOR LOW TERMINATION RATES

The main evidence used to argue that the international experience supports the benefits of low (below costs) termination rates is a cross country comparison on selected variables.

Thus, it is argued that countries with low mobile termination rates or even B&K exhibit higher minutes of use and lower revenue per minute (interpreted as a proxy for prices), and do not systematically show lower penetration rates (see Table 1).

The advocates of this view claim that these conclusions hold even when statistical analysis is used to control for other variables, more specifically GDP per capita, penetration of fixed telephony, proportion of subscribers with GSM technology, market share of the two largest players, % of prepaid subscribers and the existence of number portability (source Littlechild: 2006).

	Wireless penetration	MoU	RPM (€)	Termination mechanism
Canada	60.90	424	0.07	B&K RRP
USA	84.00	814	0.03	B&K RRP
Hong Kong	138.30	495	N/A	B&K RRP
Singapore	125.00	339	0.06	B&K RRP
Europe	118.70	159	0.14	CPNP/CPP
France	89.00	247	0.12	CPNP/CPP

Table 5: Comparison in selected metrics for Calling Party Networks Pays-CPP and Bill and Keep-RPP countries

Source: Global Wireless Matrix, Merrill Lynch (4Q 07)

However this type of analysis is too simplistic to be used in drawing inferences for regulatory policy:

○ *The analysis does not address the relevant economic question.* The fact that we observe differences in some indicators does not imply that overall customers are better off. For instance price plans in the US are in the form of "buckets" of minutes. One of the reasons for their existence, is the need to overcome customer's reluctance to answer certain calls for which they are not willing to pay. Once the bucket of minutes is purchased, the opportunity cost of talking is quite low and, if the expectation is not to run out of minutes, even zero. This could lead to relatively high consumption of minutes, without any evidence that this is what consumers would prefer if they could choose, for instance, European-type price plans.

○ *The analysis focuses on a small set of metrics.* Other variables such as coverage which indicates the ability to make and receive calls everywhere (basic in this case, as mobility is one of the key attributes for wireless) or quality performance are not considered.

○ *Problems in the data.* The analysis is not comparing like with like:

• The minutes of use are overstated in RPP systems as inbound and outbound on-net calls are double counted. Also in some RPP countries, like the US, some operators charge for the ring time and for unanswered calls, and these minutes, which are not conversation minutes, are included in MoU figures.

• ARPU figures are overstated in CPP countries. The revenue figures per customer in CPP countries, which are used to calculate the revenue per minute, include termination revenues. As retail revenues for off-net calls also include termination (because they form part of retail prices), termination revenues are counted twice and hence RPM figures are

Analysis of the US experience

overstated in CPP countries. This comparability issue arises regardless of the level of termination rates.

- Finally, penetration rates in some CPP countries may be overestimated as some users that have several SIM cards but use only one, may be counted more than once. This is a different issue to that of users having several SIM cards and effectively using them (for instance professionals with personal and company mobile phones).

○ *The impact of other explanatory variables is not appropriately considered.* Market performance is affected by a number of variables, not only termination rates. To account for other reasons explaining market performance, Littlechild (2006) undertakes an econometric analysis using RPM, MoUs and penetration as dependent variables and GDP per capita, fixed penetration, market share of the two top players, % of subscribers with GSM technology, % prepaid customers and the existence of number portability as explanatory variables. The conclusion from this analysis is that, after accounting for these explanatory variables, RPP reduces average revenue per minute, significantly increases average usage and does not affect mobile penetration rate. We think that on the basis of the econometric analysis such conclusions cannot be maintained because

- the problems of comparability between the market indicators of CPP and RPP countries are not corrected;

- the analysis does not control for prices and quantity in the estimated supply and demand functions, which can invalidate the statistical robustness of the results; and

- there is a very small sample of countries with B&K. Therefore, inferences are based on a very limited set of examples.

○ *There is contrary evidence that should also be considered.* There are countries that have considered a change in the interconnection (and retail pricing) mechanism applicable to mobile termination. All of the ones that have considered it, have changed from RPP to CPP (Zehle, 2003), including developing countries from Central and South America and the Caribbean, Mongolia, Cambodia, Romania, Pakistan and India. Although cross-country analysis does not provide conclusive evidence on the relationship between penetration and CPP, case studies of emerging countries that have switched from RPP to CPP show a significant impact of CPP on market growth and the development of the mobile sector. Zehle (2003) states that (page 15): *"The fact that under mobile party pays cellular users have to pay for mobile terminated calls and cannot properly control costs other by switching off the phone must weigh more heavily in a price sensitive market, such as emerging markets.*

○ France also switched from B&K to a Calling Network Party Pays (CNPP) in 2005 without this leading to significant changes in usage or customers' bills.

Analysis of the US experience
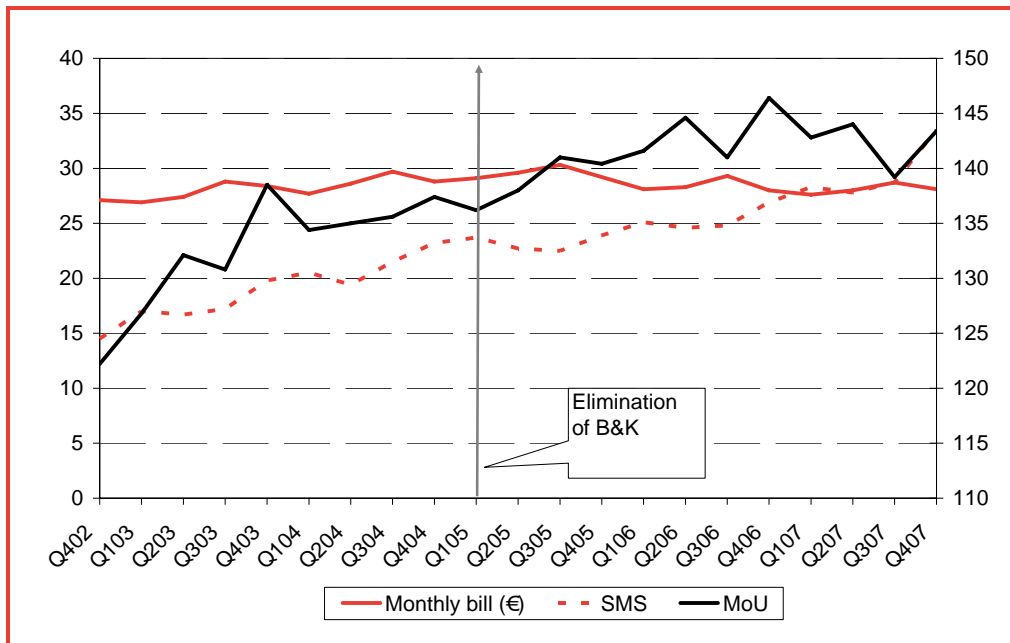
Figure 4: Evolution in France of the monthly bill and minutes of use before and after the introduction of MTRs

Source: Arcep's Quarterly Reports

4.3 COMPARISON WITH THE US

4.3.1 Introduction

We now turn to an analysis of the US and European experience, focusing on a series of key performance indicators. The purpose is to test if the claim that US consumers are better off than their European counterparts is supported by the data.

As mentioned earlier, it is reasonable to take the US as a relevant benchmark for the EU. In addition, among the B&K/RPP countries, the US is the closest to Europe in terms of income and demographics, as it is shown in the table below.

	GDP p.c. (€)	Population (millions)
Hong Kong	**20,175**	**7**
Singapore	**24,502**	**4**
Europe	24,854	495
Canada	**32,456**	**33**
US	31,460	303

Table 6: GDP p.c. and Population Comparison for selected CPP and RPP countries

Source: Merrill Lynch Global Wireless Matrix, 4Q 07, with the exception of Europe. Source: http://epp.eurostat.ec.europa.eu/

In what follows:

- We first expand in the metrics used for the comparison, including subscription and geographic coverage.

- Secondly, we adjust the information on MoU, ARPU and RPM to make these performance indicators comparable.

- By using these data, we then assess whether it can be said that US customers are better off than European mobile customers.

4.3.2 Subscription

Subscription in the US lies well behind subscription in the EU

Before undertaking a comparison of penetration rates, it is necessary to adjust reported rates for inactive subscribers. Data on subscribers for European countries may be overestimated because of the existence of inactive subscribers (subscribers who churn between operators but are still active in operators' accounts). To control for this we compare US penetration figures with those of the EU for which we have found information on active subscribers, defined as those who have made or received a call/SMS in the last 3 months. As can be seen in the chart below, the US lags significantly behind European countries in terms of penetration.

This result is consistent with reported penetration rates from other sources. For instance the United Nations reports 75% penetration for the US and 107% for Europe.[38]

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[38] See *The Global Information Society: a Statistical View*. April 2008. Page. 25
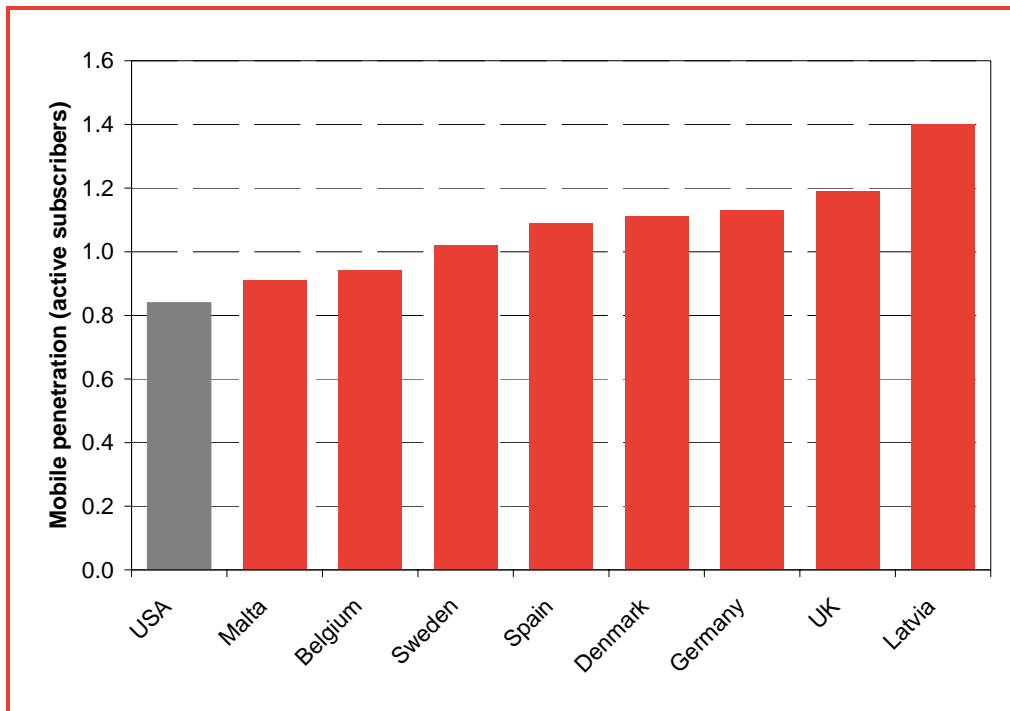
Figure 5: Mobile penetration (active subscribers) in the US and Europe

Source: 13th Implementation Report and Merrill Lynch Global Wireless Matrix, 4Q 07

Other evidence also points out that penetration in the US is below EU levels. For instance, customer surveys provide comparable information to the extent that survey participants are asked the same question. In this respect, we have found comparable survey based information on mobile penetration for households in the US and Europe. Thus, in 2007, in the EU-27, 83% of households had at least 1 mobile telephone. In 2007 the percentage was 75% for the US. With the exception of Romania and Bulgaria, all EU countries are above the US rate (see Figure 6 below and Table 8 in Annex 4)

Analysis of the US experience

Houses with at least one mobile phone
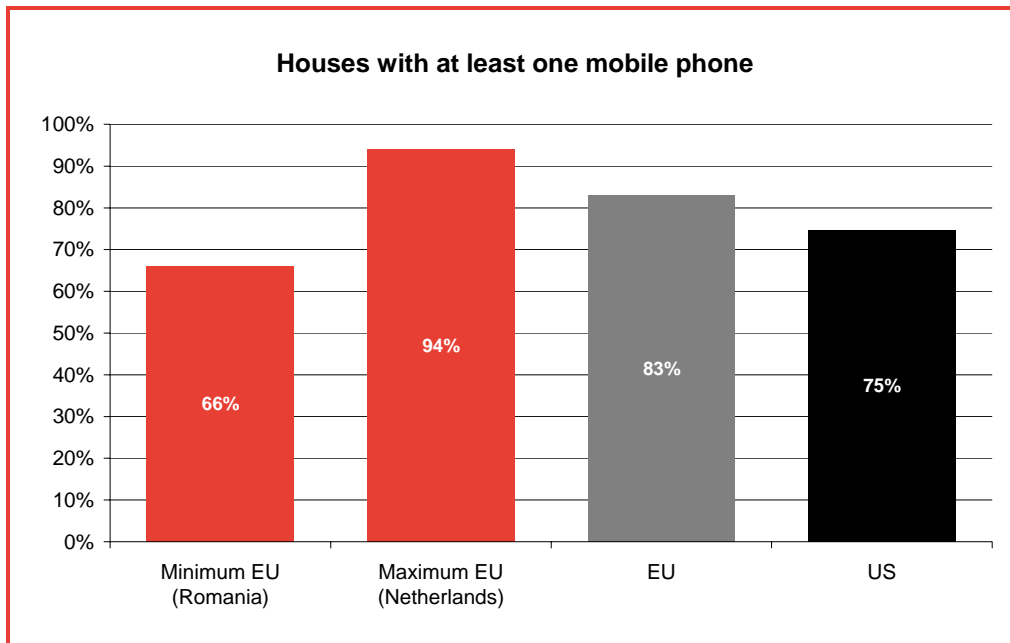
Figure 6: Percentage of households with at least 1 mobile phone (*see more details in Table 8 in Annex 4*)

Source: For the US: Blumberg SJ, Luke JV. Wireless substitution: Early release of estimates from the National Health Interview Survey, July - December 2007. National Center for Health Statistics. Available from: http://www.cdc.gov/nchs/nhis.htm. For Europe: European Commission: Sondage sur les communications électroniques. Eurobaromètre Spécial 293. Novembre – décembre 2007 (available at http://ec.europa.eu/information_society/policy/ecomm/doc/library/ext_studies/household_07/eb68_2_ecomm_full_rep_fr.pdf)

Lags in penetration also reduce the welfare of consumers

The figure below shows that penetration in the US seems to be 3-4 years behind European levels. Although measuring the time lag requires more careful analysis, the chart shows that even if the US reach similar penetration levels, the time lag lasts several years. There is also no apparent trend for convergence in penetration.

Eventually if in the long term US penetration reaches European levels, the delay in the diffusion of mobile services would be expected to reduce the welfare of consumers quite significantly. For instance, Hausman (1997) estimates that the costs of delay in the introduction of cellular telephony services in the US was US$ 25 billion per year.
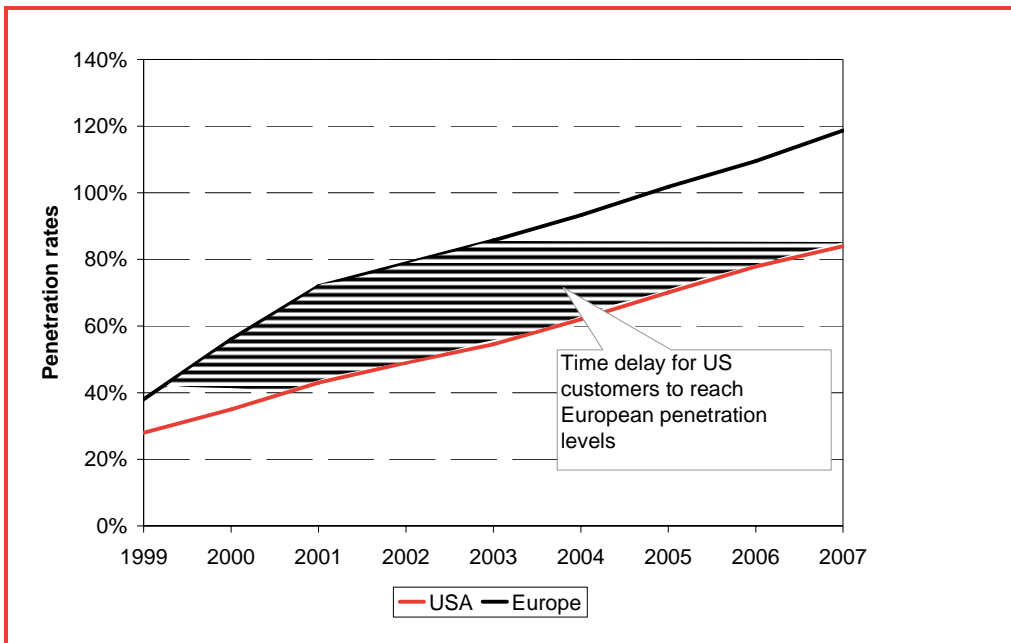
Figure 7: Evolution in mobile penetration (US vs. Europe)

Source: Global Wireless Matrix, Merrill Lynch, 4Q 07

4.3.3 Coverage

Population coverage figures in the US are comparable with those of the EU-27 However in terms of geographic coverage, the US scoring is much worse than in the EU.

The figure below plots both population and geographic coverage. The figure for geographic coverage in the US is a bit larger when computed over land (excluding water and desert) area instead of total area.[39] However, in both cases the US is quite behind Europe in terms of geographic coverage. This is the case even when, contrary to European operators, US wireless operators received in 2007 98%, or $1.18 billion, of the $1.2 billion that the program paid out each year to CETCs (competitive eligible telecommunications carriers[40] – non-incumbent carriers that have been certified for participation in the high-cost program).[41]

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[39] The source for water area is https://www.cia.gov/library/publications/the-world-factbook/print/us.html and for desert area: National Park Service, http://www.nps.gov/archive/moja/mojadewd.htm

[40] CETCs are non-incumbent carriers that have been certified for participation in the high-cost program. The high-cost program is one of four Universal Service Programs receiving 62% of the total Universal Service funds. It provides financial support to carriers operating in high-cost—generally rural—areas in order to offset their costs, thereby allowing these carriers to provide rates and services that are comparable to the rates and services that customers in low-cost—generally urban—areas receive.

[41] United States Government Accountability Office (GAO) report to Congressional Committees. Telecommunications. June 2008. Available at http://www.gao.gov/new.items/d08633.pdf

Analysis of the US experience
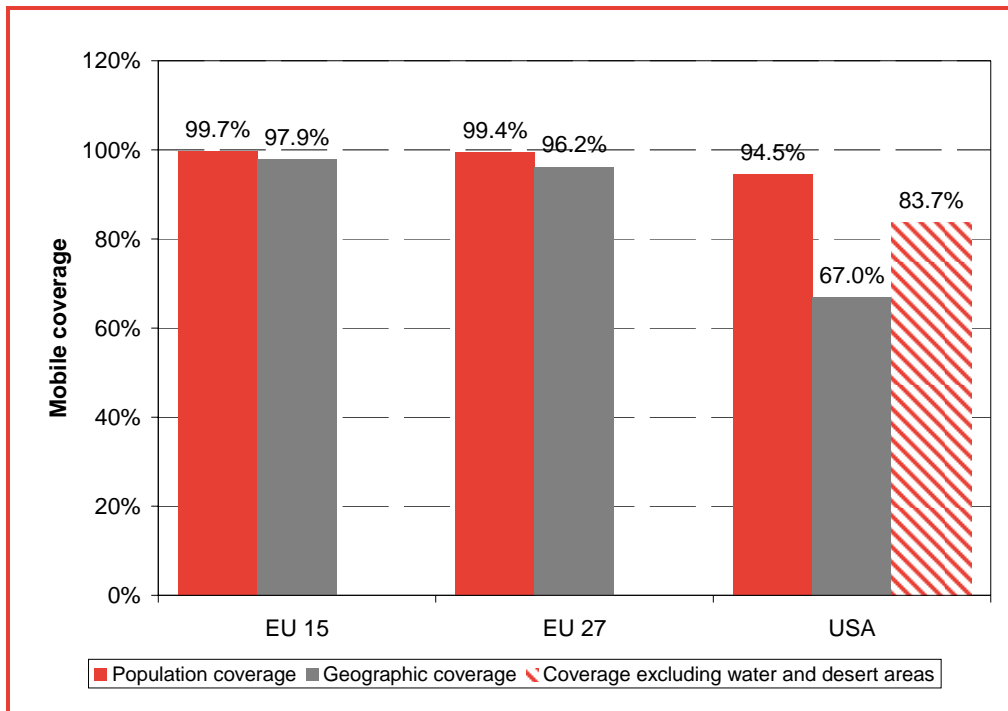
Figure 8: Population and geographic coverage in the US

Source: GSM Association and FCC

The difference in geographic coverage may be reflecting that population density is lower in the US than in the European Union and the higher costs to cover remote areas. This interpretation should however take into account the following considerations

- it is in less populated and remote areas where the utility of mobile telephony for society is higher, as it allows people living or travelling through these areas, to be contactable; and

- these remote areas are less developed economically, so lower coverage would also reflect that mobile service offers in the US are targeted to high usage consumers, who possibly are not located there. According to this, low coverage would also be explained by the US service offers compared to the European ones.

Evidence from Sweden supports the last point made: it has lower population density and yet significantly higher population and geographic coverage than the US.[42]

4.3.4 Minutes of use

Reported billed minutes for the US operators include:

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[42]   According to the GSMA data, population coverage in 2006 for Sweden was 99.9%. The figure for geographic coverage in the same year was 86.5% and 94.7% if we exclude water areas.

Analysis of the US experience

- ring time for answered calls, as they are also billed; and

- for some operators charging for it, ring time for unanswered calls.

Therefore, the minutes of use (MoU) reported by US operators include in addition to conversation minutes ring time, even if the call is not answered.[43]

To ensure that we are comparing true conversation time both in the US and in Europe we have adjusted the MoU figures in the US to exclude ring time and take account of the billing method. We then have compared it with the European data, which has also been adjusted to reflect the billing method in the different countries.[44]

We also adjust the US MoU to control for the fact that on-net minutes are counted twice, as both the outgoing and the incoming leg are billed to the customer. In CPP countries like those in Europe, on-net M2M minutes are counted once. Annex 1 explains this adjustment.

The following chart shows the MoU for the US and European countries before and after the adjustment. As can be seen, the difference in the US reported minutes vs. true conversation minutes is quite significant and implies a 46% reduction. The divergence in the European countries is explained by the billing method. Thus for those European countries not billing by second, true conversation minutes are lower than those reported.

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[43]   Verizon and. AT&T charge for unanswered calls if the ring time exceeds 60 and 30 seconds, respectively. Sprint does not charge for unanswered calls and we have not found information regarding the other operators. We have assumed that these other operators do not charge for ring time in unanswered calls.

[44]   See Annex 1 for a detailed explanation of the adjustments.

Analysis of the US experience

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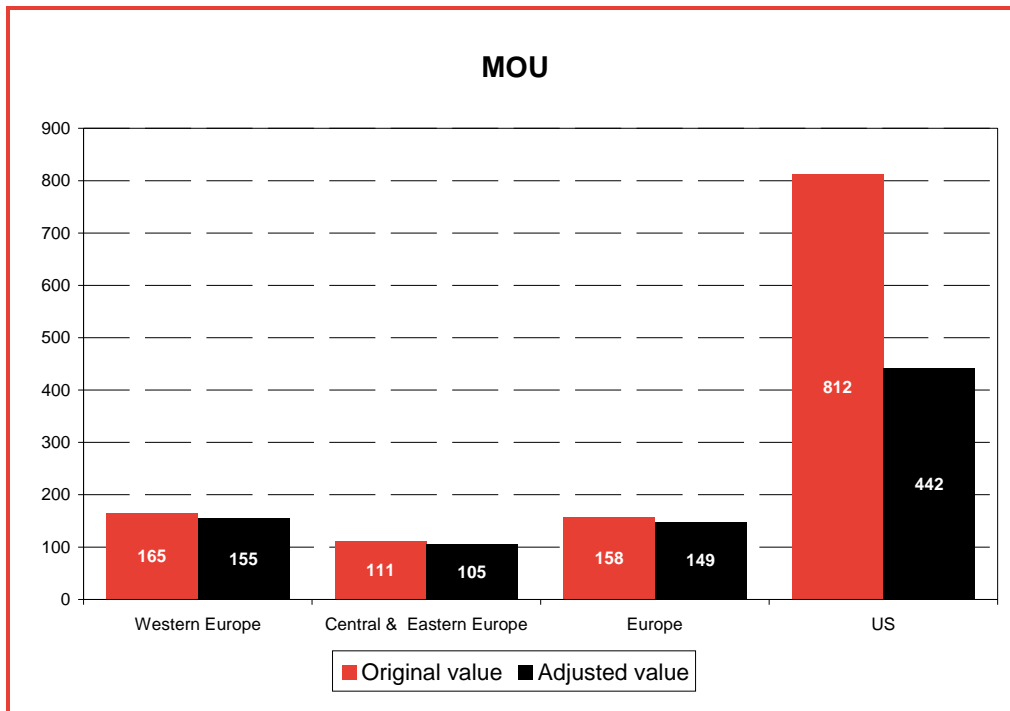
Figure 9: Minutes of use (MoU) before and after adjustments to control for non-conversation time (*see more details in Table 9 in Annex 4*)

Source: Frontier Analysis from Merril Lynch's information

After these adjustments, the US MoU is still above the European levels. We now turn to the reasons explaining this difference.

Lower levels in penetration and in the percentage of prepaid users

As the number of subscriber grows, the proportion of low usage customers in the operators' client base increases. This implies that the average minutes of use decreases as customers with less preference for the service purchase it later. Similarly, prepaid customers generally exhibit a low usage profile. As the share of this type of customer increases, average usage decreases.

We have not corrected US - MoU figures to control for this effect because we did not find reliable information to support the calculations. It is possible however to provide an indication of the potential magnitude of this effect. Littlechild (2006) estimates an elasticity of -2.3 on the impact of the percentage of prepaid customers on MoU. If we used this, and taking the percentage of prepaid customers in the US at 15% (source: FCC) and 60.9% for the EU (source: EC's 13th Implementation Report) the US MoU figures should be further reduced by 107 minutes.

Analysis of the US experience

Prepaid - postpaid customers in the US and Europe
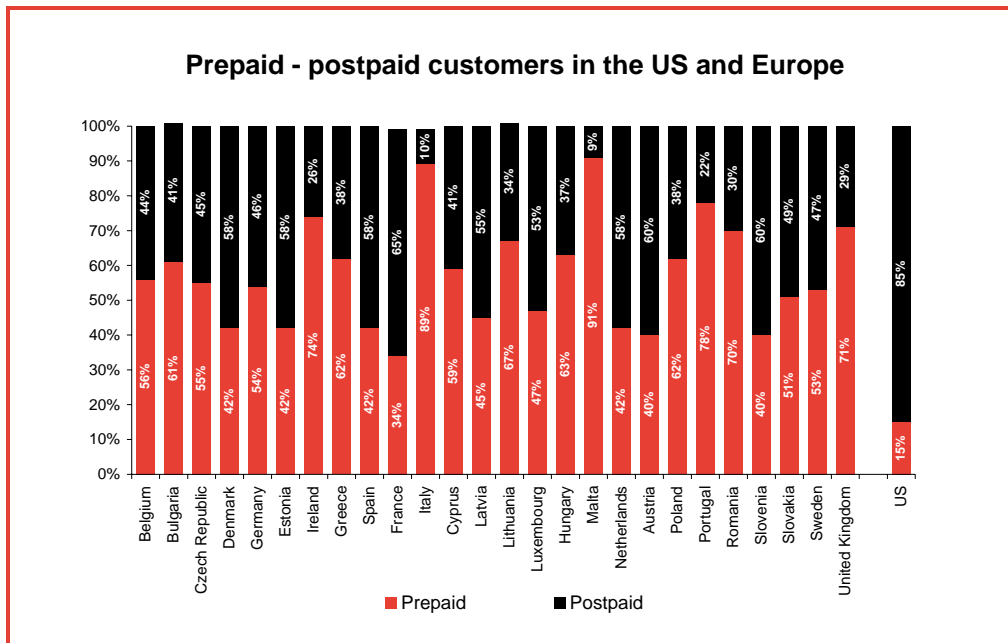
Figure 10: Distribution of prepaid and postpaid customers in Europe and the US

Source: FCC and European Commission

US price plans

The price plans in the US encourage the consumption of many minutes through the offering of "buckets" of minutes in post paid and the relative high prices of prepaid plans.

Post-paid wireless plans in the US are often "buckets" of minutes by which a monthly fee is paid for a specific number of minutes each month, whether they are used or not. If customer uses more minutes than in the monthly allotment, a much higher charge is paid for the extra minutes. Unused minutes do not carry over to the next month. For instance the cheapest post-paid plans are commercialized by T-Mobile and Sprint and offer 300 minutes a month at a cost of 29.99US$ (excluding taxes).

Most of these plans have free on-net calls, and free calls during nights and weekends. Usually customers must pay a sign-up fee an may get the phone free in exchange for signing up a minimum period of time (usually 2 years) subject to an early termination fee. For instance Verizon Wireless' contract termination fee starts at $175, and is reduced $5 per month for each full month toward the contract's term that the customer completes[45]. Family plans are becoming very

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[45]   Source: FCC (2008). The FCC has recently announced its intention to regulate the conditions to apply early termination fees, in order to ensure that all operators prorate the fees over the life of a contract and eliminate them when customers renew contracts and do not upgrade their equipment. Source: The Wall Street Journal, 13 June 2008)

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popular in the US. They allow several users to share a pool of minutes but are demanded mainly by medium and high users.[46]

The price of prepaid plans in the US also encourages the consumption of the postpaid ones. Standard (meaning European type) prepaid plans are not offered by all operators. They imply charges for incoming calls and a price per minute ranging from 10 to 33 US$ cents. The following table reflects the "pay as you go" plans offered by AT&T and T-Mobile (Sprint and Verizon wireless do not have prepaid plans announced on their web pages).

	Daily/monthly price	Anytime minutes	Text messaging	Top-up (US$)	Expiration (days)	Sign-up fee	Contract length	Minimum phone price	Taxes included
AT&T	0	0.25	0.15	15 25, 50, 75 100	30 90 365	0	0	9.99	No
T-Mobile	0	30	N/A	10	90	0	0	0	No
	0	130	N/A	25	90	0	0	0	No
	0	400	N/A	50	90	0	0	0	No
	0	1000	N/A	100	365	0	0	0	No

Figure 11: "Pay as you go" prepaid plans in the US

Source: Operator's web pages - consulted in June 2008

The figure shows that getting the cheapest price per minute requires 100 US$ expenditure, whilst the minimum expenditure leads to prices ranging from 20 to 30 US$ cents a minutes. In all cases, incoming calls are charged at the same price. It is also worth highlighting a couple of things regarding the top-up. Because incoming calls are charged, the US customers need to pay the top-up in order to have the phone active. Second, in the US, the expiration time is generally either 30 or 90 days while in comparison European countries, such as the UK and Germany, it is unlimited.

There are two other types of price plans offered in the US, which somehow reflects the complexity that these plans confer to the final users: (i) "pay by the day plans", by which the user pays a fixed amount (between 1-3 US$ every day he/she makes or receives a call); and (ii) monthly payments in exchange for a fixed number of minutes (offered by AT&T only).

The next table shows the pay by the day plans. To estimate the price per minute in this case, we need to make assumptions on the number of days where the customer will use the cellular (in the same way final customers will need to envisage how many days he/she wants the phone to be active, which highlights the complexities of these plans). It is clear that these plans encourage call concentration in specific days (to save in the fixed costs per day and spread them in a higher number of minutes) and switching the mobile off or not taking calls to avoid the fixed payments when the customer does not want to initiate calls.

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[46] For instance, Family plans are 76% of price plans for subscribers with monthly expenditure above 100 US$. For monthly expenditure below 20 US$, this ration is 19% approximately (source M:Metrics Inc). This is consistent with the prices of Family plans. The minimum expenditure for a Family plan is $60, while the minimum expenditure for an individual plan is $30. This means that, if two people are to share a plan, the monthly minimum expenditure is still a burden for low users. In addition, low fee family plans are not a very good deal when compared to individual plans. For example, the lowest fee family plan allows the user to talk 550 minutes, whereas he/she could obtain 900 minutes in an individual plan for the same price. However, for medium and high users they can be cheaper than individual plans.

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If the use is low, as one would expect in prepaid, the price per minute is high in comparison with postpaid plans. For instance, assuming that the customer calls 15 days a month and 3 calls per day, 1 in peak time and 2 at night time, with an average duration of 3 minutes for each call, the price per minute ranges from 0.21 to 0.34 US$ in the case of Verizon (and this does not account for the cost of the handset, 60US$); 0.21 for AT&T and 0.15 for T-Mobile.

Pay by the day										
Company	Daily price	Cost per minute	Weekend	Text messaging	Top-up (US$)	Expiration (days)	Sign-up fee	Contract length	Minimum phone price	Taxes included
Verizon	0.99	0.1	0.1	0.1	15-29.99	30				
	1.99	0.05	0.05	0.05	30-74.99	60	0	0	59.99	N/A
	2.99	0.02	0	0.02	75-99.99	90				
					100+	365				
AT&T					15	30				
	1	0.1	0.1	0.15	25, 50, 75	90	0	0	9.99	No
					100	365				
T-Mobile					10, 25, 50	90				
	1	0.1	0.1	N/A	100	365	0	0	0	No

Figure 12: Pay by the day prepaid plans in the US

Source: Operator's web pages

Regarding "monthly payments" type of plans, the one with the lowest monthly price (29.99 US$) implies a price per minute of 0.15 US$, applying also to incoming calls. The price per minute decreases and can be lower than 5 cents a minute, assuming that all minutes are consumed, but this requires a minimum expenditure ranging from 40 to 70 US$ and paying 10 US$ for the handset. At these levels, post-paid plans become more attractive for US customers.

In summary, the higher MoU in the US is explained by the type of price plans observed in this country, which encourages high consumption at low prices in exchange for high levels of monthly expenditure. The relative high prices of pre-paid plans, also implies that relatively low usage customers are excluded from the market, leading to a higher average level of minutes compared to Europe.

4.3.5 Average Revenue Per User (ARPU)

Before comparing with the US we have corrected European figures to account for double counting in mobile termination revenues. In CPP countries, ARPU figures include M2M termination revenues. As the price of outgoing M2M calls *offnet* also includes termination costs, these are counted twice.[47] In the US this problem does not arise because M2M interconnection is settled by using B&K.[48]

As the following figure shows, the ARPU per user is higher in the US than in the EU-27 before and after the adjustment. This is consistent with the price plans in the US, which are biased towards post-paid customers and the use of bucket of minutes in exchange for a high monthly expenditure.

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[47]   This issue arises regardless of level of termination rates.

[48]   This adjustment is explained in Annex 1.

Voice ARPU (EU€)

Figure 13: Average Revenue Per User (ARPU) comparison between US and European countries (€) (*see more details in Table 10 in Annex 4*)

Source: Frontier Analysis from Merril Lynch's information

Thus, the 29€ a month per customer[49] is 3 times higher than the average revenue obtained by mobile operators from customers in Central and Eastern European countries and 1.5 times higher than Western European ones. Taking the European average, the difference is 12€ a month per customer.

4.3.6 Revenue per minute

Revenue per minute (RPM) is used in international comparisons as a proxy for retail prices. Following the adjustments in the MoU and the ARPU, the RPM figures change accordingly, as they are calculated as the ratio between the ARPU and the MoU.

Below we reported the RPM figures in US$ and in Purchasing Power Parity (PPP) US$. The latter reflect an exchange rate which takes into account the different cost of life between the US and European countries.

After the adjustments, the RPM figure for the US rises from 4€ cents per minute to 7€ cents or 9US$ cents (PPP), although it is still below the European level.

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49   Note that this figure does not vary with the adjustment as the double counting problem does not arise in the US.
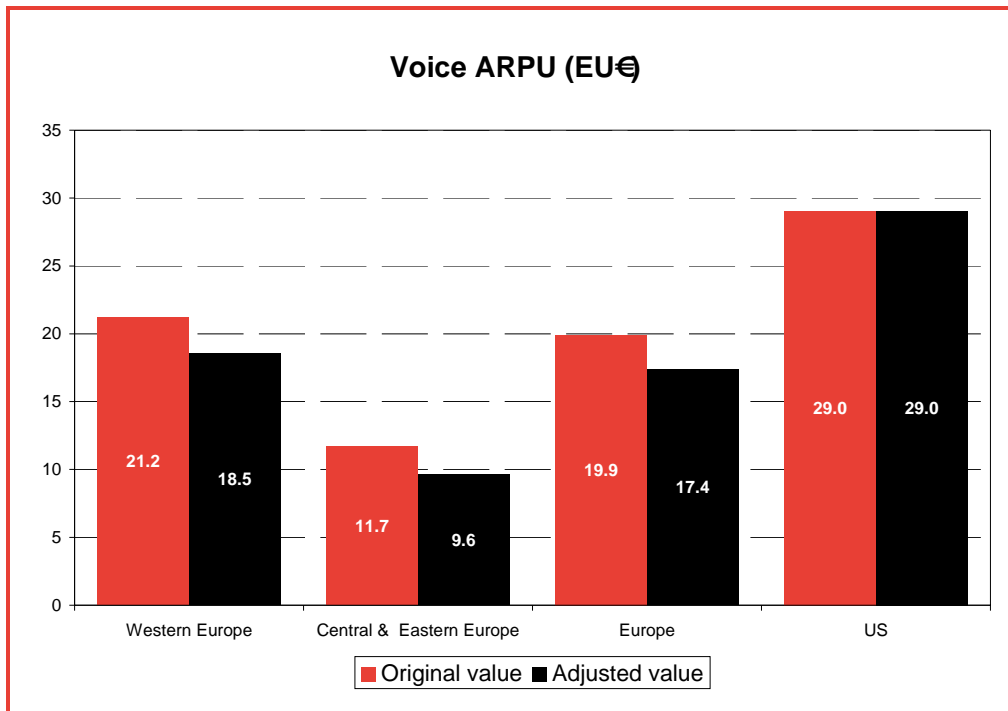
RPM (EU€)
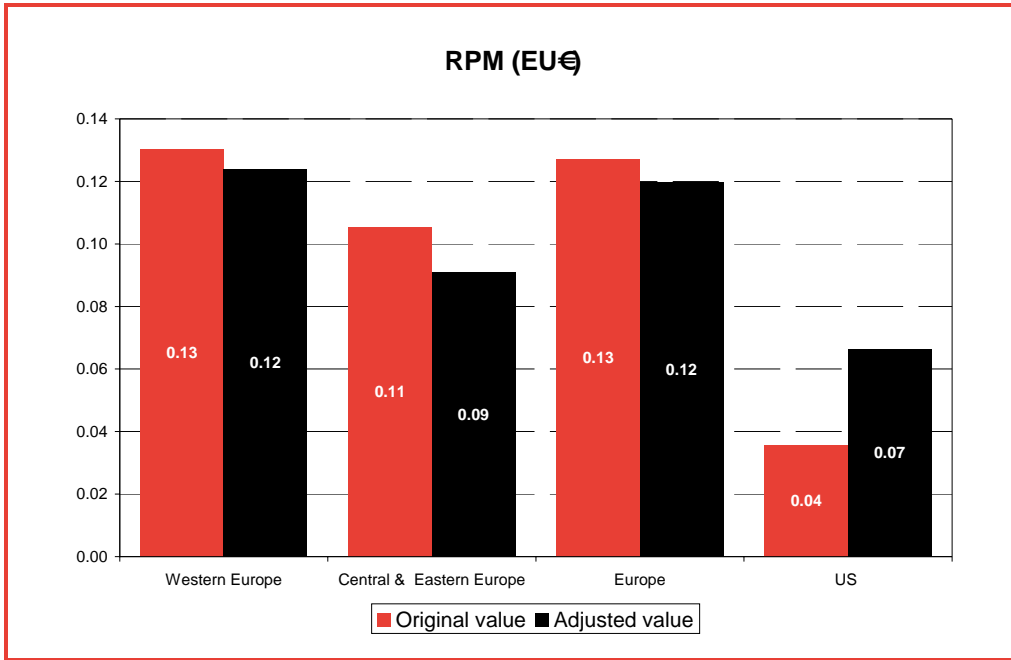
Figure 14: Revenue Per Minute (RPM) comparison between US and European countries (€) (*see more details in Table 11 in Annex 4*)

Source: Frontier Analysis from Merril Lynch's information

RPM - PPP (International$)
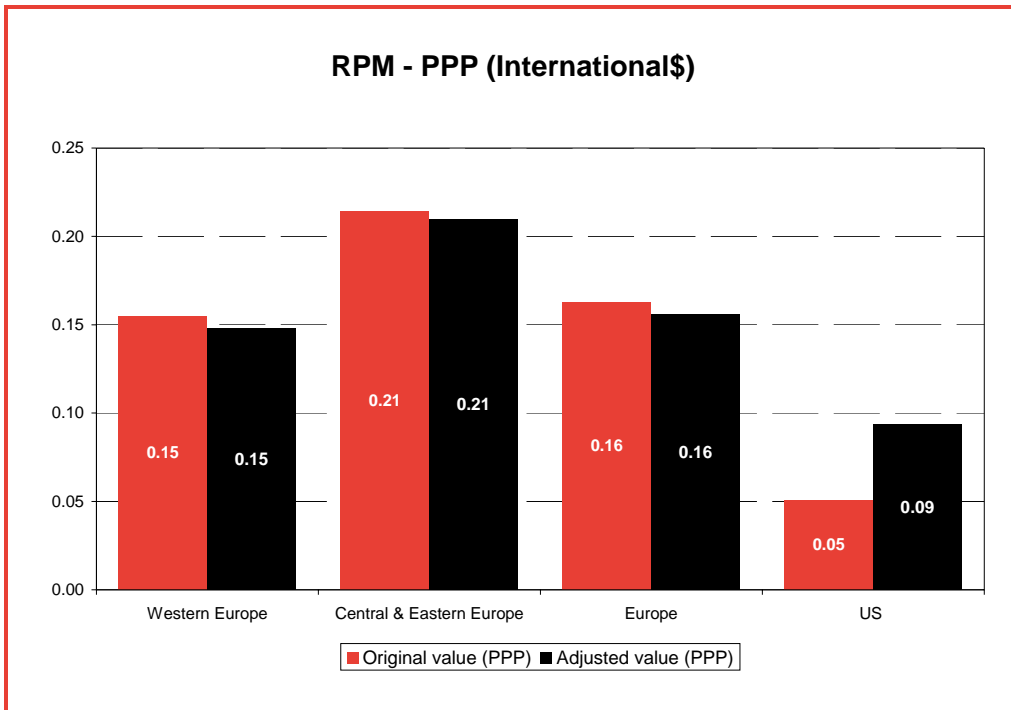
Figure 15: Revenue Per Minute (RPM) comparison between US and European countries

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(PPP US$) (*see more details in Table 12 in Annex 4*)

Source: Frontier Analysis from Merril Lynch's information

Note that there are still other factors that have not been taken into account and could partly close the gap between the RPM of the US and Europe:

- The higher percentage of prepaid customers implies lower MoU, which leads, ceteris paribus, to higher RPMs. If we use the elasticities reported in Littlechild (2006) to adjust for this, the MoU in the US would decrease by in 107 minutes, and the RPM would increase to 0.09 US$ cents/minute.

- The higher income per capita in the US, which ceteris paribus, leads to higher traffic consumption and lower RPM in the US. We have not found reliable estimates on income elasticities to adjust the US' MoU and RPM figures.

Lower US RPM figures should not be surprising as demand cannot absorb the large amount of traffic offered by the operators without corresponding call reductions. However this should not be interpreted as evidence of consumers being better off in the US. We deal with this issue in the following section.

4.4 IMPLICATIONS FOR EUROPEAN MOBILE CUSTOMERS

After accounting for the differences in the measurement of subscribers, MoU, and ARPU, we conclude that those customers with a cellular in the US consume more minutes, at lower prices per minute, and have higher expenditure as measured by ARPUs.

The US model also produces a gap in geographic coverage and in penetration.

Given these differences, a key question is to what extent EU customers would be better off with the US system. This is the focus of our next Section.

4.4.1 Implications for the welfare of European customers[50]

The fact that US customers consume more minutes at lower prices (leading to higher expenditure) than their Europeans counterparts does not necessarily imply that US customers are better off.

This would only be the case if US customers had the option to choose European type of plans and they refused it. In other words, US customers would be better off under the US offers if they could reduce their expenditure by reducing the number of conversation minutes but decided not to do it.

But this is clearly not the case. As we have seen, US pricing plans offer the option of talking much more minutes in exchange for a high monthly fee. Other

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[50] To keep this section simple, we have not sought to quantify the impact of the lower levels of penetration and coverage in the US, beyond the simulation analysis undertaken in the previous section. If falls in penetration compared to what they would have been under the existing system, were the outcome of using such a system in Europe, as our modelling implies, this would produce a considerable harm for European customers.

plans like paying lower line rentals and getting higher price per minute for each call are not available. The options left for a customer who does not want to talk as much as say, 500 minutes a month, unlimited on-net calls, etc. in exchange for paying a smaller monthly bill are either taking an expensive prepaid plan or not subscribing at all.

The conclusion would be different if the US monthly bills were lower than in the EU but had the same MoU as they currently have. European customers would then be unambiguously better off under these plans because they would give them more minutes and lower expenditure. However this is not the case.

In fact, the available evidence suggests that the European consumer would be worse off under the US plans. If we use the OECD telecommunications consumption basket, (which is not an unreasonable assumption as the OECD basket is used in the EU's Implementation reports) we can compare how much a European customer would spend with US and European plans. This is shown in the next figure.

Cost of OECD baskets (International US$)

	Low user	Medium user	High user
Western Europe	15,8	35,5	55,6
Central & Eastern Europe	19,3	39,7	71,5
US	15,9	52,4	53,1
US (including cost of incoming calls)	19,6		
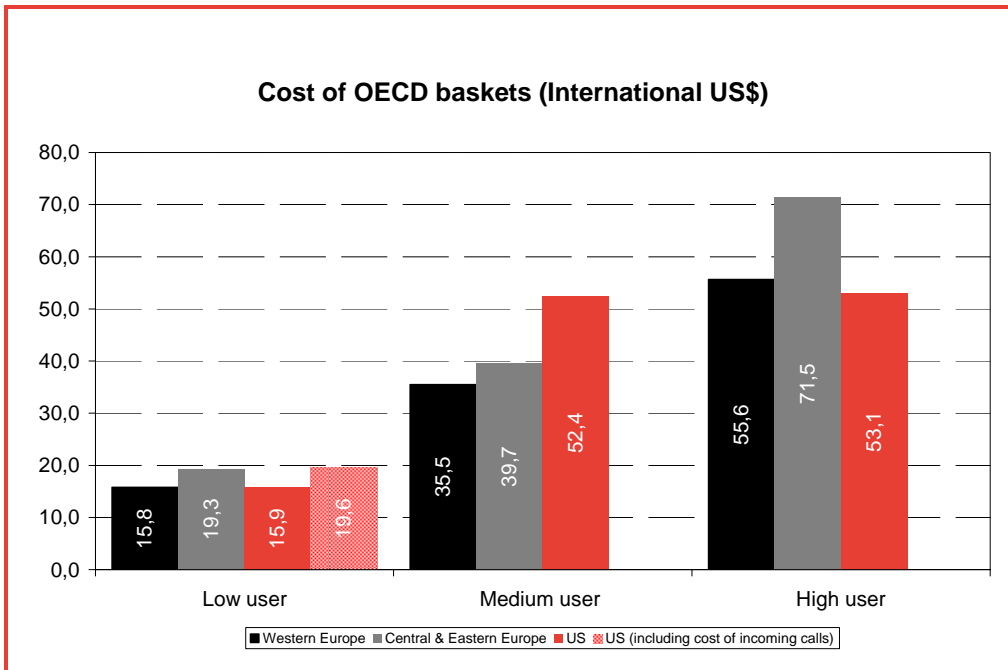
Figure 16: Mobile expenditure for OECD countries: low, medium and high user

Source: OECD Communications Outlook, pages 216-218

The OECD baskets consider only outgoing calls. When comparing the costs for the same number of calls between RPP and CPP countries, the charges for incoming calls are not included. The US figures are therefore underestimated, in this comparison, as they are compared with CPP countries, which offer all incoming minutes free. In summary therefore:

- The comparison shows the effect of the US pricing plans, namely that they offer a good deal for high consumers of mobile minutes/services.

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The minimum[51] expenditure for high users in the US is lower than in European countries.

- As the usage intensity decreases, the US price plans score worse. This is clearly observed for medium users, where the US minimum expenditure is 13 and 17 PPP US$ higher per month, than those in Western and Central and Eastern European countries. Put differently, according to these calculations, a medium user in a European country would pay more than an additional $200/per year if only US plans were available.

- The US scoring for low users seems to indicate that the US is cheaper than the average of European countries. Unfortunately the OECD does not indicate what price plan is used for the US. We believe that this result is based on the "pay as you go" AT&T prepaid price plan which charges 0.25US$/min for outgoing and incoming calls, and 0.15US$ per SMS.[52] As we have seen earlier in this section, prepaid plans in the US do not look appealing for low users and, in fact, prepaid penetration in the US is a fraction of European levels.

- As indicated earlier, the calculation of the minimum monthly expenditure is not considering that incoming calls are charged in this prepaid plan. As an illustration, it would require subscribers to this package to receive only one incoming call for each three outgoing calls, for the minimum monthly expenditure to become 19.6 US$, above the European levels. Thus, we think that the result for the US must be treated very cautiously in this case. This is supported by other studies, which found that the minimum expenditure for low users is higher in the US than in the European countries including Sweden, Netherlands, Norway, the UK, Italy, France and Germany.[53]

The GSMA (2008) has released a report which reinforces the above results. More specifically, it reflects that when including the costs of incoming calls and applying the OECD methodology, the US plans offer a good deal for high users but not for medium and low users (as reflected in the following three Figures).

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[51] The OECD basket comparison assumes the choice of the least cost option for any given level of usage.

[52] If we apply this price plan to the OECD low user profile we obtain a minimum expenditure of 15.95US$, quite similar to that reported for the OECD.

[53] Analysys (2007)

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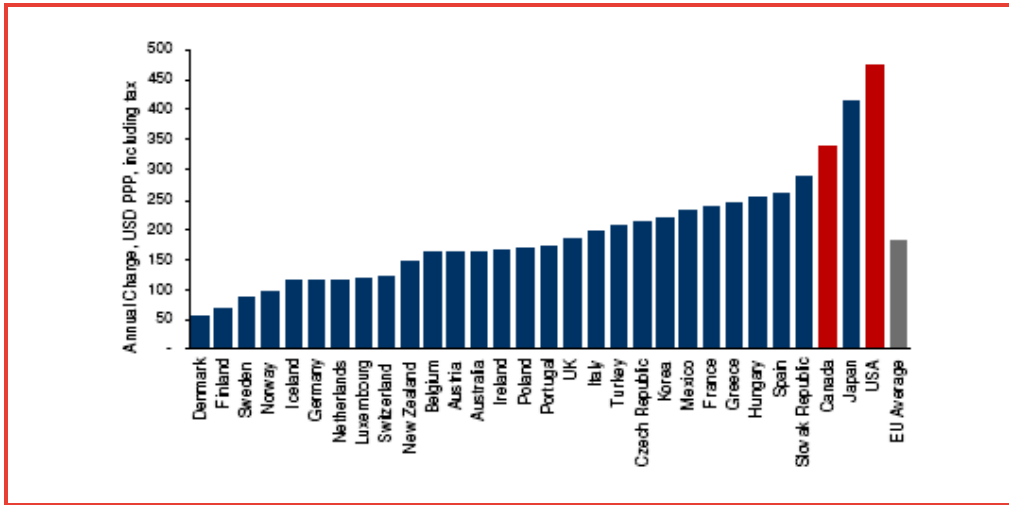
Figure 17: Adjusted OECD basket of low user mobile telephones, May 2008
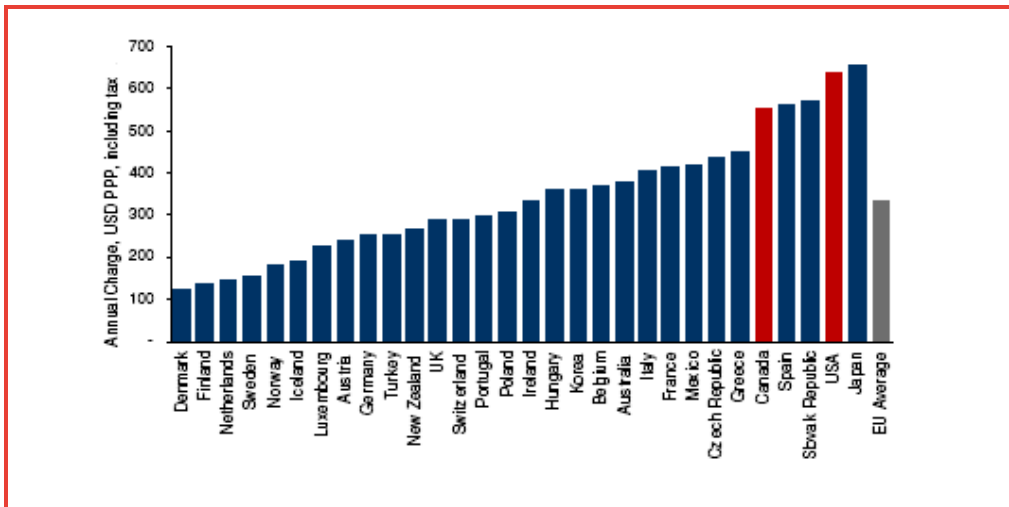
Source: GSMA (2008)

Figure 18: Adjusted OECD basket of medium user mobile telephones, May 2008

Source: GSMA (2008)

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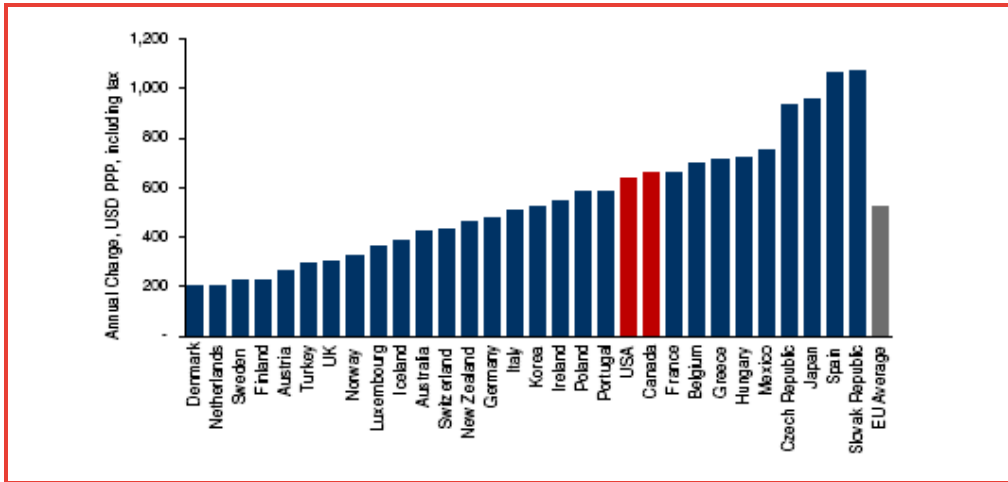
Figure 19: Adjusted OECD basked of high user mobile telephones, May 2008

Source: GSMA (2008)

4.5   CONCLUSIONS

In this section we have reviewed the existing evidence supporting mobile systems with low or zero termination rates. We have argued that this evidence cannot be used to support a regulatory action to move towards the interconnection regime existing in these countries.

If we take the US example, which is a reasonable benchmark to compare with, we can conclude that its performance in terms of penetration and coverage is well below the European standards, so in this respect, European customers are much better off.

Regarding the other metrics such as MoU, ARPU we find that the US customers consume more minutes but at higher monthly expenditures than their European counterparts. As the option of consuming less minutes, paying more per minute and having lower overall expenditure is not available for US customers, we can not conclude on the basis of this evidence that they are better off than European users.

Additional evidence on the relative position of different types of user suggests that only high users would be better off. Medium and low user customers would be worse off as they prefer a lower level of minutes in exchange for a lower monthly expenditure, even if they imply a higher price per minute. This is not surprising when looking at US price plans: postpaid plans imply higher minimum consumptions (the cheapest option is 30 US$ per month) and prepaid plans are not as appealing as in Europe (which would explain the much lower levels of prepaid customers in the US).

The overall effect on consumer welfare for existing subscribers of having US-type price plans will depend on the proportion of high vs. medium and low users customers. The proportion of medium and low usage profile subscribers is much higher than high usage subscribers, as the MoU for high user is more than 300

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minutes a month, well above the average MoU of European customers, around 160 minutes, as reported by Merril Lynch. We would therefore expect a significantly larger number of subscribers to be worse off, compared to the number of subscribers that would be better of if US tariff plans were offered in Europe.

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5 Mobile termination costs and the EC recommendation

5.1 INTRODUCTION

The Commission has published recently a recommendation on the regulatory treatment of fixed and mobile termination rates in the EU[54]. The objective of the recommendation is to achieve a further level of harmonisation across EU member states in relation to the approach followed by NRAs in determining cost oriented termination charges. In relation to mobile termination, the motivation for the recommendation is the observation that there is a significant variation in the approach of different NRAs to the setting of cost oriented mobile termination rates, and the resulting levels of termination across different EU states.

Consistent with economic theory, the recommendation supports the setting of cost oriented mobile termination rates by NRAs. However, the current Draft of the EC Recommendation includes proposals that could lead to prices being set at a level significantly below the efficient level. More specifically, the recommendation is proposing that:

○ ***The incremental cost of wholesale voice call termination should exclude coverage costs*** (see *'Principles for the calculation of wholesale termination rates in mobile networks'*, in the Annex of the Draft Recommendation).

○ ***The termination costs should exclude any contribution to the recovery of fixed and common costs***, on the grounds that the termination charge needs to reflect the benefits of receiving calls, and hence should be set below "average" cost (Paragraph 14 of the Draft Recommendation)

○ **A bottom up LRIC model should be used as a benchmark of the efficient network costs with the assumption of NGN (all-IP) technologies** as the basis for modelling the core network (Paragraph 11 of the Draft Recommendation).

In this section of the report we provide our assessment of the recommendation in relation to the setting of mobile termination rates, focusing on two key arguments that relate to this report:

○ First, whether there is a justification for excluding 'coverage network costs' and other fixed and common costs; and

○ Second, whether the Commission's recommendation in respect of costing of an efficient network is appropriate.

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[54] Draft Commission Recommendation on the regulatory treatment of fixed and mobile termination rates in the EU, Brussels C(2008)

5.2 TREATMENT OF FIXED AND COMMON COSTS

5.2.1 Proposed increment structure

The Commission proposes that only those costs which are "avoidable" to the provision of mobile termination should be recovered from MTRs. Coverage costs, as costs which are fixed with respect to traffic, are specifically identified as a cost which should not be recovered from MTRs. Full cost recovery would require that operators recover fixed and common costs from the other services delivered over the network.

5.2.2 Recovery of coverage network costs

As indicated above, the Commission is arguing that the costs of a minimum coverage network requirement should be excluded from the calculation of termination costs, as they are not incremental to the provision of this service. The Commission seems to be proposing therefore that the current structure of charges for mobile services may not be efficient, and that the costs of a minimum coverage network should *not* be recovered from call charges. There are two important distinguishing characteristic for the provision of mobile services:

○ First, the cost structure of mobile networks is different to that of fixed networks, with the copper access network being dimensioned based on the number of customers served –i.e. independently of the level of traffic, while the radio access network in mobile networks being dimensioned based on the level of traffic -to a large degree independently of the number of subscribers[55].

○ Second, unlike the pricing structure of fixed communications services, the pricing structure of mobile services has evolved in what are widely recognised to be competitive markets, reflecting the underlying costs.

The pricing structure faced by the vast majority of mobile subscribers is pre-pay, where following the acquisition of a handset, call prices paid by subscribers cover all the costs of the mobile services they consume. This is in line with the principle of cost causality – the costs of adding an additional subscriber to the network is immaterial, and prices paid by mobile subscribers enable them to make and receive calls wherever they are. They therefore cover the cost of the whole mobile network, including any coverage cost. The same applies to calls received by mobile subscribers, as these can be received wherever calls can be made.

In relation to post-pay subscribers, there has also been a proliferation of the offer of 'packages' of minutes by most mobile operators throughout the EU. Post-pay subscribers' monthly subscription costs include therefore, the costs, of making a

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[55] The cost of a hypothetical minimum "coverage" network would be independent of both the number of subscribers and of the volume of traffic but could be considered a fixed and common cost. Such a cost may be efficiently recovered by applying a Ramsey pricing rule. However the incremental cost of any notional "access service" purchased by mobile subscribers is minimal as very few costs are subscriber driven, hence the majority of coverage costs under a Ramsey pricing rule would be recovered through traffic services

certain number of calls. Thus, there is no indication in relation to the retail pricing structure faced by post-pay subscribers that the charges reflect a distinction between a 'coverage' element, and a 'usage' element. Any recurring subscription element may be related to efficient recovery of the relatively high "retail" costs associated with serving contract customers.

The analogy that seems to be drawn by the Commission between mobile and fixed services, seems therefore flawed. The Commission recognises itself that the setting of termination charges needs to try and achieve, to the extent possible, an efficient allocation of resources, as would be the outcome in a competitive market. For example, it states in relation to the appropriate cost accounting concept (see Paragraph 9 of the Draft Recommendation):

In a competitive environment, operators would compete on the basis of current costs, and would not be compensated for costs which have been incurred through inefficiencies

In competitive mobile markets the pricing structure that has emerged for the vast majority of mobile customers does not distinguish between 'coverage' and 'capacity' charges in relation to outbound mobile calls. The Commission has not provided a clear cost causality rationale as to why inbound calls should be treated any differently from outbound calls, when it comes to the NRAs' approach to setting termination charges to achieve an overall efficient pricing structure.

5.2.3 Exclusion of other common costs

The Commission is also arguing that no other fixed and common costs between the termination and other services should be recovered from the termination rate set by NRAs. The grounds on which this seems to be argued is that NRAs should recognise the presence of call externalities, and therefore seek to set termination rates below cost. As indicated in the earlier part of our report, the presence of call externalities can justify the setting of termination rates below cost. As discussed earlier however, in the presence of network externalities the reverse is desirable. The evidence on the magnitude of the two externalities is relatively limited, especially in relation to the value called parties attach to calls received (the call externality). There should therefore not be a presumption that the appropriate level of termination rates is below cost – this is an empirical question.

Even if call externalities were present and required the setting of termination rates below cost, there is no reason a priori to expect any relationship between such externalities and the magnitude of fixed and common costs. In this respect, the justification provided by the Commission for NRAs to seek to reduce or eliminate any contribution made by termination rates to the recovery of fixed and common costs, seems totally unfounded.

Finally, operators must recover fixed and common costs in the long run in order to maintain investment incentives. Ramsey pricing rules set out the optimal recovery of fixed and common costs in order to maximise efficiency – these require that recovery of such costs is done in inverse proportion to the demand (super) elasticities for the relevant services. Due to practical difficulties in applying Ramsey pricing rules, regulators have set regulated prices using

mechanical rules such as Equi-Proportionate Mark Ups (EPMU) and the LRAIC (Long-Run Average Incremental Cost) approach to recover a proportion of fixed and common costs from regulated prices (see Annex 3 for a description of the different approaches).

A "pure" LRIC approach, as seems to be advocated by the Commission, by setting the price of regulated services to only include the avoidable costs of delivering that service will, by definition, recover no fixed and common costs from that service. A zero allocation of common costs to a service cannot be consistent with a Ramsey pricing rule, as this would require that the super-elasticity for the service to be infinitely higher than for other services. Thus, even in the presence of call externalities, a "pure" LRIC approach would result in prices that were demonstrably inefficient.

5.3 THE PROPOSED COST ESTIMATION APPROACH

5.3.1 Indirect costs

Paragraph 4 of the draft recommendation identifies avoidable costs and common costs, with a manager's salary being given as an example of a common cost. This classification ignores the existence of indirect costs, those costs which have an indirect causal relationship with delivering an increment of demand. Thus, for example, while an individual manager's salary may not directly relate to the delivery of mobile termination services, if this increment was not required, there would be a reduction in the network infrastructure required, in the number of staff maintaining the network and hence in the number of managers required. Thus managers' salaries can have an indirect causal relationship with the delivery of MTRs, and should be considered avoidable costs.

The Commission's proposals, to the extent that they propose identifying indirect costs as common costs rather than avoidable costs, would underestimate the level of incremental costs.

5.3.2 Bottom-up modelling

Regulatory network costing should attempt to derive a best estimate of the expected forward looking costs of an efficient operator. It should be noted that in a competitive market, the actual level of costs would be expected to be in a range around this efficient level of costs, reflecting risks associated with making investment decisions without perfect foresight.

Basing information on a bottom up model alone risks producing inaccurate estimates of the level of costs for a number of reasons:

- Inaccurate estimation of the number of network elements required, by failing to take full account of issues such as terrain and non-homogeneity of demand when estimating costs;

- Inaccurate estimation of operating costs incurred by failing to reflect country specific characteristics, such as for example terrain, required capacity and coverage in different parts of the country (e.g. to reflect

tourism flows, or seasonal demand), differing operating costs in different types of regions; and

- Not taking full account of the costs associated with migration to new technologies.

Mobile operators have generally developed their businesses in a competitive market, with strong incentives to minimise costs.[56] Therefore, where possible, a validation exercise should attach weight to evidence indicating the actual costs of mobile operators, compared to cost estimates produced from 'hypothetical' cost models.

5.3.3 Considering new technology

The costing exercise should take account of an operator's need to upgrade the network over time to minimise costs. However this must consider the series of investment decisions made by operators over time rather than simply being based on the latest available technology. For example, given the constant evolution of technology, it may be more cost efficient to not deploy the latest technology, but to wait until current technology provides a material benefit and/or the existing technology is no longer fit for purpose. [An example can be seen in PC operating systems where the introduction of a new operating system, for example Windows Vista, does not result in all businesses immediately migrating to this new system].

The Modern Equivalent Asset principle within Current Cost Accounting allows this constant technological progress to be reflected in costs without requiring bottom-up models to constantly reflect cutting edge technology.

The Commission's proposed requirement that the modelling of the core network should be based on NGNs, when such networks are only now beginning to be deployed, does not appear to fully recognise either the current cost base of operators or the existing, well established, treatment of technological evolution in Current Cost Accounting. Given the limited operating experience on NGNs, there is a strong risk that such an approach would produce inaccurate estimates.

5.4   CONCLUSIONS

In this chapter we examined the Commission recommendation on the regulatory treatment of fixed and mobile termination rates in the EU, as far as it relates to some key aspects of setting of appropriate mobile termination charges. We have argued that:

- The Commission's proposal to exclude the costs of a minimum 'coverage' network from the costs that are recovered from call services, is not justified on cost causality principles, and is inconsistent with the pricing structures observed in competitive mobile markets for such services;

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[56]   The fact that call termination may be considered a bottleneck does not affect this conclusion. As most assets are common between call origination and termination, the beneficial effect of competition on minimising the costs of call origination spread over call termination services.

○ The Commission's proposal to exclude from the mobile termination rate, any contribution to the recovery of fixed and common costs and of indirect costs, is very unlikely to lead to an efficient pricing structure, as there is no relationship between the magnitude of such costs and the materiality of any call externality. Even in the presence of call externalities, we would expect an efficient pricing structure to require all services to make some contribution to the recovery of all these costs.

○ The requirement that the modelling is based on an NGN network, when such technology is now beginning to deploy, risks to produce inaccurate estimates.

Mobile termination costs and the EC recommendation

6 Conclusions

In this report we have analysed what would be the likely impact on consumers of drastically reducing mobile termination rates (MTRs) below efficient levels. The conclusions are as follows:

○ Both the economic theory and the empirical evidence indicate that consumers can not be expected to be better off by reducing MTRs below cost.

○ There is no evidence showing that efficient MTRs are below costs. In fact, existing information points to low non-internalised call externalities. Thus cost based MTRs seem to be the most reasonable benchmark to set regulated prices.

○ The reduction in consumer welfare of setting inefficiently low MTRs is likely to be substantial. These losses come from the lower level of subscription compared to a counter-factual of termination rates being set at cost. The lower level of subscription is the result of higher retail prices, as the costs of incoming calls are not covered by termination revenues.

○ Consistently with the economic theory, the US experience exhibits relatively low penetration and coverage and high usage. If the US price plans were applied to Europe, we estimate that heavy users would be better off, while low and medium users would be worse off. It is this reduction in value for less intensive users that explains the lower levels of penetration in the US, and the low number of prepaid users. Overall, more European customers would be expected to be worse off, as the proportion of low and medium users is higher than the proportion of high users, in Europe.

○ As currently drafted, the EC recommendation on the regulatory treatment of fixed and mobile termination rates will likely underestimate the costs of terminating calls.

Annex 1: Adjustments in MoU and ARPU

The purpose of this annex is to explain the adjustments made to the MoU and ARPU reported by the mobile operators in order to make homogeneous US-EU comparisons.

We make three adjustments

- MoU Adjustment #1: to transform billed minutes into conversation minutes in both the US and the European countries;

- MoU Adjustment #2: to control for the double counting of on-net calls in the US– as they are billed to both the outgoing and the incoming leg of the call; and

- Voice ARPU Adjustment #1: to remove termination revenues from the voice ARPU of operators in European countries because their ARPU includes M2M termination revenues twice (via retail prices charged to customers and via termination revenue charged to other operators).

MOU ADJUSTMENT #1: FROM BILLED MINUTES TO CONVERSATION MINUTES

The billing method is different across countries: while all US operators bill by minutes, which implies that conversation time is rounded up to the next full minute increment, there is a wide range of billing methods in the EU (by seconds, by minutes, with a minimum charge of 30 or 60 seconds, etc.).

In addition, there are two other main differences in billing that must be taken into account: ring time and unanswered calls, which are always free in Europe but not in the US.

We therefore need to transform the MoU reported by the operators, which generally correspond to billed minutes, to conversation minutes. In order to do so we calculate, for each European country under study, a conversation time/billing time ratio (or Adjustment #1 ratio, A1R). This ratio is used to multiply the original MoU figure to obtain the (Partially) Adjusted MoU for each country, which reflects conversation minutes of use.

Partially Adjusted MoU = Original MoU[57] * A1R   (1)

To calculate the conversation time/billing time ratio for a given country we divide the average conversation time by the average billing time.

$$A1R = ACT/ABT   (2)$$

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[57]   The MoU is taken from Merrill Lynch's Q407 Global Wireless Matrix

where:

ACT = average conversation time (seconds)

ABT = average billing time (seconds)

We obtain the information regarding the average conversation time from the OECD basket for medium user (108 seconds)[58]. Following the standard procedure to transform billing time into conversation time, we calculate the average billing time.

$$ABT = MC + BI * e^{(-MC/ACT)} / 1 - e^{(-BI/ACT)} \qquad (3)$$

where :

ABT = average billing time (seconds)

MC = minimum charge (seconds)

BI = billing increment (seconds)

ACT = average conversation time (seconds)

For Europe, we obtain MC and BI for each country from Teligen's OECD Telecoms Price Benchmarking Baskets 2006, which describes the billing methods of EU mobile operators. ACT is taken from the OECD medium-user basket (108 seconds). We therefore have data for all the variables in (3) except for ABT, which we can calculate by solving the equation above.

Example

As explained above, Average Conversation Time (ACT) for Austria is 108 seconds. The minimum charge (MC) for an Austrian consumer is 60 seconds, and the billing increment (BI) is 30 seconds. Using equation (3) we conclude that the Average Billing Time (ABT) equals 131 seconds.

$$ABT = 60 + 30 * e^{(-60/108)} / 1 - e^{(-30/108)} \qquad \rightarrow ABT = 131$$

This implies that the conversation time/billing time ratio (or Adjustment 1 ratio, A1R) equals 0.83.

$$A1R = ACT/ABT = 108/131 = .83$$

We now multiply the MoU reported by Merrill Lynch for Austria (192 minutes) by A1R to obtain the (Partially) Adjusted MoU:

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[58]   Teligen, OECD Telecoms Price Benchmarking Baskets 2006

Annex 1: Adjustments in MoU and ARPU

Partially Adjusted MoU = 192 * .83 = 159 minutes

We see from this last equation that the MoU adjustment for Austria is 17% (i.e. 1 - .83). The adjustment for the rest of the EU countries varies depending on the billing method and ranges from 23% for Italy and Finland to 0% for those countries that bill by second.

For the US, we use the same methodology – assuming call duration follows a negative exponential distribution – but we adapt it to take into account the fact that customers are billed for ring time and sometimes for unanswered calls. We know the formulae for the average billing times of answered and unanswered calls.

$$ABT_{AC} = MC + BI * e^{(-MC/(ACT+MRT_{AC}))} / 1 - e^{(-BI/(ACT+MRT_{AC}))} \qquad (4)$$

> where :
>
> ABT_{AC} = average billing time for answered calls (seconds)
>
> MC = minimum charge (seconds)
>
> BI = billing increment (seconds)
>
> ACT = average conversation time (seconds)
>
> MRT_{AC} = mean ring time for answered calls (seconds)

$$ABT_{UC} = MC + BI * e^{(-MC/MRT_{UC})} / 1 - e^{(-BI/(MRT_{UC})} \qquad (5)$$

> where :
>
> ABT_{UC} = average billing time for unanswered calls (seconds)
>
> MC = minimum charge (seconds)
>
> BI = billing increment (seconds)
>
> MRT_{UC} = mean ring time for unanswered calls (seconds)

We also know the formula for the (weighted) average billing time.

$$ABT = ABT_{AC} + \alpha * ABT_{UC} \qquad (6)$$

> where:
>
> ABT = average billing time (seconds);
>
> ABT_{AC} = average billing time for answered calls (seconds);
>
> ABT_{UC} = average billing time for unanswered calls (seconds); and
>
> α = billed unanswered calls/answered calls

Annex 1: Adjustments in MoU and ARPU

All companies bill by minutes in the US, which implies that both MC and BI are 60 seconds. We assume MRT_{AC} and MRT_{UC} are 15 and 25 seconds, respectively. According to CTIA's Semmi-Annual Industry Survey 2007, ABT for the US is 204 seconds. α is the product of two elements: the percentage that unanswered calls represent over answered calls and the percentage of unanswered calls that are billed to customers. We assume unanswered calls represent 15% of answered calls and we calculate the percentage of calls that are billed to customers taking into account the different policies of US operators. Specifically, Verizon Wireless and AT&T charge for all unanswered calls with ring time exceeding 60 and 30 seconds, respectively. Sprint never charges for unanswered calls. As we did not find information for the other operators, we have conservatively assumed that the rest of operators do not charge for unanswered calls. Using the operators market shares reported in *Q407 Global Wireless Matrix*, we conclude that 21% of unanswered calls are billed to customers. This implies that billed unanswered calls are 3% (15% * 21%) of answered calls, i.e., $\alpha = .02$.

We now have 3 equations with three unknowns (ACT, ABT_{AC} and ABT_{UC}), so we are able to solve the system and obtain ACT, which is equal to 157. This way we can calculate the Adjustment 1 ratio for the US and apply it to the MoU reported by Merrill Lynch to obtain the (Partially) Adjusted MoU.

$$A1R = ACT/ABT = 157/204 = .77 \tag{7}$$

$$\text{Partially Adjusted MoU} = \text{Original MoU}^{\bullet} * A1R = 812 * .77 = 624 \tag{8}$$

In other words, US reported MoU should be reduced by 23% (i.e. 1 - 0.77) to reflect true conversation minutes.

MOU ADJUSTMENT #2: ON-NET CALLS

The number of billed minutes differs between RPP countries and CPP countries. In RPP countries on-net minutes are billed twice, both to the person who makes the call and to the person who receives it. However, under CPP on-net minutes are billed once, only to the person who makes the call. As the next table shows, billed minutes for the other types of calls are the same under both systems.

$^{\bullet}$ We take the original MoU from Merrill Lynch's Q407 Global Wireless Matrix

Annex 1: Adjustments in MoU and ARPU

	CPP minutes	RPP minutes
F2M	1	1
M2M on-net	1	2
M2M off-net	2	2
M2F	1	1
M2International	1	1
Received in mobile abroad	1	1
Others	1	1

Table 7: Billed minutes under RPP and CPP

Source: Frontier Economics

By using the traffic distribution shown in the next table (which corresponds to Spain[59] as we did not have data for the US) we estimate that 1 conversation minute is counted 1.23 times in CPP countries[60], i.e. EU countries, and 1.74 times in RPP countries[61] such as the US. The ratio between these two values gives us a conversion factor (A2R) equal to 0.71 which is to be applied to RPP minutes.

In other words, we know each minute is counted 1.74 times in RPP countries but only 1.23 times in CPP countries. Therefore, if we want to adjust the MoU in a RPP country in order to compare it with the MoU in a CPP country we need to divide the original MoU by 1.74 and multiply it by 1.23 or, equivalently, multiply the original MoU by 0.71.

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[59]   CMT, Annual Report, pp. 198, 221

[60] $1.23 = 10\% * 1 + 51\% * 1 + 23\% * 2 + 11\% * 1 + 1\% * 1 + 1\% * 1 + 3\% * 1$ (see table 2)

[61] $1.74 = 10\% * 1 + 51\% * 2 + 23\% * 2 + 11\% * 1 + 1\% * 1 + 1\% * 1 + 3\% * 1$ (see table 2)

Annex 1: Adjustments in MoU and ARPU

	Call distribution	CPP minutes	RPP minutes
F2M	10%	1	1
M2M on-net	51%	1	2
M2M off-net	23%	2	2
M2F	11%	1	1
M2International	1%	1	1
Received in mobile abroad	1%	1	1
Others	3%	1	1
Billed calls	100%	1.23	1.74
Conversion factor RPP to CPP	= 1.23/1.74 = 0.71		

Table 8: RPP minutes/CPP minutes ratio

Source: Frontier Economics

We apply this adjustment to the Partially Adjusted MoU to obtain the Adjusted MoU.

Adjusted US MoU = Partially Adjusted US MOU * A2R   (8)

Adjusted US MoU = 624 * .71 = 442   (9)

As on-net traffic is free in the US, the proportion for this type of traffic is presumably higher in the US than in Spain, which would produce a lower conversion factor. By taking the proportion of on-net traffic for Spain we are underestimating the double-counting problem and overestimating the difference in MoU between US and Europe.

VOICE ARPU ADJUSTMENT #1: TERMINATION REVENUES

CPP operators include wholesale termination revenues in the ARPU figures. As the price of outgoing M2M off-net calls also includes termination payments, these are counted twice. This problem does not arise in the US as M2M interconnection is settled by using B&K. We therefore subtract the wholesale termination revenues (TR) obtained by European operators from their original ARPU data.

Annex 1: Adjustments in MoU and ARPU

Adjusted Voice ARPU = Original Voice ARPU$^\bullet$ – TR   (10)

We estimate TR by multiplying M2M Termination Minutes by the Mobile Termination Rate (MTR) in each country.

TR= MTR * M2M Termination Minutes

M2M Termination Minutes for each country are obtained multiplying the MoU by the Proportion of M2M Off-net Traffic.

M2M termination minutes = Adjusted MoU * Proportion of M2M Off-net Traffic (11)

Finally, the proportion of M2M off-net traffic (.19) is taken from public data of the Spanish market[62], as shown in the following table.

$^\bullet$ We calculate the Original Voice ARPU using data from Merrill Lynch's Q407 Global Wireless Matrix

[62] CMT, Annual Report, pp. 198, 221

Annex 1: Adjustments in MoU and ARPU

	Spain call distribution	CPP minutes	RPP minutes
F2M	**10%**	**1**	**1**
M2M on-net	**51%**	**1**	**2**
M2M off-net	**23%**	**2**	**2**
M2F	**11%**	**1**	**1**
M2International	**1%**	**1**	**1**
Received in mobile abroad	**1%**	**1**	**1**
Others	**3%**	**1**	**1**
Billed calls	**100%**	**1.23**	**1.74**
M2M termination adjustment	= 23%/1.23 = .19		

Table 9: RPP minutes/CPP minutes ratio

Source: Frontier Economics

Example

We have calculated above the Adjusted MoU for Austria, which is 148 minutes. We can therefore calculate M2M termination minutes.

$$\text{M2M termination minutes} = 148 * .19 = 28 \qquad (12)$$

Average Mobile Termination Rate for Austria on July 1st 2007 was €.09, which equals US\$.11 after applying the exchange rate in *Q407 Global Wireless Matrix*. Termination revenues are therefore US\$3.1.

$$TR = .11 * 28 = 3.1 \qquad (13)$$

Voice ARPU for Austria is US\$28.3. If we subtract the termination revenues we obtain the Adjusted Voice ARPU for Austria.

$$\text{Adjusted Voice ARPU} = 28.3 - 3.1 = 25.2 \qquad (14)$$

Annex 1: Adjustments in MoU and ARPU

This adjustment implies an 11% reduction of Austria's voice ARPU. The reduction for the rest of the European countries ranges from 10% for Belgium to 20% for Poland.

Annex 1: Adjustments in MoU and ARPU

Annex 2: Details on the results of modelling

INTRODUCTION

In this chapter we offer details on the modelling exercise of the potential impact of reducing MTRs below cost on consumers. This includes the impact on

- overall average prices paid;
- mobile market penetration; and
- the total value obtained by consumers from using mobile telephony.

The methodology adopted for this analysis is based on a simulation model of competition between mobile operators following the standard "Hotelling type" differentiated Bertrand model adopted in most of the academic literature on the topic of mobile pricing and the impact of mobile termination rates.

This model allows for subscribers to choose between competing networks, based on the relative value that each network offers to its subscribers. This value, the per capita consumer welfare, is measured as the difference between the value that a consumer gets for the product he/she consumes, in this case the value of making and receiving calls, less any charges made by the mobile operator to which he/she is subscribed. The model also simulates the impact of changes in the level and structure of prices on the likely levels of mobile penetration.

The model abstracts from the existence of network externalities. These externalities arise when existing subscribers of a network benefit from new subscribers joining the network. In mobile markets the presence of additional subscribers generates a positive externality on existing ones since it gives the possibility of calling additional people. The implication of this is that, in the presence of network externalities, the desirable level of the termination rate is expected to be above cost, as described in Section 2. We have decided not to model network externalities explicitly, in the interest of keeping the simulation and results more transparent (and tractable). This implies that the results do *not include* the negative impact on welfare from setting a termination charge below cost, in the presence of network externalities.

This approach involves a significant amount of calibration and a certain degree of judgement. The greatest sensitivities relate to the assumed scale of any existing call externality. By call externality we refer to the relative value that a consumer gets when he/she receives a call, compared to the value this consumer gets when making a call.

THE MODEL

The model has been used to analyse the impact of lowering MTRs on a typical Western European market and also for the impact on a typical Central and Eastern European one. In each case the demand for mobile to mobile (M2M), fixed to mobile (F2M) and mobile to fixed (M2F) calls have been calibrated at existing call prices so that per capita demand is typical for current experience of

the market in question. The model was also calibrated to approximate the LRIC costs for call origination and call termination.

The model analyses the impact of altering MTRs on the volume of M2M and F2M calls. The model assumes in all cases that MTRs for M2M and F2M calls are equal. The model also analyses the effect of reducing MTRs under two structures of retail tariffs, one where networks do not charge for receiving calls and the other where networks do charge reception charges. In this last case called parties pay a price for receiving calls.

In the model it is also assumed that the demand for calls has a constant elasticity (rather than linear demand). This is because linear demand functions can produce erratic and unpredictable results as retail prices move a long way from their current levels, due to the impact such a change has on price elasticities. The elasticity of demand for calls and the elasticity of participation were calibrated by reference to US data, allowing the differences in participation and call charges to be reasonably reflected in the sensitivity of demand.

In the absence of evidence on the scale of call externalities the impact of reducing MTRs has been estimated for a range of possible externality values.[63] In our view it is likely that call externalities not already internalised within particular user groups, are likely to be relatively small. Hence in the consideration of our results we consider that scenarios with low call externalities are intrinsically more plausible than those with larger call externalities.

Finally, we have sought to model the impact of changing MTRs and call structures on mobile penetration. In our basic model it is assumed that all subscribers behave in the same way (as regards call volumes) and differ only insofar as they have different search costs in choosing to join one of the two networks. In reality of course subscribers are very varied in their calling behaviour and this will mean that reductions in the *average* value that consumers get from mobile communications will result in some subscribers (who make relatively few calls) finding that it is no longer in their interests to continue being mobile subscribers. These customers will quit the network, leading to a fall in overall mobile penetration. We have calibrated mobile participation as a function of overall average consumer welfare based on the evidence that we have from different mobile markets.

Retail tariffs

The model treats subscribers as contract customers, paying call charges and a fixed periodic subscription charge.[64] This assumption seems reasonable given the prevalence of packages in the US offering large "buckets" of minutes.

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[63]   The scenario of low call externalities implies that the ratio between the benefit received by the called party and that of the calling party is 0.1. In the high call externality, this value is 0.7

[64]   The model assumes that consumers are offered a single contract by each mobile operator, abstracting from the existence of post-pay and pre-pay customers with a potential heterogeneity in terms of the call externality.

Annex 2: Details on the results of modelling

The model assumes uniform on-net and off-net pricing, which follows the predictions in Jeon *et al* (2004). In the absence of reception charges networks will set call charges at the average cost of on-net and off-net calls. Hence call charges fall as the MTR declines.[65] The reason is that lower MTRs translate in lower off-net cost for call originating networks, while the cost of on-net calls does not depend on the level of MTRs. As a result the average cost of on-net and off-net calls falls, and so do call retail call prices, as MTRs decline.

Jeon *et al* (2004) also predict that with competitively set charges for receiving calls (in both off-net and on-net calls), optimal outbound charges will equal the cost of off-net calls (equal for on-net calls) and so outbound call charges fall faster as MTRs decline than in the absence of reception charges. Now, in addition to off-net call costs falling as MTRs decline, the net costs of on-net calls also decline due to the reception charge earned by the originating mobile operator in on-net calls. In this scenario, competitively set charges for receiving calls are fixed to recover any shortfall in costs due to interconnection charges being set below cost.

Factors affecting the results

Without reception charges the effect of reducing call charges on M2M and F2M calls is to increase the average volumes of calls made per subscriber. In isolation this is obviously beneficial to subscribers. However, in the absence of reception charges, reducing MTRs *also* causes competing networks to increase their fixed subscription charges to subscribers so as to recover the losses made on calls. Remember that, without reception charges, all networks will fail to fully recover the cost of on-net calls through call charges, while they are also making a loss on terminating off-net calls on their own networks because the MTR is below cost.

The increase in subscription charges caused by reducing MTRs has a detrimental effect on consumer welfare, which offsets the effect of cheaper calls. The net effect on consumer welfare depends on the balance of these two effects.

In contrast, if reception charges are permitted then networks do not make losses on calls (on average) so the pressure to increase fixed subscription charges is alleviated. However, the introduction of reception charges has a mixed effect. On subscribers, provided the reception charge is small (or the value of the call externality is large), reception charges will have no effect on call volumes, while the reduction in MTRs, and consequently lower call charges, will result in an increased average volumes of calls made per subscriber. This would unambiguously make consumers better off. However, if reception charges become large (or the value of the call externality is small), high reception charges cause subscribers to refuse to accept calls, which may reduce the average volume of calls made. This can seriously reduce subscribers overall welfare, because of its impact on total call volumes. The overall impact on consumer welfare depends on the trade off between these factors.

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[65] US evidence shows that mobile operators do not price off-net calls below on-net calls, even in the presence of B&K. This would be the prediction of the model with network-based price discrimination.

Annex 2: Details on the results of modelling

These factors, as well as influencing average per capita consumer welfare, also translate into changes in the mobile participation rate, as increases (or decreases) in the average benefit granted to mobile consumers will, at the margin, lead to low value subscribers joining (or leaving) the market.

The following sections present sequentially the results obtained on a typical Western European market and for the impact on a typical Central & Eastern European one.

WESTERN EUROPE RESULTS

Without reception charges

In the case where networks do not charge for receiving calls, the effect of reducing MTRs results in higher volume of calls, due to cheaper call charges, but also higher subscription charges per subscriber (to compensate for networks making losses on calls). Remember that without reception charges the uniform call charge induces network operators to make losses on on-net calls and on terminating off-net calls on their own networks, with MTRs below cost.

As the volume of calls that a typical subscriber would make increases, so the value consumers get from being on the network also rises and, other things being equal, penetration would rise. This effect on the value of consumers joining the network is larger the larger is the call externality on the receivers. On the other hand the value for a consumer in joining the network decreases as subscription charges increase.

We find that the reduction in call charges could increase Average Minutes of Use (AMoU) significantly, by up to 1.6 times when MTRs equal 2€ cents. The effect on AMoU are shown in the following Table 1.[66] Under this caller party pays scenario, the effect of reducing MTRs on AMoU does not depend on the size of the call externality.

We have evaluated the total value for a typical consumer of joining the mobile network as the MTRs decrease. Absent reception charges, and depending on the magnitude of the call externality, we find that reducing MTRs could reduce consumer benefits in Western Europe. At MTR equal to 2€ cents the average consumer welfare per subscriber could decrease by between 3%, if call externalities are assumed to be low and by less than 1% if large call externalities are assumed. The fall in per subscriber consumer welfare is due, in the current scenario, to an increase in subscription charges, which more than offsets the increase in consumer welfare due to higher volumes of calls (due to lower call charges).

The model treats the likelihood of participation in the market to be a function of the average consumer welfare offered by each network. Hence, as the consumer welfare per subscriber falls when MTRs decrease, so does participation in the

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[66]   Without reception charges the volume of calls and the level of the subscription charge do not depend on the value of the call externality.

Annex 2: Details on the results of modelling

market and mobile penetration rates. The reduction in consumer surplus with MTRs equal to 2€ cents could lead to a reduction in mobile penetration of up to 9%, when call externalities are small, and up to 1%, when call externalities are large. This is shown in Table 1.

The combination of these factors – the decrease in per subscriber consumer welfare and lower levels of penetration with lower MTRs - implies that total consumer surplus could fall up to between 1% and 11% if MTRs are set equal to 2€ cents, with drastic more reductions with MTRs eventually going to 1€ cent.[67]

WE CPP		Average Minutes of Use (% of AMoU with MTR at cost)	Per subscriber Consumer Surplus (% of CS with MTR at cost)		Penetration		Total Consumer Surplus (% of CS with MTR at cost)	
			Low Call Externality	High Call Externality	Low Call Externality	High Call Externality	Low Call Externality	High Call Externality
MTR (€cents)	2	162%	97%	100%	91%	99%	89%	99%
	1	198%	95%	99%	84%	96%	81%	94%

Table 10: Average Minutes of Use, Per subscriber Consumer Surplus, Penetration and Total Consumer Surplus. Western Europe - Without reception charges

Source: Frontier Economics

With reception charges

In the case where networks do charge for receiving calls, the effect of reducing MTRs has a mixed effect. At the beginning, the volume of calls rises as MTRs are reduced below the cost of termination, provided that reception charges are small or the value of the call externality is large. The effect of a larger volume of calls is due to cheaper call charges, for MTRs below, but still close to, termination cost levels and consequently, relatively low reception charges. However as MTRs are reduced further, and reception charges become high relative to the call externality), the volume of calls decline, as high reception charges cause subscribers to refuse to accept calls. In the case where networks do charge for receiving calls subscription charges do not increase as MTRs fall. The reason for subscription charges being kept constant is that with reception charges, networks do not make losses on calls. The effective call charges in the event of a call, paid by the caller and the receiver, cover exactly the cost of such call.

The impact on AMoU, when networks charge for receiving calls, is highly sensitive to the call externality. For small values of the call externality reducing MTRs to 2€ cents could result in AMoU falling to 32% of the level achieved at cost based MTRs. This effect is mainly due to the effect of high reception charges on the subscribers' willingness to receive calls. For low call externalities

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[67]   Total consumer surplus aggregates the consumer surplus of all subscribers in the market.

Annex 2: Details on the results of modelling

subscribers will start not answering their phones, even for low reception charges (or what is the same for relatively high MTRs). With large call externalities, MTRs equal to 2€ cent lead to 50% increase in the volume of call minutes per subscriber.

As before, we have evaluated the total value for a typical consumer of joining the mobile network as the MTRs decrease. With reception charges, and depending on the magnitude of the call externality, we find that reducing MTRs could reduce average consumer benefits in Western Europe. At MTR equal to 2€ cents the average consumer surplus per subscriber could decrease by 12% (if call externalities are assumed to be low) or increase by 1% (if call externalities are assumed to be large). As shown in Table 2Table 11, for assumed large call externalities, consumer surplus per subscriber may rise very slightly from the reduction of MTRs to 2€ cent.

As before, the model also treats the likelihood of participation in the market to be a function of the average consumer surplus offered by each network, hence as consumer surplus per subscriber falls, so does the mobile penetration rate. The reduction in consumer surplus per subscriber when reducing MTRs at 2€ cents could lead to a 37 % reduction in penetration, when call externalities are small, or increase it by 2%, when call externalities are large.

The combination of these factors, the decrease in per subscriber consumer welfare and lower levels of penetration with MTRs equal to 2€ cents, implies that total consumer surplus could fall up to 45% or increase by 3% when MTRs are lowered to 2€ cent.

Annex 2: Details on the results of modelling

WE RPP		Average Minutes of Use (% of AMoU with MTR at cost)		Per subscriber Consumer Surplus (% of CS with MTR at cost)		Penetration		Total Consumer Surplus (% of CS with MTR at cost)	
		Low Call Externality	High Call Externality	Low Call Externality	High Call Externality	Low Call Externality	High Call Externality	Low Call Externality	High Call Externality
MTR (€cents)	2	32%	150%	88%	101%	63%	102%	55%	103%
	1	30%	143%	87%	100%	60%	100%	52%	100%

Table 11: Average Minutes of Use, Per subscriber Consumer Surplus, Penetration and Total Consumer Surplus. Western Europe - With reception charges

Source: Frontier Economics

CENTRAL AND EASTERN EUROPE RESULTS

We have also calibrated our model for a typical Central or Eastern European mobile market.

In general we find that the results are very similar to those for Western Europe in terms of the impact on call volumes, mobile and consumer welfare, albeit starting from a base of lower AMoU and penetration.

Without reception charges

The reduction in call charges could increase AMoU significantly, by up to 1.6 times. This is shown in the following Table 3. Remember that without reception charges the uniform call charge induces network operators to make losses on on-net calls and on terminating off-net calls on their own networks, with MTRs below cost.

Absent reception charges, and depending on the magnitude of the call externality, we find that reducing MTRs to 2€ cents could reduce per capita consumer surplus in CEE by 2% if call externalities are assumed to be low, and keep it invariant if call externalities are assumed to be large. As shown in Table 3 per capita consumer surplus may fall further as MTRs reduces to 1€ cent. The overall fall in consumer surplus is due, in the current scenario, to an increase in subscription charges, which more than offsets the increase in consumer welfare due to higher volumes of calls.

The reduction in consumer surplus at MTRs equal to 2€ cents could lead to a reduction in penetration of up to 9%, when call externalities are small, or remain constant for large call externalities. This is shown in Table 3.

The combination of these factors implies that total consumer surplus could fall by 10% when call externalities are assumed to be small. However, for large call externalities we estimate that total consumer surplus would remain invariant as MTRs are equal to 2€ cents although it would be reduced if MTRs reduce further. This is shown in Table 3.

Annex 2: Details on the results of modelling

CEE RPP		Average Minutes of Use (% of AMoU with MTR at cost)	Per subscriber Consumer Surplus (% of CS with MTR at cost)		Penetration		Total Consumer Surplus (% of CS with MTR at cost)	
			Low Call Externality	High Call Externality	Low Call Externality	High Call Externality	Low Call Externality	High Call Externality
MTR (€ cents)	2	167%	98%	100%	91%	100%	90%	100%
	1	206%	97%	99%	84%	97%	81%	96%

Table 12: Average Minutes of Use, Per subscriber Consumer Surplus, Penetration and Total Consumer Surplus. Central and Eastern Europe - Without reception charges

Source: Frontier Economics

With reception charges

As we have already noted, the impact on AMoU is highly sensitive to the call externality. For small values of the call externality reducing MTRs to 2€ cents could result in the Average Minutes of Use falling to 33% of the level achieved at cost based MTRs. This effect is mainly due to the effect of high reception charges on the subscribers' willingness to receive calls. For low call externalities subscribers will start not answering their phones, even for low reception charges (or what is the same for relatively high MTRs). With large call externalities the total volume of calls might increase by 53%. Table 4 shows the results for small and large call externalities.

The overall impact on consumer welfare, which translates in participation rates, depends on the trade off between these various factors. Depending on the magnitude of call externalities, we find that reducing MTRs to 2€ cents could reduce per capita consumer surplus by 13%, if call externalities are small, or raised it by 1% if call externalities are large. If call externalities are low the effect of reception charges is to reduce per capita consumer surplus significantly for any reduction in MTRs. This is shown in Table 4. The overall fall in consumer surplus is due, in the current scenario, to a decline in the volume of calls and the lower value that subscribers get from receiving calls when the MTRs decline, and consequently reception charges rise.

The reduction in consumer surplus with MTRs equal to 2€ cents could lead to a reduction in penetration of up to 37%, when call externalities are small. This is shown in Table 4. When call externalities are assumed to be large reducing MTRs to 2€ cents may induce a 3% increase in penetration.

The combination of these factors implies that total consumer surplus could fall up to 45% for small call externalities. However, for large call externalities we estimate that total consumer surplus could be fractionally higher.

Annex 2: Details on the results of modelling

CEE RPP		Average Minutes of Use (% of AMoU with MTR at cost)		Per subscriber Consumer Surplus (% of CS with MTR at cost)		Penetration		Total Consumer Surplus (% of CS with MTR at cost)	
		Low Call Externality	High Call Externality	Low Call Externality	High Call Externality	Low Call Externality	High Call Externality	Low Call Externality	High Call Externality
MTR (€ cents)	2	33%	153%	87%	101%	63%	103%	55%	103%
	1	31%	146%	86%	100%	59%	100%	51%	101%

Table 13: Average Minutes of Use, Per subscriber Consumer Surplus, Penetration and Total Consumer Surplus. Central and Eastern Europe - With reception charges

Source: Frontier Economics

Annex 2: Details on the results of modelling

Annex 3: Cost modelling concepts

To date so called "LRIC" regulatory cost models, attribute total network costs to services including a share of common corporate costs, across the range of network services provided. This allocation is carried out through a two stage process

1. An LRIC exercise to estimate the costs of an efficient network;

2. An Element Based Costing (EBC) approach to allocate the overall network cost to individual services, for example mobile termination.

Under an EBC approach the cost of each component is then attributed to the services using the component on the basis of a common metric, such as call minutes, which reflects the cost driver for the component. The unit cost for a given component allocated to a service is the <u>average</u> unit cost per measure of volume multiplied by the <u>average</u> number of times the service uses the component (the 'routing factor'). Due to this averaging process, such models are sometimes termed Long Run Average Incremental Cost models (LRAIC).

There are a number of advantages to a LRAIC approach:

- As the allocation of component costs to services is a fully allocated cost approach, there is no need for an additional stage of mark ups to recover fixed and common costs;

- As component costs, including any fixed costs, are allocated on the basis of a consistent metric to all services, the allocation of costs is transparently non-discriminatory;

- As component costs are only allocated to those services that use the components, the principle of unbundling is maintained;

- The overall level of costs can be robustly estimated through a combination of bottom up engineering models and top down information on actual network dimensions; and

- The allocation of costs between services is not dependent on the accurate calculation of cost volume relationships.

Annex 4: Support tables for the analysis of the US experience

Country	%	Country	%
Austria	86%	Lithuania	83%
Belgium	84%	Luxembourg	92%
Bulgaria	68%	Malta	88%
Cyprus	91%	Netherlands	94%
Czech Republic	92%	Poland	79%
Denmark	92%	Portugal	82%
Estonia	89%	Romania	66%
Finland	93%	Slovakia	81%
France	81%	Slovenia	91%
Germany	78%	Spain	80%
Greece	86%	Sweden	91%
Hungary	82%	UK	87%
Ireland	90%	EU	83%
Italy	91%	US	75%
Latvia	88%		

Table 14: Percentage of households with at least 1 mobile phone

Source: For the US: Blumberg SJ, Luke JV. Wireless substitution: Early release of estimates from the National Health Interview Survey, July - December 2007. National Center for Health Statistics. Available from: http://www.cdc.gov/nchs/nhis.htm. For Europe: European Commission: Sondage sur les communications électroniques. Eurobaromètre Spécial 293. Novembre – décembre 2007 (available at http://ec.europa.eu/information_society/policy/ecomm/doc/library/ext_studies/household_07/eb68_2_ec omm_full_rep_fr.pdf)

Country	Original value	Adjusted value	Country	Original value	Adjusted value
Austria	192.0	159.1	**Italy**	139.0	107.1
Belgium	157.0	139.3	**Netherlands**	151.0	151.0
Czech Republic	115.0	102.1	**Poland**	96.0	96.0
Denmark	180.0	180.0	**Portugal**	119.0	103.4
Finland	307.0	236.6	**Spain**	162.0	162.0
France	249.0	249.0	**UK**	185.0	185.0
Germany	102.0	90.5	**WE**	165.3	155.1
Greece	151.0	146.0	**CEE**	111.2	105.5
Hungary	165.0	144.7	**Europe**	158.1	148.5
Ireland	239.0	239.0	**US**	812.0	441.6

Table 15: Minutes of use (MoU) before and after adjustments to control for non-conversation time

Source: Frontier Analysis from Merril Lynch's information

Annex 4: Support tables for the analysis of the US experience

Country	Original value	Adjusted value	Country	Original value	Adjusted value
Austria	19.5	17.3	**Italy**	16.7	14.5
Belgium	23.2	20.8	**Netherlands**	23.1	19.8
Czech Republic	15.6	13.6	**Poland**	9.6	7.7
Denmark	22.3	19.0	**Portugal**	17.1	14.9
Finland	24.4	21.3	**Spain**	26.2	23.2
France	28.6	25.0	**UK**	23.7	20.8
Germany	13.5	11.9	**WE**	21.2	18.5
Greece	20.1	17.0	**CEE**	11.7	9.6
Hungary	15.6	12.9	**Europe**	19.9	17.4
Ireland	31.7	27.1	**US**	29.0	29.0

Table 16: Average Revenue per User (ARPU) comparison between US and European countries (€)

Source: Frontier Analysis from Merril Lynch's information

Annex 4: Support tables for the analysis of the US experience

Country	Original value	Adjusted value	Country	Original value	Adjusted value
Austria	0.10	0.11	Italy	0.12	0.14
Belgium	0.15	0.15	Netherlands	0.15	0.13
Czech Republic	0.14	0.13	Poland	0.10	0.08
Denmark	0.12	0.11	Portugal	0.14	0.14
Finland	0.08	0.09	Spain	0.16	0.14
France	0.11	0.10	UK	0.13	0.11
Germany	0.13	0.13	WE	0.13	0.12
Greece	0.13	0.12	CEE	0.11	0.09
Hungary	0.09	0.09	Europe	0.13	0.12
Ireland	0.13	0.11	US	0.04	0.07

Table 17: Revenue Per Minute (RPM) comparison between US and European countries (€)

Source: Frontier Analysis from Merril Lynch's information

Annex 4: Support tables for the analysis of the US experience

Country	Original value	Adjusted value	Country	Original value	Adjusted value
Austria	0.119	0.127	**Italy**	0.148	0.167
Belgium	0.174	0.176	**Netherlands**	0.174	0.149
Czech Republic	0.280	0.276	**Poland**	0.202	0.199
Denmark	0.113	0.111	**Portugal**	0.224	0.225
Finland	0.091	0.102	**Spain**	0.202	0.179
France	0.126	0.110	**UK**	0.152	0.134
Germany	0.148	0.148	**WE**	0.155	0.148
Greece	0.197	0.173	**CEE**	0.214	0.210
Hungary	0.194	0.183	**Europe**	0.163	0.156
Ireland	0.143	0.123	**US**	0.051	0.094

Table 18: Revenue per Minute (RPM) comparison between US and European countries (PPP - International US$)

Source: Frontier Analysis from Merril Lynch's information

Annex 4: Support tables for the analysis of the US experience

References

Analysys (2007): Talk is cheap in Canada: an inter-country comparison of mobile wireless prices. 27 June 2007 (available at www.ic.gc.ca)

Armstrong, M. (1998) "Network Interconnection in Telecommunications," *Economic Journal*, 108: 545-564.

Armstrong, M. (2002): "The Theory of Access Pricing and Interconnection", *Handbook of Telecommunications Economics*, Volume 1, Edited by M.E. Cave et. al. Elsevier Science B.V.

Armstrong, M. and J. Wright (2007): "Mobile Call Termination", September 2007.

Berger, U. (2004): "Access Charges in the Presence of Call Externalities". *Contributions to Economic Analysis & Policy* 3.1: Article 21.

Berger, U. (2005): "Bill-and-Keep vs. cost-Based Access Pricing Revisited". *Economics Letters*, 86(1), 107-112.

Calzada, J. and T. Valletti (2008): "Network Competition and Entry Deterrence", *Economic Journal.*

Cambini, C. and Valletti (2008): "Information exchange and competition in communications networks", *Journal of Industrial Economics.*

DeGraba, P. (2000): "Bill and Keep at the Central Office as the Efficient Interconnection Regime", OPP Working Paper Series No.33, December, FCC.

DeGraba (2003): "Efficient Intercarrier Compensation for Competing Networks when Customers Share the Value of a Call", *Journal of Economics and Management Strategy* 12: 207-230.

FCC (2008): *Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services*. WT Docket No. 07-71

Gans, J. and S. King (2001): "Using "bill and keep" interconnect arrangements to soften network competition", *Economics Letters*, vol. 71: 413-421

Genakos and Valletti (2008): "Testing the 'Waterbed' Effect in Mobile Telephony", *CEIS Tor Vergata, Research Paper Series*, Vol.6, Issue 2, No. 110 .

GSM Association, GSM América Latina y AHCIET (2005): "Excedente de consumo a partir del uso de los servicios móviles en América Latina", December

GSM Association (2008): GSMA Europe response to the ERG Consultation Document on Regulatory Principles of IP-IC/NGN Core

Jeon, D.S., Laffont, J.-J. and Tirole, J. (2004). "On the 'Receiver-Pays' Principle",

RAND Journal of Economics, vol. 35: 85-110.

Hausman, J. (1997): "Valuing the Effect of Regulation on New Services in Telecommunications." *The Brookings Papers on Economic Activity. Microeconomics*, vol. 28, 1997, pp. 1-54

Hausman, J. (2004): "Economic Analysis of Regulation of CPP". Submission to New Zealand Commerce Commission on behalf of New Zealand Telecom.

Harbord, D. and M. Pagnozzi (2007): "On-Net/Off-Net Price Discrimination and 'Bill and Keep' vs. 'Cost-Based' Termination Pricing", European Mobile Challengers' Workshop, 8 November 2007.

Harbord, D. and M. Pagnozzi (2008): "On-Net/Off-Net Price Discrimination and 'Bill-and-Keep' v. 'Cost-Based' Regulation of Mobile Termination Rates", mimeo.

Hoerning, S. (2007): "On-Net and Off-Net Pricing on Asymmetric Telecommunications Networks," *Information Economics & Policy*, 19(2): 171-188.

Laffont, J.-J., P. Rey and J. Tirole (1998a): "Network Competition I: Overview and Non-discriminatory Pricing", *RAND Journal of Economics* 29: 1-37.

Laffont, J.-J., P. Rey and J. Tirole (1998b): "Network Competition II: Price Discrimination", *RAND Journal of Economics* 29: 38-56.

Littlechild, S. (2006): "Mobile Termination Charges: Calling Party Pays versus Receiving Party Pays," *Telecommunications Policy*, 30(5-6): 242-277.

Markus, J. S. (2004): "Call Termination Fees: The U.S. in global perspective" presented at the *4th ZEW Conference on the Economics of Information and Communication Technologies*, Mannheim, Germany, July 2004.

Ofcom (2003): "Consumers' Use of Mobile Telephony". Q14 August 2003. 27 October 2003.

Ofcom (2005): "Wholesale mobile voice call termination markets – a proposal to modify the charge control conditions". Explanatory Statement and notification of proposals. June 2005.

Ofcom (2007): "Mobile call termination". A Statement by Ofcom. 27 March 2007.

RCRWireless News. "Class action nets group of top wireless carriers for texting, other charges". May 16, 2008.

Schiff, A. (2007): "The 'Waterbed' Effect and Price Regulation". Mimeo.

Taylor, L.D. (2002): "Customer Demand Analysis". Handbook of Telecommunications Economics, Volume 1, Edited by M.E. Cave et al. Chapter 4.

Valletti and Cambini (2005): Valletti, T. and C. Cambini (2005): "Investments and Network Competition", RAND Journal of Economics, Vol. 36, No.2: 446-467.

Valletti and Houpis (2005): "Mobile Termination: What is the 'Right' Charge?", Journal of Regulatory Economics, Vol: 28, Pages: 235 - 258

Wright, J. (2002a) "Access Pricing under Competition: An Application to Cellular Networks," *Journal of Industrial Economics*, 50: 289-315.

Wright, J. (2002b) "Bill and Keep as the Efficient Interconnection Regime?" *Review of Network Economics*, 1(1): 54-60.

References