REGULATION OF MOBILE TERMINATION RATES

by

FAHRİ BAŞAR ULUSOY

Submitted to the Graduate School of Arts and Social Sciences
in partial fulfillment of
the requirements for the degree of
Master of Arts
in
Economics

Sabanci University

Spring 2005

REGULATION OF MOBILE TERMINATION RATES

APPROVED BY:

Assoc. Prof. Dr. İzak Atiyas ....…….

(Thesis Supervisor)

Assoc. Prof. Dr. Hakan Orbay ....…….

Prof. Mehmet Baç ....…….

DATE OF APPROVAL: ……..

ABSTRACT

REGULATION OF MOBILE TERMINATION RATES

By Fahri Başar Ulusoy

Mobile market has grown very fast during the last decade and revenues from mobile telephony have increased. The sudden growth in mobile telephony market revealed regulatory needs in particular services. The crucial service that regulators mainly focus was Mobile Termination service since it was identified that operators have monopoly power in termination service. By this identification, a debate on whether mobile termination rates need to be regulated arose.

This master thesis examines the debate in detail. Some argue that mobile termination rates are high and high termination rates may cause some market failures. To understand whether mobile termination rates are high, the incentives of the mobile operators are discussed. Mobile operators have different incentives to set high termination charges for fixed-to-mobile (FTM) and mobile-to-mobile (MTM) calls. Therefore, it is plausible to examine termination issue separately in FTM and MTM markets.

The thesis illustrates that while FTM termination rates need to be regulated since incentives are strong, MTM termination charges are less likely to be regulated. However, termination charges are high not only for FTM, but they are also high for MTM in many countries. Therefore, countries regulate termination rates in both FTM and MTM markets.

The issue of mobile termination in Turkey is discussed and compared to the Europe. The regulatory procedures in mobile termination rates in Turkey seem to be the opposite of those in Europe: while FTM termination rates are not regulated, MTM termination rates are regulated.

ÖZET

MOBİL SONLANDIRMA ÜCRETLERİNİN REGÜLASYONU

Fahri Başar Ulusoy

Mobil market son on yılda çok hızlı bir şekilde gelişti ve mobil telefonlardan elde edilen gelirler de çok yükseldi. Mobil telefon marketindeki bu ani büyüme belirli servislerde regülasyon ihtiyaçlarını ortaya çıkardı. Operatörlerin sonlandırma servisinde tekel güce sahip oldukları saptandığından regülatörlerin odaklandığı önemli servislerden biri Mobil Sonlandırma servisi oldu. Bu saptamayla mobil sonlandırma ücretlerinin regüle edilip edilmeyeceğine dair bir tartışma ortaya çıkmıştır.

Bu master tezi tartışmayı detaylı bir şekilde ele alıyor. Bazıları mobil sonlandırma ücretlerinin yüksek olduğunu ve bu durumun markette bir takım olumsuzluklara yol açabileceğini savunuyor. Mobil sonlandırma ücretlerinin yüksek olup olmadığını anlamak için mobil operatörlerin dürtüleri tartışılıyor. Mobil operatörlerin, sabitten mobile ve mobilden mobile aramalarda yüksek sonlandırma ücretleri saptamak için farklı dürtüleri bulunmaktadır. Bu yüzden, sonlandırma konusunu sabitten mobile ve mobilden mobile aramalarda ayrı ayrı incelemek makuldür.

Tez gösteriyor ki dürtüler kuvvetli olduğundan sabitten mobile sonlandırma ücretlerinin regüle edilmesi gerekirken, mobilden mobile sonlandırma ücretleri regüle edilmeye daha az meyillidir. Fakat, bir çok ülkede sonlandırma ücretlerinin sadece sabitten mobile için değil aynı zamanda mobilden mobile için yüksek olduğu gözüküyor. Bu sebepten, ülkeler sonlandırma ücretlerini hem sabitten mobile hem de mobilden mobile marketlerde regüle ediyor.

Türkiye'deki mobil sonlandırma sorunu tartışılıp Avrupa ile kıyaslanmıştır. Türkiye'de mobil sonlandırma ücretlerindeki düzenleyici prosedürler Avrupa'dakilerin tam tersi gözükmektedir: sabitten mobile sonlandırma ücretleri regüle edilmezken mobilden mobile sonlandırma ücretleri regüle edilmektedir.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

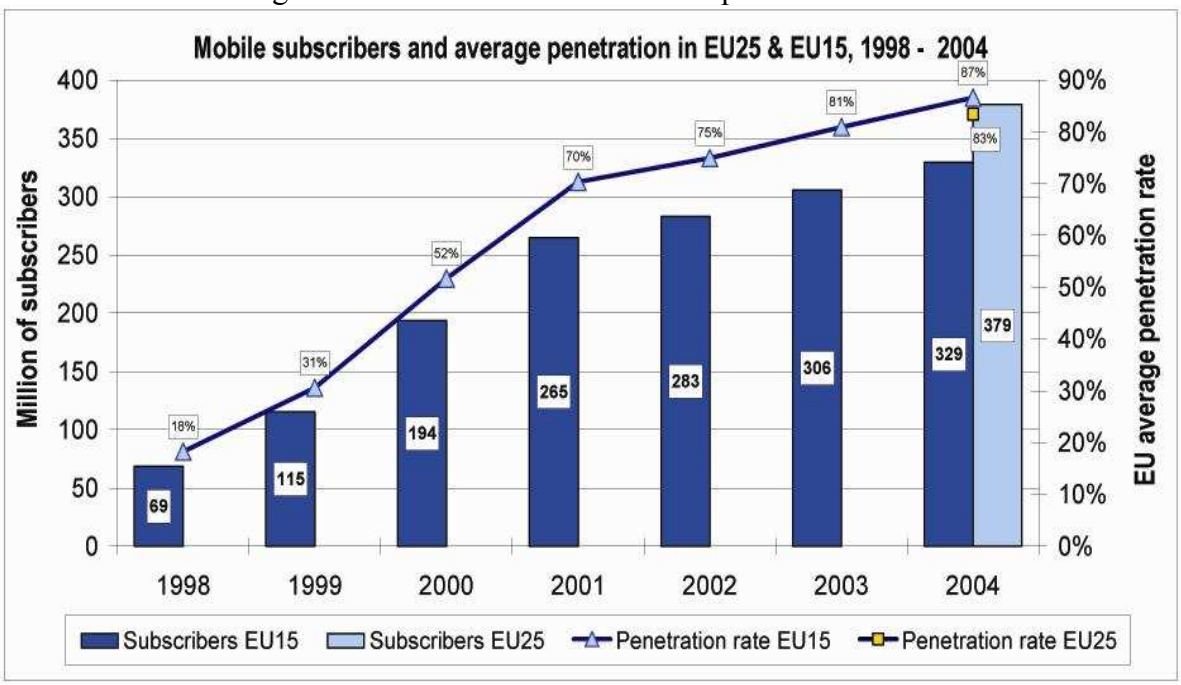
LIST OF SYMBOLS AND ABBREVIATIONS

€	Euro
$	United States Dollar
Agcom	NRA of Italy
CC	Competition Commission of United Kingdom
ComReg	NRA of Ireland
CPP	Caller Party Pays
CUG	Closed User Group
FNO	Fixed Network Operator
FTM	Fixed-to-Mobile
MNO	Mobile Network Operator
MNP	Mobile Number Portability
MTF	Mobile-to-Fixed
MTM	Mobile-to-Mobile
MTR	Mobile Termination Rate
NRA	National Regulatory Authority
RPP	Receiver Party Pays
SMP	Significant Market Power
TMNE	Tariff Mediated Network Externality
TL	Turkish Lira

1. INTRODUCTION

Mobile telecommunications are believed to be one of the most growing, innovative and competitive telecommunication sector. During the last 10 years, the mobile telephone industry has experienced a dramatic growth which can be attributed to regulatory and competitive factors. Indeed, a significant change in the penetration rate in Europe illustrates how the mobile telephone sector has been growing from 1998 to 2004. As seen below, while the number of mobile subscribers was 69 million (merely 18% of the population of EU15 countries), the number of subscribers reached 329 million; 87% of the population of the EU15 countries. Moreover, the mobile subscriber number was 379 million; corresponding to 83% of the total population of EU25 countries. Today, the penetration rate approaches 100% percent, and the number of mobile telephone subscribers exceeds the number of fixed telephone subscribers in many countries; such as Luxembourg (122%), Sweden (103%), Czech Republic (99%), Italy (98%), Finland (94%) and Austria (93%) (European Commission 2004, figure 42)[1].

Figure 1.1 - Penetration rates in European countries



Source: European Commission (2004)

[1] Percentages in parenthesis indicate mobile penetration June 2004 rates.

Moreover, worldwide revenues from mobile telephony have also increased significantly between 1991 and 2003. According to ITU, in 1991 worldwide revenues in mobile telephone markets amounted to 19 billion U.S. $, and the number of mobile subscribers to 16 million in the world. For 2003, ITU states that worldwide revenues were 414 billion U.S. $ with 1.3 billion mobile subscribers (ITU, 2003).

Because of this extraordinary positive development, mobile telephone markets have drawn the attention of regulatory authorities. Especially after the declaration of the new EU framework in 2002, this regulatory focus on mobile market was intensified. A new framework for communication networks was introduced which was designed to harmonize European regulation in order to reduce entry barriers and facilitate effective competition to the benefit of consumers. Under the new regulatory regime, each country was required to establish a National Regulatory Authority (NRA) to monitor the competition in communication markets and define the relevant market segments. Moreover, NRAs had a responsibility to decide whether an operator had significant market power (SMP) on a particular segment and had responsibility to apply appropriate regulatory policies. Under the new EU framework, segments were defined narrowly; thus, the number of segments to be regulated increased. Therefore, each country's NRA began to examine this mobile market more carefully, because the mobile market had a potential to grow and risks of the incumbent's anti-competitive behavior which would capture more money from this growing market. This narrow examination made many new segments subject to *ex ante* regulation. On the basis of an EU communications directive on access and interconnection, the mobile call termination has been defined as one of these new segments to be subject to *ex ante* regulation since each operator was a monopolistic provider of termination service. Indeed, the market for call termination on individual mobile networks was presently identified in the list of markets of the Commission Recommendation as a candidate market for *ex ante* regulation by NRAs (Buigues, pg.18, 2004).

The 7th implementation report shows that mobile termination rates (MTR) in countries with calling party pays (CPP) regime are high (EU average is approximately 19.08 € cents), approximately ten times higher in Europe than fixed termination rates (EU average is approximately 1.86 € cents for double transit).[2] Moreover, there are significant differences between mobile termination rates in different countries. The 7th

[2] These numbers are taken from chart 8 and chart 3 of 7th implementation report.

Implementation Report (European Commission, 2001, chart 8) highlights that range of peak time mobile termination charges is from 12.85 € cents to 23.69 € cents among Member States. These differences among Member States and the high price of mobile termination have been a factor for regulation in considering whether regulation is needed or not. There is a common belief that mobile operators have little incentive to set MTR at cost level because they are monopolists in supplying termination service. Cost based regulation is supported in order to overcome the potential market failure caused by the above cost termination rates. This idea causes a debate between economists. Some economists, such as Prof. Jerry Hausman and Prof. Julian Wright, oppose this regulation. Prof. Hausman (2002) argues that the reason for high MTR in countries using CPP regime is the consumers' ignorance of the charge they pay for their termination. He concludes that consumer information would solve the potential market failure without cost based regulation. Julian Wright (2002) shows that above-cost termination charges do not imply that termination charges are set too high from a welfare perspective since revenue from termination will be used for mobile users. Using termination revenue for mobile users means low mobile retail price and high penetration rates. Therefore, regulation at cost based may not be desirable. On the other hand, some economists like Mark Armstrong support cost based regulation. He argues that under CPP operators earn monopoly rents from termination. He advocates regulation of MTR at marginal cost plus a factor.

As stated above, MTR, which is a crucial and new topic in regulation, leads to a debate among economists whether regulatory intervention (cost-based regulation) from an economic perspective is needed. This theme is also the main question of the thesis. Both sides of the debate are evaluated and compared in the thesis by examining theoretical as well as practical approaches. Moreover, even if one decides that regulation is needed, the new question arises which whether cost-based regulation is the best solution from a welfare perspective. For this purpose, light-handed regulations are discussed and illustrated by real life applications in different countries. As a conclusion, I will question whether the existing cost-based regulation in Turkish mobile termination market is appropriate regulation. I try to answer this question by examining the origins of mobile termination concept in Turkey and by comparing the existing regulation with the other light-handed regulations.

The thesis is organized as follows: Following section determines the MTR problem and its welfare consequences. Moreover, the reason why MTR should be examined separately in fixed-to-mobile (FTM) and mobile-to-mobile (MTM) is discussed. In section

3, MTR issue in FTM market is explored. Furthermore, the debate on whether the regulation on MTR is needed in FTM markets is questioned and some empirical evidence will be given to discuss the debate. In section 4, MTR issue in MTM markets is explored. The debate on whether the regulation on MTR is needed in MTM markets is questioned. In section 5 and 6, the cost based regulation and other light-handed regulations are examined, respectively. In the last part, the thesis discusses the MTR issue in the Turkish mobile market and examines the existing cost-based regulation.

2. MOBILE TERMINATION PROBLEM

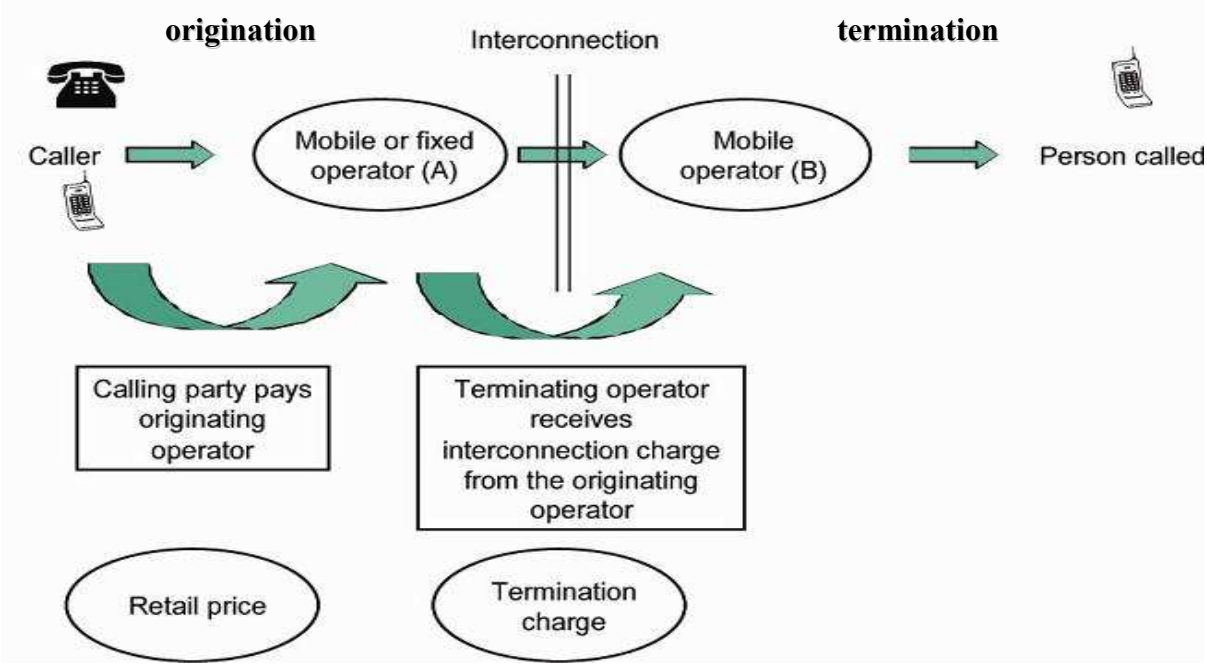
2.1. Mobile Termination Service

Mobile termination service is a wholesale input, which is used by fixed-line and mobile networks, in order to complete calls to mobile subscribers connected to other networks. This service is referred to as wholesale because it is sold and purchased by network operators rather than retail customers.

When a mobile call is made between two consumers, two essential elements- origination and termination- are involved. Where the person making the call, origination, over the network on which the person receiving the call, termination, are on different networks, a point of interconnection between two networks exists as seen in figure 2.1. Origination is the carriage of calls from the end-point where the user makes the call, or originates, to the interconnection point between two networks. Thus, the call is carried by the facilities of the network to which the user calling subscribes. Termination service is the carriage of a call from a point of interconnection between two networks to the consumer who is called. For termination, the call is carried by the facilities of the network to which the user called subscribes. There are two kinds of mobile call termination: termination of calls from the fixed-line; termination of calls from another mobile operator. To complete the calls, network owner that originates the call generally purchases terminating access from the network owner that terminates the call. The called network sets the termination charge and retail MTM and FTM charges are collected from the call-originating customer by the network that originates the call. This regime is known as 'calling party pays' regime (CPP) common to all European countries (ACCC, 2004).

Figure 2.1 shows the money flow. The caller pays the retail charge to operator A. Operator A pays the interconnection charge to the interconnected operator B. In short, operator B has revenue from termination and operator A has revenue from origination.

Figure 2.1 - Origination, termination and interconnection



Source: Bomsel et al (2003)

2.2. The Problem of Mobile Termination Charges under CPP Regime

Under the CPP regime, the caller pays the total retail price of the call[3]. The call termination charge is included in the originating network's (either fixed or mobile) cost and reflected in the retail price set by the originating network. Due to CPP, there is an essential disconnection between the person who pays for the calls and, indirectly for the termination charge, and the person who chooses of the terminating network. In other words, although the caller pays, he cannot choose of the network that he calls since it has been decided by the called party. Therefore, called parties' mobile network has monopoly power over termination (OFTEL, 2003b). This view is taken by the United Kingdom telecommunications regulator OFTEL, which stated in 1997:

> Mobile network operators, like all network operators, have a monopoly position over the 'termination' of calls on their own networks. Operators have such a monopoly position because when someone wants to make a call to a mobile, or any other phone, then the calling party has no choice but to call the network to which the called party has subscribed (OFTEL [1997], paragraph 1.2).

[3] The other regime is Receiver Party Pays (RPP). In RPP, called party pays the termination part of the call and origination part is paid by the caller.

The argument is as follows: Mobile operator chosen by the called party sets the termination charge that the caller faces. Each mobile network operator can set any charges for termination without any threat from their rival operator due to the monopoly position over termination. This is the direct outcome of CPP regime since adoption of the CPP means that mobile operators can charge other operators for termination, and other operators have to pay these charges. For calls from fixed-to-mobiles, mobile networks may have less incentive to keep termination charges low because fixed networks will pay a high charge as they have an interest in ensuring that all calls made by their subscribers are terminated. For off-net mobile-to-mobile calls (i.e. from one mobile operator to another), mobile networks may again have little incentive to keep termination charges low, since reducing termination would only give an advantage to the mobile competitors in the retail mobile market by reducing their cost. Therefore, mobile network operators (MNOs) have an incentive to set high termination charge under the CPP regime. High termination charge may cause some welfare problems. Therefore, some regulations may be needed over FTM and MTM termination charges.

From the above discussion, two questions appear: what are the effects of high MTR and is there really an incentive difference between setting termination rates of FTM and MTM. These two questions are important to understand since they are the basis of the two different debates in MTR. The first debate is about how above-cost MTR affects welfare. Some argue, such as Armstrong, that high MTR should be regulated since it affects the welfare of the society negatively, while the others support the idea that above cost termination rates improve welfare. To understand this debate, the crucial effects of above-cost termination charges and their relations with welfare are discussed in part 2.4. Second, there is debate whether the mobile operators have an incentive to set high termination rates. Some argue that mobile operators do not have incentive to increase the termination rates because there are some market forces that constrain the operators. On the other hand, the opponents support that market forces are not strong enough to constrain the incentive of setting high termination rates. However, incentives are different in FTM and MTM termination rates, so, the market forces are different. Thus, to understand the difference in the incentive of mobile operators to set high termination in FTM and MTM is helpful to deal with this debate. Indeed, mobile operators have different reasons to set high termination fees for calls from fixed networks (FTM) and calls from mobile networks (MTM). Part 2.5 discusses why the incentives of setting termination rates are different.

To understand these debates clearly, the effects of externalities related with MTR should be examined. These externalities influence the socially optimal MTR. Moreover, externalities may justify above-cost MTR from a social welfare point of view. In short, externalities affect the two debates stated above and, thus, should be understood before examining the debates.

2.3. Externalities

2.3.1. Call Externality

Only the caller has to pay for phone calls in CPP regime; however, the utility of the phone call is shared between the caller and the receiver. As the receiver gets utility from incoming calls, then the cost based pricing could not be the socially optimal choice since the number of calls that the called party receives is less than they desire. Indeed, Armstrong (2002) has derived that the termination rates should be set below cost in order to encourage calls when mobile subscribers derive a benefit from incoming calls.

2.3.2. Network Externality

Additional subscriber increases the utility of the network to all other subscribers who may potentially communicate with him or her. In other words, as the network grows in the number of subscribers, subscription to the mobile network becomes valuable for the callers since they can reach and contact more people. All phone users (both mobile and fixed) thus take the extra utility as the number of mobile subscribers increases. In this view, two network externalities appear: mobile-line network externality and fixed-line network externality. While mobile-line externality includes the mobile user's extra utility from extra mobile subscriptions, fixed-line network externality is the externality enjoyed by the fixed-line users to reach and call extra mobile subscriber.

The fixed-line network externality causes essential welfare debates. As the subscribers benefit from an additional subscriber, some type of subsidy for marginal users may be necessary to reach the socially optimal level of number of mobile subscribers[4]. In

[4] Marginal users are both users decide to join and users decide to unsubscribe.

fact, some argue that it may be plausible and efficient to acquire the cost of the subsidization from fixed operators due to fixed-line network externality. This view causes an important debate over whether this cross-subsidization is fair and optimal[5]. Therefore, setting termination rate above cost may be optimal when network externalities exist. On the other hand, it may be the case that social optimal penetration rates can not be attained only to cross-subsidize the fixed users. In that situation, government subsidization may be appropriate to acquire social optimal penetration level. In general, government subsidization is not considered by telecommunication authorities and tries to find the optimal by the funds just in telecommunication market, not any subsidization from outside. In my thesis, I follow this general approach.

In the network externality concept, there is another externality known as tariff-mediated network externality (Laffont et al, 1998b). Due to tariff differences between on-net and off-net call prices, subscribing to the network with higher market share, i.e. larger network, provides advantage to its own subscribers since these subscribers average cost is lower than the others. Its average cost is lower because larger network provides that their subscribers have relatively more on-net calls than the others if the same prices are charged. Therefore, for marginal users, subscribing to the larger network is more valuable. This externality may be used to deter new entry and, thus, may decrease the social welfare if the new entrant is more efficient.

2.4. Effects of High Termination Charges

In this section, the positive and negative impacts of high termination are discussed. These impacts are crucial for determining the effect of high MTR on welfare.

2.4.1. Potentially Negative Effects of High Termination Charges

2.4.1.1. High MTR causes high wholesale cost

Termination charge of a mobile network is a cost for the other networks to complete the call on another network. Therefore, a raise in MTR means an increase in cost

[5] Cross-subsidization means that acquiring termination profit by charging fixed users and use this profit to capture marginal mobile subscriber.

of fixed and mobile networks. An operator that has to deliver a call to a mobile network will have a higher cost of delivering the call for its subscribers. This operator may compete with retail service of the mobile network that does not have this cost; thus, undermining the competition since operators facing high MTR cannot behave as aggressive as the operators not facing high MTR. Due to different termination charges, some operators' cost level is higher than the others and, thus, operators with high costs cannot cut their retail prices as the operators with low cost level. The result is that the low cost firm has an advantage to decrease its retail price below the retail price of high cost operator to compete in subscribers (IRG, 2004).

The effect of termination on cost also results another problem of using inefficient sources. In general, using products of a low cost firm is efficient. However, using termination service of a low cost firm may be inefficient since the nature of the low cost is not due to using efficient sources. Nature of this cost may arise from difference in timing of entry. For example, assume in a mobile market the existence of an incumbent and a potential entrant, which uses more efficient technology than does the incumbent. The incumbent may have an advantage of a significant portion of population as subscribers. In that case, the incumbent may increase its termination charges to raise the cost of new entrant, an increase which may be reflected to the retail price of the entrant. Thus, the more expensive sources of incumbent are used by the customer who decides their calling strategy by the level of retail prices.

In addition, the high cost of terminating calls to a mobile network can also influence the entry decision of potential entrant on mobile network. A potential entrant may be deterred from entering the market due to high termination cost. This will especially be so in the case of high calling traffic from entrant to incumbent. If calling traffic from entrant to incumbent is higher and termination charge of incumbent is also high, than the entrant will be confronted with a net termination payment to the incumbent. In addition, the entrant cannot recover this payment by setting high retail prices since the higher the retail price, the lower the number of subscribers. Therefore, the potential entrant may decide not to enter the market if MTR of the incumbent is high, and there will be net out flow of calls to incumbent (IRG, 2004).

The high MTR affects fixed operators more negatively and undermines the competition between the mobile and fixed. In general, while fixed services are regulated at the cost level in the world, mobile services are not. Therefore, terminating on fixed network is cheaper than on mobile networks. In a bilateral relation between a fixed

network operator with a MNO, a fixed operator has its termination revenue on lower (regulated) fixed termination charges and its cost on the mobile network based on high MTR. Consequently a fixed operator has large net out payments to a MNO. Due to the fact that in most countries the volume of FTM exceeds the volume of MTF calls, this imbalance in out payments is enhanced significantly. This payment causes a welfare problem due to cross-subsidization. Cross-subsidization may lead to distribution of income problem since fixed users encounter high charges and profit from their payments is somehow distributed to the mobile users'.

2.4.1.2. High MTR enabling high retail prices:

MTR is part of the costs of an originating operator when completing calls that terminate on another mobile network. Thus, MTR is reflected to the retail prices. Excessive termination charges for calls to mobile networks cause high end-user prices. The effect of high termination charges on retail prices is most noticeable in FTM retail prices, due to the fact that fixed operators can not compensate the high cost of terminating calls to a mobile with revenue from terminating calls to its own fixed network. Indeed, fixed operators have a net out payment of termination service for the bilateral relation with mobile operators. Therefore, fixed operators have little choice but to incorporate the full cost of terminating calls to mobiles into its retail prices. Moreover, a high MTR leads to a higher off-net MTM retail price since mobile networks include MTR as a cost and reflect MTR to retail price to some extent (IRG, 2004).

High retail prices for FTM and off-net MTM calls due to high termination charges may lead to some inefficient outcome. These high retail prices affect consumer choice and generate an inefficient allocation of resources. Mobile networks use more resources than fixed technology; thus it is more efficient to use a fixed telephone to make calls when possible. However, those retail prices give the wrong signals to consumers as retail prices direct consumers towards calling on-net MTM rather FTM calls. As termination charges increase, consumers prefer to make on-net calls and, thus, the optimal level of FTM calls decreases. As a result, the high retail price caused by high termination charges generates an inefficient allocation of resources by directing consumers towards more costly resource-intensive service (Oftel, 2003b).

2.4.1.3. High MTR enabling leverage of market power in mobile termination market into retail markets

If the integrated network operates in both fixed and mobile telephony markets, high termination charge may undermine the competition in fixed retail market. High termination charge of the mobile part makes it possible for the integrated network to offer low retail prices to its own fixed end-users for calls to its own mobile network part. This gives an advantage to integrated network to gain subscribers in fixed market since other fixed network operators face higher termination charges and, thus, higher FTM retail prices for calls to the integrated network. This is essential especially in the case that the call to the mobile part of the integrated network is a significant share of the total volume of FTM calls. In that case, the integrated operator prefers to set high termination charges to acquire extra profit and use this extra profit to cross-subsidize fixed retail market. This affects the competitive balance in the fixed-retail market (IRG, 2004).

2.4.2. Potentially Positive Effect of High Termination Charge

In the case of low mobile penetration, setting high termination rates (above cost) may lead to higher consumer welfare than setting termination rates at cost level. As stated above, mobile operators use high termination charges to cross-subsidize mobile subscribers by getting extra termination revenue from fixed users. In other words, mobile operators increase FTM call prices and decrease mobile subscription fees or rentals, causing both a negative and a positive effect on consumer welfare. Due to the increase in FTM price, FTM callers lose some of their surplus. On the other hand, mobile subscribers have an extra surplus due to decrease in mobile subscription fees or rentals. Therefore, change in total consumer surplus due to increase in MT depends on those two effects. Here, mobile penetration rate is a crucial concept to determine dominant effect. As FTM termination charges rises, fixed users have more incentive to subscribe to mobile operators since MTM call prices are seen as a substitute to FTM calls. The rise of penetration rate means that both mobile users and fixed users can now call more people who are away from their fixed lines, known as fixed line network externality. Obviously this gives more utility to fixed users since they can reach more people make more calls to a mobile. This externality effect alleviates the impact of price increase in FTM calls on consumer surplus of fixed users. Therefore, it is possible that the benefits to mobile users of lower mobile

subscription fee or rentals can outweigh the loss in surplus to FTM callers. Wright (2000) provides a numerical example to show that with partial mobile penetration, the socially optimal termination charge could in fact be many times above cost. His numerical example shows that even with a 50% cellular penetration rate and even with a monopoly FTM provider, optimal termination charges can be significantly above cost. In addition, as mobile penetration rates increase, the extent to which the socially optimal termination charges exceed costs, falls. As an extension of this work, the effect of termination rates on consumer surplus, FTM traffic, and mobile penetration when the mobile penetration is partial has been examined. They use actual data on Columbia where the mobile penetration is 20%. They find that mobile penetration is positively related with MT. In addition, they show that consumer surplus and FTM traffic is maximized at the level where MT is above cost. As a conclusion, high termination charges may be the socially optimal choice in the case of partial mobile penetration (Thompson et al).[6]

On the other hand, there is another argument that claims high MTR may be welfare improving even when penetration rate is high. High penetration rate means that a significant part of the population has mobile phones. Therefore, it can be argued that even if termination charges are set above costs, since most consumers have a mobile phone, what callers to mobiles lose in paying high termination charges, they gain in low access and outgoing call charges. This approach is true for the cases that callers to mobiles and mobile subscribers are the same people. However, there is significant number of callers in each country that use more FTM calls than MTM calls. The people without a mobile phone are most adversely affected by above cost termination charges since this people call mobiles but do not own one. In general this group includes a disproportionate number of elderly and low income people (OFTEL, 2003b).

Oftel (2002) estimated that roughly 19 percent of British households, representing over 8 million people, have fixed-line telephone but do not have a mobile phone and that 10 percent of their total fixed calls are to mobile phones. The same research of the Oftel also shows that roughly two-thirds of fixed line-only households earn less than £11,500. Therefore, increase in termination charges may cause a rise in surplus of mobile users'

[6] Wright (2000), and Thompson, Renard, and Wright assume that there is no substitution between FTM and MTM calls. If substitution assumption is added to the model, then high termination charge leads to lower termination revenue than before Mobile penetration rate is lower than before, and, so, FTM traffic gets lower and consumer welfare is lower.

who generally have higher incomes and may cause a decrease in surplus of fixed users with relatively less income. This effect worsens the distribution of incomes.

There may be a counter-argument which is that mobile-only users might be disadvantaged by the lowering of termination charges. However, it is a common belief that this effect is outweighed by the number of fixed line-only consumers who are adversely affected by high termination charges. An Oftel survey shows that the group of mobile-only customers represents just 7 per cent of households (OFTEL, 2003a).

In addition, individuals with both a fixed line and a mobile phone suffer a detriment from excessive mobile termination charges. This condition is true for all of those people who use their fixed line instead of their mobile phone to call a mobile or make more off-net calls to mobile than they receive.

As a conclusion, high MTR may positively affect social welfare in the case of low penetration rates. For this reason, many countries do not regulate mobile market in its starting period. On the other hand, although some advocate that high termination charge may still be welfare improving in the case of high mobile penetration rate, high MTR causes unequal distribution of income and also may not be social optimal.

2.5. Difference in Incentives in Setting MTR in FTM and MTM Markets

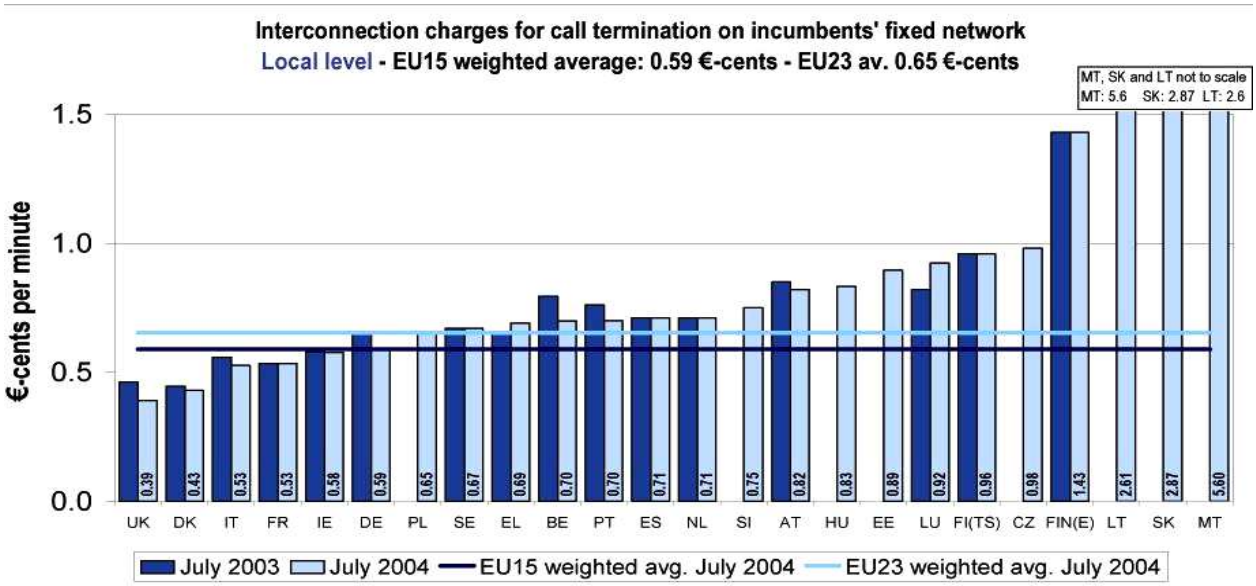
The termination issue differs in FTM and MTM markets because fixed and mobile operators' incentives are different. Mobile operators set high FTM termination rates since mobile operators have an incentive to gain net transfer from fixed operators. On the other hand, mobile operators set high MTM termination since they have an incentive to collude or deter new entry. In this section, the reasons of these incentives are examined.

For MTM calls, it is possible that the termination charges paid by each operator to the other cancel out[7]. That is, net call minutes between mobile networks are likely to be zero. This 'canceling out' is quite possible within the termination market for MTM calls as a whole, where all operators interconnected. Patrick Rey and Bruno Jullien express this issue by saying "… MTM termination clearly cannot be a source of a profit for mobile industry as a whole. By definition, the sum of all MTM termination charges within the mobile industry is zero. Hence the mobile operators collectively cannot be generating

[7] It is plausible if termination rates of MTM calls are reciprocal.

profits from MTM call termination" (Vodafone, 2004). It is therefore argued that MNOs have no incentive of getting extra termination profit by raising the price of MTM termination services above their cost. Since any increase in the price of MTM termination is likely to be matched by their rival MNOs so no net profit is gained from price increase in termination.

Figure 2.2 - Interconnection charges on incumbents' fixed network in Europe



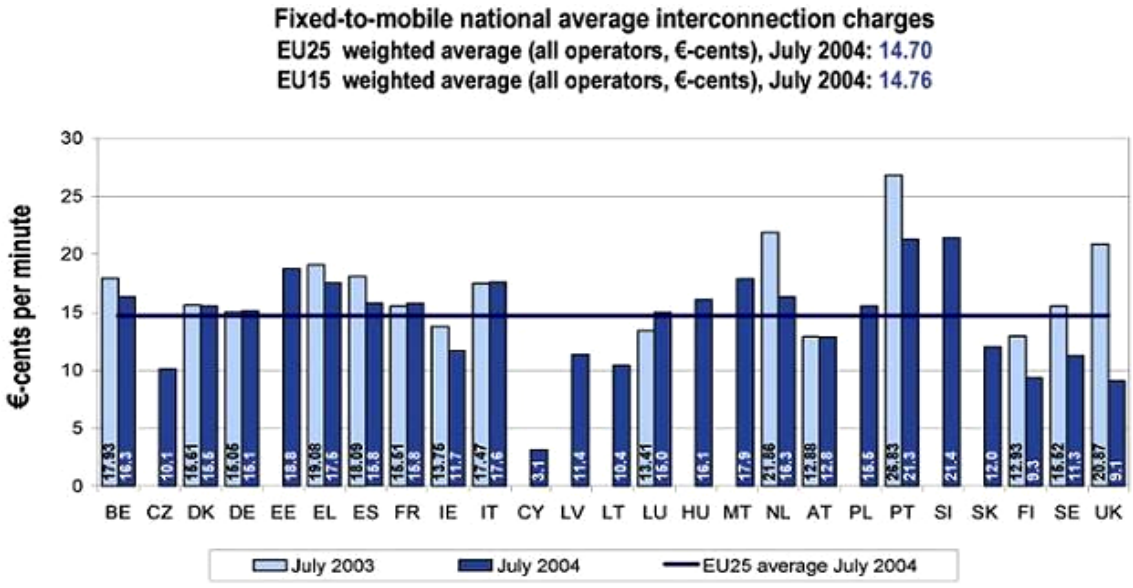
Source: European Commission (2004)

On the other hand, mobile operators can capture profit from termination rates in FTM calls for several reasons. Firstly, call traffic symmetry is unlikely to be the case with regard to FTM calls because retail prices and therefore demand elasticities of FTM and MTF calls differ. Secondly, termination rates on fixed network are significantly lower than those on mobile networks. As seen in figure 2.2, charges of call termination on fixed network among 23 European countries are ranged from 0.39 € cents/min (United Kingdom) to 2.87 € cents/min (Slovakia)[8]. In addition, the average of call termination rates in 15 European countries on a fixed network is 0.59 € cents/min and average of those in 23 European countries is 0.65 € cents/min as seen figure below. On the other hand, charges of call termination in FTM market among 25 European countries range from 9.1 €

[8] Termination rate in fixed network in Malta is 5.6 € cents/min, but it is outlier.

cents/min (United Kingdom) to 21.4 € cents/min (Slovenia)[9] as seen in figure 2.3. The average of call termination in FTM markets of 25 European countries is 14.70 € cents/min and the average of those of 15 European countries is 14.76 € cents/min. In the light of these charges, FTM call minutes would need to be about one twenty-fifth of MTF call minutes before fixed operator could recover mobile termination costs. However, FTM call minutes are generally higher or slightly lower than MTF call minutes. For example, in France the ratio of mobile termination charge to the fixed termination charge is approximately 35 in year 2002.[10] For zero gain, MTF call minutes should be roughly 35 times more than FTM call minutes. However, MTF call minute is 18.7 billion minutes and FTM call minute is 10.4 billion minutes in 2002 at France (Bomsel et al, 2003). This corresponds to approximately the ratio of 1.8, not 35, and illustrates that mobile operators' net positive gain. Thus, it seems more unlikely to have a net gain of zero in termination market which mobile and fixed operators interact. It is more likely to have a profit by mobile operators in the termination issue with fixed network. Thus, mobile operators have an incentive to increase mobile termination rates.

Figure 2.3 - National average FTM interconnection charges in Europe



Source: Source: European Commission (2004)

[9] FTM termination rate in Cyprus is 3.1 € cents/min, but it is outlier and do not reflect the European average.

[10] Average national FTM charge is 18.87 cents/min and interconnection charge on fixed network is 0.53 cents/min in 2002 at France.

As stated above, mobile operators can acquire net termination transfer from fixed operators since an increase in FTM termination means one in termination revenue for mobile operators due to the inelasticity of FTM calls. On the other hand, mobile operators may not get extra profit of termination from the increase in MTM termination since MTM charges are generally reciprocal, and an increase in MTM termination indirectly means an increase in cost of termination.

Mobile operators still have an incentive to increase MTM termination because of collusion and deterring entry. MNOs may use termination rates as a tool to attain monopoly retail price by collusion. Since every mobile operator can raise its rivals' call prices through high termination fees[11], a mutual price increase for termination services can result in a collusive equilibrium with strategically high termination fees and accordingly high mobile call prices. In other words, MNOs can collude over MTM termination rates that correspond to the monopoly retail price. Laffont, Rey and Tirole (1998) and Armstrong (1998) demostrate that networks use their reciprocal termination charges as an instrument of collusion: by raising each other's cost, they can dampen the effects of competition between them and thus raise their profits.

Moreover, MNOs use termination rates to deter new entry. In the case of network externality and high switching costs, an entrant firm needs mark-up to the consumer to change their operator. For example, entrant should charge low off-net MTM prices compare to incumbent firm if the entrant desires to capture potential mobile users[12]. Potential mobile users might have relatives who subscribe to different operators, and thus they should make calls to both entrant and incumbent. In that situation, the incumbent will probably be called more than the entrant since the incumbent has a larger number of subscribers. This gives an advantage to the incumbent due to "tariff mediated network externality"[13]. Therefore, potential mobile users are more likely to prefer incumbent firms when they charge the same off-net prices. The entrant prefers to set lower off-net prices to

[11] If there is a uniform price in retail market, then the increase in termination strongly affects the retail prices. If there is a two-part tariff, it is also affect the retail price but not as strongly as the one in uniform pricing case.

[12] Here I define potential entrant user as a potential mobile user who currently does not subscribe to any mobile operator.

[13] In the case that on-net and off-net call prices are different, tariff mediated network externality exists. Generally off-net call prices are significantly higher than the on-net call prices. Comparing an incumbent with an entrant, it is expected that subscribers of the

acquire potential mobile users. In that case, the incumbent operator may respond by increasing termination rates which indirectly increase the off-net prices of new entrant. This response prevents entrant to aggressively compete in mobile subscription. In other words, entrant cannot acquire a sufficient market share; thus, deterring the entry decision.

As stated above, MTM and FTM termination rates are set above cost for different incentives. Therefore, to overcome this problem regulation of MTM and FTM termination, rates should be examined separately. The next two chapters examine the MTR issue in FTM and MTM markets separately.

---

entrant will make proportionately more off-net calls than the subscribers of the incumbent. Hence subscribers of the entrant experience higher average call charges.

3. TERMINATION RATE ISSUE IN FTM MARKET

As stated in the previous chapter, mobile operators may have an incentive to set high termination rates. In the following section, some theoretical articles are examined whether mobile operators have an incentive to set above-cot FTM termination rates and also inquire whether regulation is need. Some economists argue that there are some forces that constrain the incentive to set high FTM termination rates. On the other hand, some argue that the sources of the incentive are more important than these forces. The second section illustrates these forces and sources. In addition, data on the impact of the forces and sources in the real world is provided.

3.1. Literature Review on Regulation of FTM Termination Rate

In this section, recent literature that analyses FTM call termination is reviewed. The theoretical literature on models which explain how unregulated mobile operators may possibly behave to set FTM termination charge is reviewed in the following section. Then it is concluded that FTM termination charges should be regulated due to the incentives of mobile operators to set suboptimal FTM termination charges.

Wright (2002) analyzed the level of fixed-to-mobile termination rates if termination rates are unregulated and if there is a competition in mobile retail market. He illustrates that mobile operators have an incentive to set fixed-to-mobile termination rates at, or above, the monopoly level. In the case of FTM termination, mobile operators compete for the right to terminate calls by competing for mobile subscribers. However, competition on the subscriber does not lead to set termination rates at a socially optimal level. Mobile operators set above cost termination rates for fixed lines calls since they use the profit from the termination to capture more customers by decreasing retail prices in the competing mobile market. In addition, as termination rates get higher, mobile customers become more valuable. Thus, mobile operators have no incentive to set termination rates at cost level. Wright examines the termination rate levels in the cases of differential FTM prices

and uniform FTM prices. When each mobile operator charges different termination fees to the fixed operator, fixed operator uses differential FTM prices. On the other hand, the fixed operator charges uniform FTM prices when all mobile operators charge a uniform termination fee. Wright concludes that when the fixed operator sets differential FTM prices depending on which cellular network calls terminate, mobile operators may set termination rates at monopoly level. When fixed operator sets uniform FTM prices, mobile operators may set even higher than monopoly level.

George Houpis and Tommaso Valletti (2004) analyze whether the FTM termination rate needs to be regulated and what is the social optimal FTM termination rate is in the case of network externality and heterogeneous customers. In their model, there is one fixed network and one mobile network[14]. They assume that there are no MTM and FTF calls. This assumption eliminates the substitution opportunities of the customers. However, customers may prefer to use mobile-to mobile (MTM) or fixed-to-fixed (FTF) calls in the case that FTM call prices increase. This makes FTM calls more inelastic and, thus, the level of mobile termination may probably be calculated higher than in the case of MTM and FTF substitution is available. Another assumption is customer preferences. They assume customers derive utility only when they make calls and not when they receive calls. This assumption eliminates the call externality. However, in many cases customers get utility from calls from relatives, their friends and their bosses. Without call externality, socially optimal level may be even below the cost level. Under these assumptions, they model how termination rates change as the aim of the regulation changes when network externality and heterogeneous customers exist. They examine the level of termination fee if the regulators aim 1st, 2nd and 3rd best solution and compare it with unregulated case. They find that mobile operators set high termination rate in unregulated case and this causes a total welfare loss. The rest of the paper discusses the appropriate remedies to get social optimal termination rate. It is possible to set wrong level of the rate due to the lack of relevant cost and demand information, i.e. network externality and customer heterogeneity. They conclude that this wrong level set directly by the regulator may lead serious welfare implications and suggest some other alternative remedies such as yardstick, bill-and-keep to the direct setting of termination.

Mark Armstrong (1997) states the high FTM price in U.K. and presents a model of FTM calls to examine whether the mobile operators will set socially optimal levels in the

case of competition in mobile retail market. He shows that unregulated mobile operators, in the case of competition in mobile retail market, would have an incentive to set FTM termination charge at a level to maximize termination profit. He mainly considers three services: mobile-to-fixed calls, fixed-to-mobile calls and mobile subscription. Like Houpis and Valletti, he ignores the MTM and FTF substitution affect on FTM termination. He also assumes MTF termination charge is regulated at cost and FTM retail charge, at perceived cost which depends on the level of mobile termination charge. This assumption is realistic since the fixed networks' services are generally regulated in most of the countries, but mobile networks' services are not. He shows under those assumptions that if the level of mobile termination charge level is below the termination profit maximizing level, then one of the mobile operators would generate additional profits by raising the FTM termination charge. This incentive exists for the other operators. Thus, all mobile operators would push FTM termination charges to the monopoly level. Moreover, he finds that socially optimal termination charge should be set below cost to the extent mobile subscribers get utility from receiving calls. This illustrates that high termination rates will make welfare loss for the society. Therefore, the regulation on termination rates will be required.

In another article Joshua S. Gans and Stephen P. King (2000a) analyze the level of FTM termination rates in the case of customer ignorance[15]. Due to customer ignorance, customers only consider average termination charges. Therefore, while demand reduces on the average of FTM calls, the increase in the price directly affects the operator's termination revenue. This gives an incentive to mobile operators to raise the termination rate. In addition, competition in retail mobile market triggers the overpricing of termination. They support the idea that with a higher termination charge, a mobile operator benefits more from attracting a subscriber and can thus afford to offer more attractive subscription terms for customers in the case of competition. For this purpose, mobile operators aim to use termination profit to cross-subsidize subscription. As an extension of this finding, they show that mobile operators still have an incentive to set high FTM termination charges in the cases where mobile consumers care about the quantity of calls they receive from fixed network. The reason is that fixed users' quantity of calls to mobile still depends on the average mobile termination charges and, thus, termination rates

[14] In part 3.5 (pg. 13) of the article, they also briefly consider the imperfect competition in mobile market by modeling one fixed and two mobile operators.

[15] Customer Ignorance is customers cannot identify the specific mobile network they call.

do not effectively differ among networks. However, they do not examine the level of FTM termination if there are new entrant and an incumbent. In this case, the new entrant may possibly charge lower termination charge to gain customers from fixed users. But, their most critical assumption is that overall shares are fixed: fixed and mobile customers are distinct and the two forms of telecommunication are not competitors. This assumption should be relaxed to determine this new entrant situation.

3.2. Empirical Evidence on the Debate on Regulation of FTM Termination Rate

Economists argue that there are some forces that constrain the monopoly power of MNOs in setting mobile termination rates. Discussion of these forces' effects is essential to capture whether setting high termination is plausible or not for MNOs since these forces determine the level of the elasticity of demand for FTM calls. If the demand is inelastic, then the increase in mobile termination rate is rational for operators.

3.2.1. Forces that Constrain the Incentive to Increase MTR

3.2.1.1. Demand substitutes for FTM calls

There are several potential demand substitutes which may impose constraints on setting high termination charges. For example, one possibility would be to request the called party to call back, i.e., make FTF or MTF calls instead of FTM ones since FTF and MTF calls are cheaper. Other possibilities would be substituting FTM calls by data messages or on-net MTM calls. By doing these, increase in termination rate may cause a decrease in FTM call minutes. The crucial demand substitutes are examined below by empirical evidence.

3.2.1.1.1. MTM calls

If the mobile penetration rate increases, then the percentage of people who have both fixed and mobile phone increases. The growing number of mobile subscribers makes

MTM calls an increasingly feasible substitute for FTM. Mobile-to-mobile calls on the same network (on-net) are not subject to termination charge. Therefore, an on-net call can often be less expensive than a FTM call which makes the on-net mobile-to-mobile call an attractive substitute for FTM. While the mobile carrier loses the off-net termination charge when the consumer switches from FTM call to an on-net MTM call, MNO gains a retail price of an on-net MTM call. Thus, the increase in termination rates may decrease profit from termination. Moreover, total profit in calling service may also decline since generally off-net termination charges are higher than on-net call prices. OPTA[16] states in Consultation Document about MTR that MTR tariffs are three times as high as the on-net tariffs for consumers (OPTA, 2001). In addition, for an operator, while on-net calls include both termination and origination costs, terminating an off-net call only includes termination cost. Thus, it can roughly be said that on-net call's cost is twice as high as off-net termination cost[17]. As a conclusion, since termination rates for off-net calls are higher than on-net call tariff, the net gain per minute from the off-net termination is higher then the net gain per minute from the on-net calls. Therefore, increasing termination rate may cause a loss in profit. High termination rate, then, might not be a plausible strategy, if on-net MTM call is available for most of the subscribers since it pressures high FTM call price.

In fact, a survey conducted by the U.K. consultancy DotEcon (2001) shows that there was an evidence of call substitution between fixed and mobile telephony based on a telephone survey of 7,702 U.K. residents. Call substitution means that when users have a choice of access to both fixed and mobile phones, their choice for mobile operator depends on cost. DotEcon found that 40% of those consumers with access to both fixed and mobile telephones at home use their mobiles to make calls from home at least sometimes. Moreover, 26% with access to both mobile and fixed lines never make mobile calls from home. The main reason for more than 50% of respondents for choosing mobile phones to make calls at home is that mobile calls are cheaper than fixed calls (DotEcon, 2001). In addition, comparative analysis of twenty OECD countries concludes that an increase in mobile penetration significantly decreases the growth of fixed-line penetration. These data indicate that MTM calls are substitutes for FTM calls.

[16] OPTA is the NRA of Netherlands.

[17] In reality, origination and termination costs are different, but the difference is not much. Therefore, it can be assumed that they are roughly same.

The constraining effect on the mobile termination rates resulting from the ability of MTM calls to substitute for FTM calls depends on the degree of mobile penetration and the likelihood that the calling party and the called party are on the same mobile network. Indeed, the mobile penetration rate is very high. On the other hand, there is an ambiguity in whether the called and calling party is on the same network. A Vodafone survey shows that 51.8% of FTM calls are made to close friends and families (CC, 1999, table 4.22). However, Amarach Consulting (2003) finds that 95 % of the respondents have never chosen a network or changed to a new network so as to be on the same network as with friends and family members. This finding may illustrate the probability that the user subscribes to different network from people they make the most FTM calls is high. This may lead to the view that it is less probable to have an on-net MTM connection with people whom the caller makes more FTM calls. As a conclusion, the effect of on-net MTM substitution over FTM call may not be so strong.

3.2.1.1.2. Call-Back: MTF calls or FTF calls

The other substitution alternatives are MTF or FTF calls. In general, MTF and FTF calls are cheaper than FTM calls. Therefore, the fixed calling party can ask the mobile called party to call back. Call back takes place when a caller and a called party decide not to complete their conversation but instead arrange for called party to call the caller party back in order to complete the conversation. These alternatives could have less force to constrain mobile termination rate since this alternative is contingent on the receiving party's consent (the receiving party must pay the mobile origination charge under these alternatives). Here the relationship of the called party with calling party is essential. If the concentration of FTM calls is mostly between people who do not have close relations, then these alternatives could not substitute for FTM calls. MMC survey questions if a called person ever calls back to save their callers from using mobiles, 43% of the respondents state they call-back (CC, 1999, table 4.27).

There are two call back options MTF and FTF calls. By calling back in MTF, MNOs lose the termination charge and gain origination charges. However, termination charges are likely to be higher than mobile origination charges since competition between MNOs is likely to have a larger effect on origination rates than on termination rates.

Consequently, the mobile network loses revenue on balance by receiving the origination charge instead of the termination charge.

On the other hand, the FTF call back option might completely bypass the mobile network and, thus, MNOs lose total FTM termination revenue. However, this call back option is weaker than the MTF call back option as FTF is only appropriate in the case that the FTM call is not time-sensitive and consumers are willing to wait until the called party can be reached through a fixed connection (Crandall and Sidak, 2004).

The MMC survey stated above illustrates that many people call back to save their callers to call his mobile phone. However, the reasons to call back are essential in understand whether the call back option has a constraining influence on termination prices. MMC finds the following results in Table 3.1 for reasons of calling back.

Table 3.1 - Reasons for call-back

To save them in cost of the calls	52%
Overall it is cheaper	18%
It is polite	19%
To fit in at a time which suits me better	12%
Other	18%
Source : U.K. Competition Commission (CC 1999,Table 4.28)	

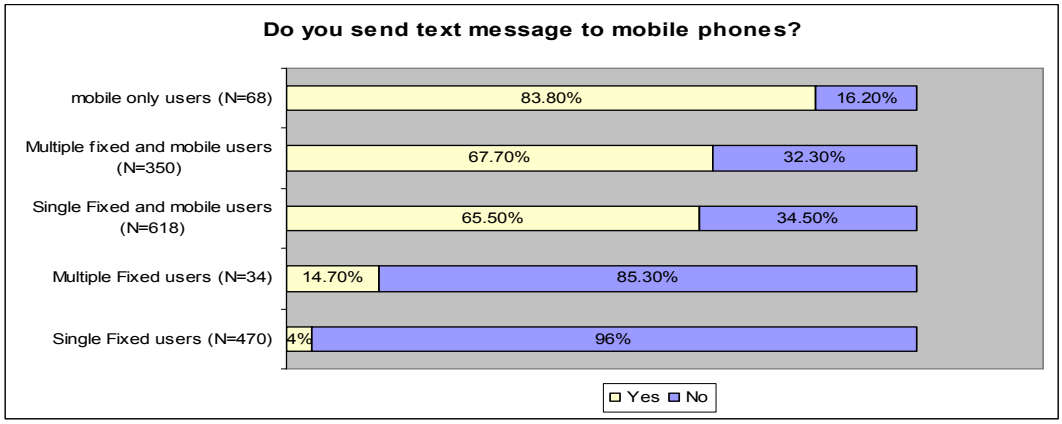
Table shows that 18% of the respondents (7.8% of all respondents) call-back because it is cheaper. This is crucial since only %7.8 of all respondents react if the retail prices changes. This means that increase in FTM charges due to high termination rates may not lead users to engage in call-back options. In this data stated above, the main reason is to save the caller in cost of the call. This reason may reflect a wish to save the caller money based on more general views on the purpose of the call, the relative incomes and relationship of the parties. By these results, CC concludes that call-back will not necessarily act as a constraining influence on termination rates (CC, 1999).

3.2.1.1.3. Data messages

Data messages can also substitute for fixed-to-mobile calls since data messages allow the caller to communicate with mobile receiver. Data messages are a good substitute for FTM calls to convey specific piece of information, such as time and place of meeting.

They can also be used to arrange call back by informing the called party of the request for a telephone conversation. However, data messages have some constraints, for instance in sending a message, a mobile telephone or computer with internet access is needed. Overall, DotEcon survey (2001) 65.5% of single fixed and mobile users and 67.7% of multiple fixed and mobile users send a data message as seen in figure 3.1. Moreover, 55.5% and 57.4% of them, respectively, make less voice calls[18]. These numbers illustrate that the significant portion of users having the mobile and fixed line use data messages as a substitution to voice calls. On the other hand, only 18% of single fixed and mobile users and 17.7% of multiple fixed and mobile users make a lot less voice calls as a result of sending data messages as seen in figure 3.2[19]. This number shows that the substitution effect of data message over FTM calls may not be very strong. Moreover, the high penetration rate is essential to determine the strength of the effect since if the penetration rate is low, then the number of single fixed users is high; thus, the data message usage is very low. As seen in the figure 3.1, only 4% of single fixed users send data messages to mobile phones and only 10.5% of them make a lot less voice calls as a result of sending text messages to mobiles.

Figure 3.1 - Do you send data message to mobile phones?

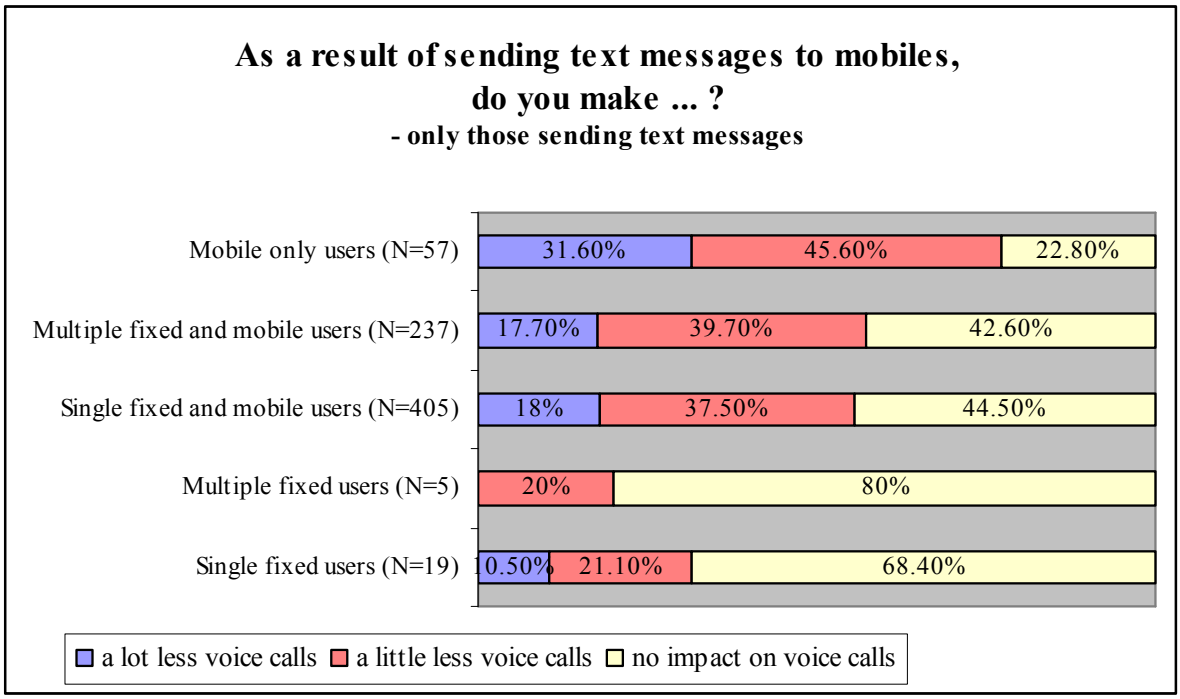


Source: DotEcon Survey (2001)

[18] This numbers correspond to %36.4 of all single fixed and mobile users; and %38.9 of all multiple fixed and mobile users.

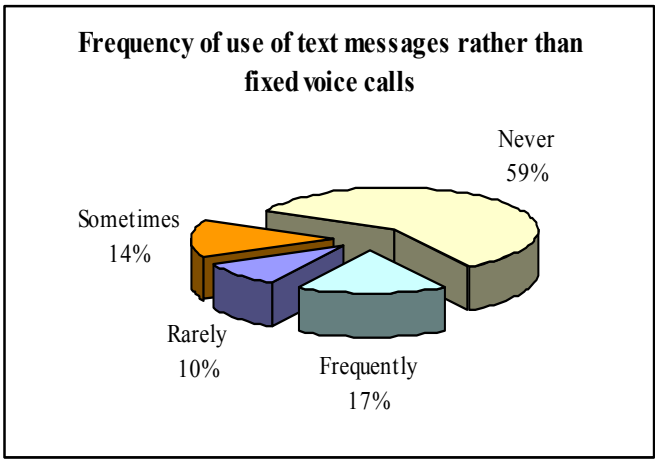
[19] This number corresponds to %11.8 of all single fixed and mobile users; and %12 of all multiple fixed and mobile users.

Figure 3.2 - Effect of data message over voice call minutes



Source: DotEcon Survey (2001)

Figure 3.3 - Frequency of use of data message rather than fixed voice calls



Source: OFTEL (November, 2002)

The consumer survey done by OFTEL (November 2002) supports the view that data message is a substitute for FTM call[20]. Approximately half of the mobile and fixed users claim that they send data messages instead of making calls from their fixed line phone at home to a mobile line. This number indicates that substitution of data message exists. However, only 17% of them use data message frequently as an alternative for FTM

[20] All consumers in this survey have both mobile and fixed lines.

calls as shown in figure 3.3. Thus, the substitution may not be very strong. In short, the substitution effect is seen in consumer surveys; however, the effect of substitution is ambiguous and probably may conclude to very small effect.

Furthermore, OFTEL states that data messages would not pressure MTR, since the operator providing the termination for data message would be the same ones providing call termination. Therefore, the operator can set a termination charges for data message at such a level as to prevent its putting pressure over voice termination. This means the operator may eliminate the substitution impact of data messages over voice calls. As a conclusion, general view about the substitution effect of data message is not very strong over voice call.

3.2.1.2. The Effect of Termination Rates on Caller's Inbound Calls

The previous part discusses that the fixed line callers can substitute some alternatives for FTM calls. As another alternative, fixed-line callers can opt not to call mobile customers or at least can elect to decrease their demand for calling mobile customers as a response to increase in termination rates. MNO loses the entire margin of terminating a call onto its mobile network when a fixed-line caller decreases his demand to contact a mobile customer. This may cause a threat on MNO's intention to increase termination rates (Crandall and Sidak, 2004).

3.2.1.3. Closed user group: Mobile customers' concern for the welfare of their callers

The most crucial force to constrain the incentive to set high mobile termination rates is the level of sensitivity of mobile subscribers to incoming calls. In general, it is believed that mobile subscribers are mostly concerned with the price of outgoing calls. If this is the case, then the high termination rate does not have any affect on subscribers' choice of mobile operator. Thus, constraints stated in previous parts which are related with the calling parties' reactions are the primary constraints for high termination rates. On the other hand, one might argue that it is doubtful that consumers are ignorant about the mobile termination rates on incoming calls. In real life, mobile subscribers might be

concerned about the price of receiving a call from a group of people (closed user group (CUG)). A family can be the best example for CUG. In a family, the mobile owner pays for the calls to his mobile; for instance, parents generally pay their children's charges originating from both fixed and mobile in family. In these situations, called party is sensitive to the cost of incoming calls from CUG since the called party also pays the termination charges. If the called parties are sensitive to the cost of incoming calls, then high termination rates might affect the called party's choice of the operator which is crucial since CUG directly influences the number of subscription to the MNO. Indeed, high termination rates correspond to high off-net calls relative to on-net call prices; therefore, it is expected that users in CUG prefer subscribing to the same network.

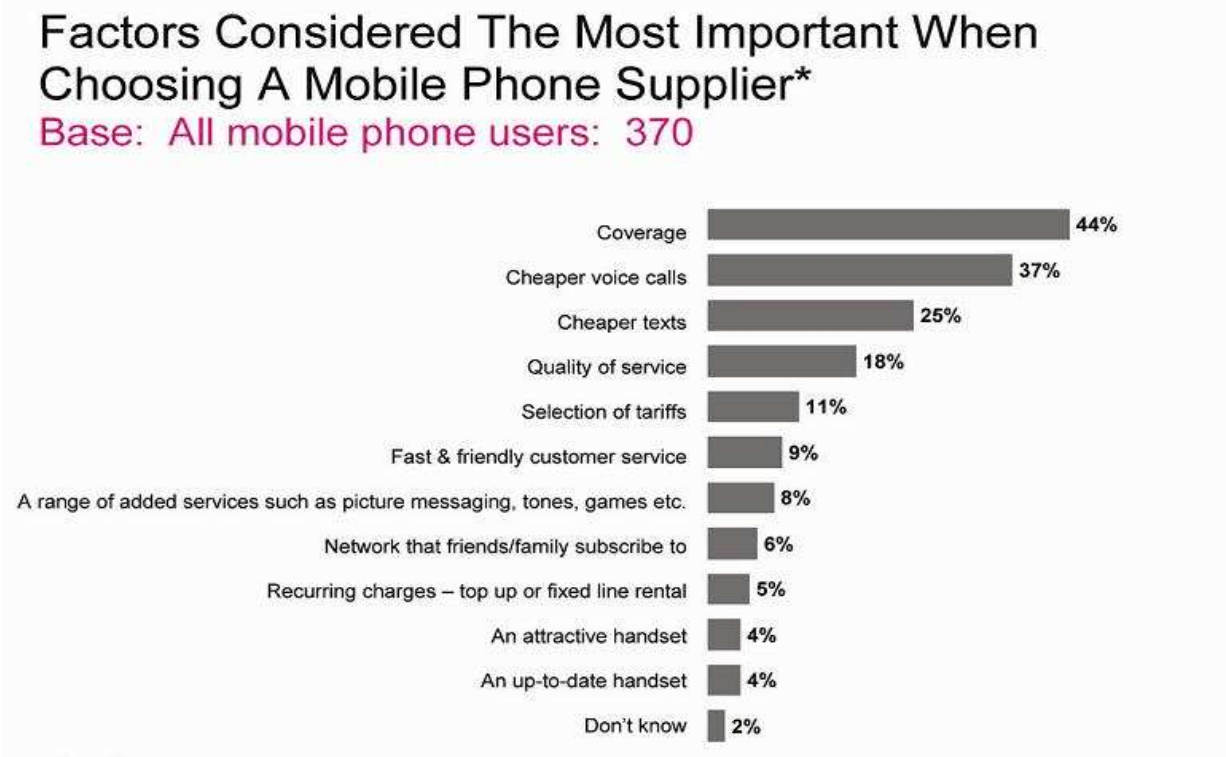
The consequence of a CUG is that mobile subscribers will pay attention to the prices of incoming calls when choosing their mobile operator, thus placing competitive pressure on MNOs to keep termination rates low. In addition, any increase in mobile termination rates might trigger the mobile users to change the mobile operator, thus causing profit reduction for mobile operator. This is the main force of the CUG that pressure the termination rates. However, researches below provide that subscribers do not change their network and choose their family member's network.

The pressure of CUG on termination rate is controversial. Two mobile operators in U.K., Orange and T-Mobile, claim that the sensitivity of CUG to incoming call prices places a competitive constraint on the level of MTR. On the other hand, many consumer surveys illustrate that this view on CUG does not hold in practice. According to Vodafone's survey done in March/April 2001, 39% of the respondents indicate that all the mobile phones for which they or the other members of the family pay, are on the same MNO. However, only half say that they are on the same network because this reduces the cost calling others. Another survey done by a mobile operator in U.K., O_2, finds that very few respondents say that they change their network so as to be on the same network as family and friends. A very similar result is found in OFTEL's survey done in November 2001 that 'wanting to be on the same network with family and friends' is one of the reasons a few respondents consider as essential in changing the current operator, while the price of making calls is given as a reason by most respondents (cited in CC, 2003). Very similar results are found in the survey done by ComReg[21] (2004). As seen in figure 3.4, only the 6% of the respondents consider ''network that friends/family subscribe to'' as a

[21] ComReg is the NRA of Ireland.

most important factor when choosing a MNO. The coverage and the price of the voice calls are the most crucial factors in choosing MNO. The essential survey by the U.K. Competition Commission (2003) explores that 81% of the respondents pay in for mobile phones have never chosen, or changed to, a network in order to be on the same network with people they speak most, i.e., friends and family. All these surveys provide that the effect of CUG is not high since people generally do not prefer to change or subscribe to the network which is the same network with members of his family or friends to decrease the cost of calls.

Figure 3.4 - Factors considered while choosing mobile operator

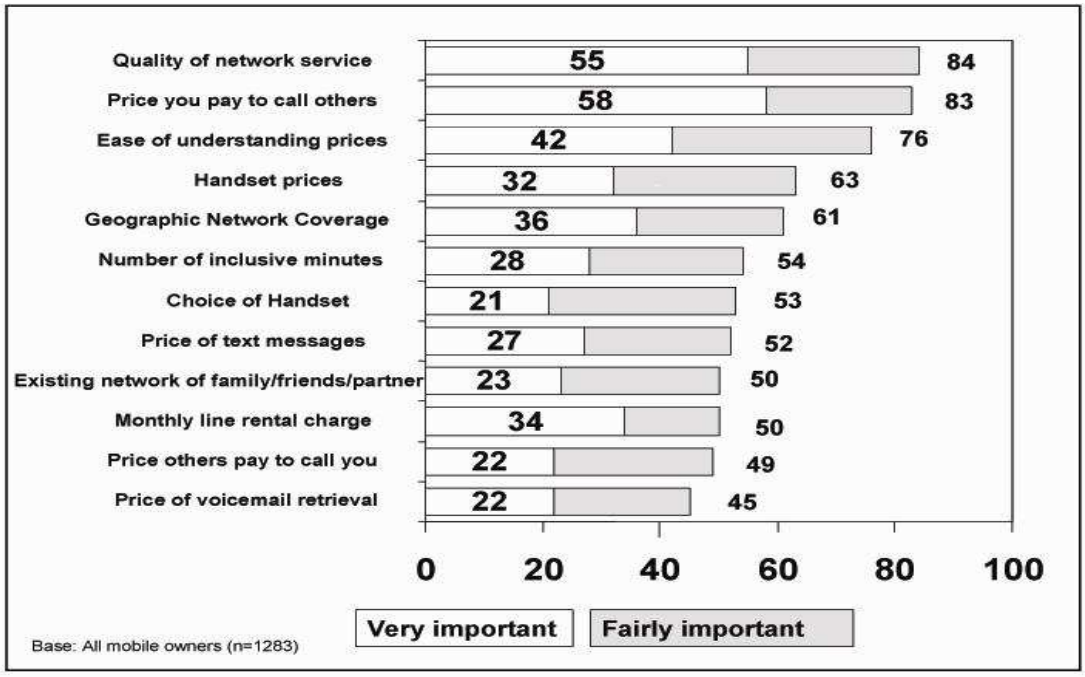


Source: ComReg 2004

There important surveys support consumers' concern about the prices of incoming calls. For example, a BMRB report shows that 70% of respondents who most often received calls from a specific group of people were not concerned about the cost that those people of calling respondents' mobile operator (CC 2003, appendix 6.2, table 9). Moreover, as seen in figure 3.5 (the same survey topic within the survey shown in figure 3.4), 22% of the respondents state ''price others pay to call you'' as very important and place it near the bottom of the list. It can be clearly seen that ''price others pay to call

you'' is relatively unimportant to consumers when choosing mobile operators (CC 2003, appendix 6.2). Figures 3.4 and 3.5 indicate that people consider mostly the price they pay to call others, quality and coverage while they choose a mobile operator and they do not consider incoming call prices much.

Figure 3.5 - Factors considered while choosing mobile operator



Source: CC 2003 (chart 4)

3.2.2. Source of Incentive to Increase MTR

3.2.2.1. Customer ignorance[22]

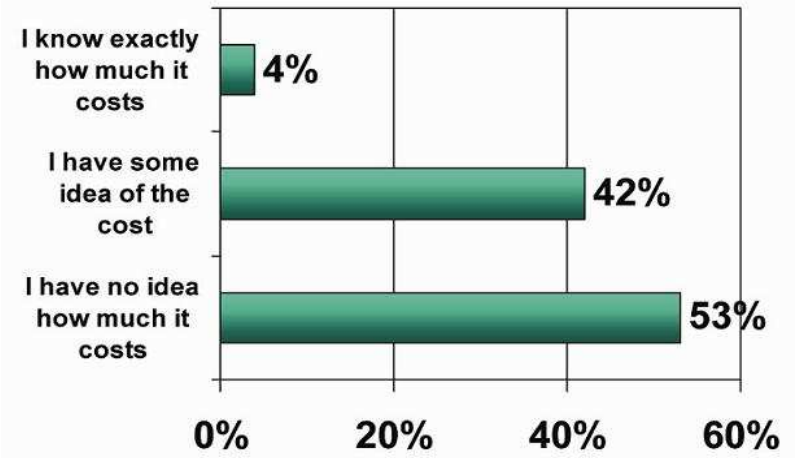
Each MNO may apply different termination rates for fixed-line operators. Thus, fixed-line operators may set different FTM charges for different mobile operators. In addition, fixed-line customers may have little knowledge of the MNOs they are calling and of call price. The inability of fixed-line customers to identify the price of the calls to specific mobile operator means that fixed line customers are likely to base their FTM calling patterns on average prices. These averages depend on the observed market shares of a mobile network. With this approach, the link between specific termination charges set by a network and the number of calls terminated on that network is broken. In fact, if a

[22] The issue of customer ignorance is addressed by Gans and King (2000a), Dewenter and Haucap (2003).

mobile network raises its termination charge, it gets the full benefit and shares with other mobile operators the reduction in the number of calls received. To understand more clearly, let mobile operator A-mobile increases its termination charge. Then, the average price that customers encounter will increase, and consequently the demand for FTM calls decreases. However, while A-mobile may compensate the decrease in profit due to demand decrease by price increase in termination, other mobile operators lose profit due to decrease in demand. Therefore, rivals compete less aggressively for mobile subscribers. As a consequence, mobile networks will have an incentive to set high termination rates.

There is debate on whether the consumers have any knowledge about the prices of fixed lines for specific mobile calls. 47% of the respondents in MMC consumer survey say that they do not know how much it costs to make a FTM call. Although 53%, those who say that they know FTM call price, appears to be significant, nearly 40% do not know the exact cost. Only 21% of the all respondents know about the exact cost of making FTM calls. (CC 1999, p.105)

Figure 3.6 - Do you think you know how much it costs to make a FTM call during peak times?



Source: Amarach Consultation (2003)

Figure 3.6 illustrates that 46% of the respondents do FTM call cost. However, although significant portion of these people have some idea of the cost, only 4% of all respondents know exactly how much it costs.

These data from consumer surveys support that consumers do not have exact knowledge about the cost of FTM calls they make which may imply that customer ignorance may exist in the FTM market.

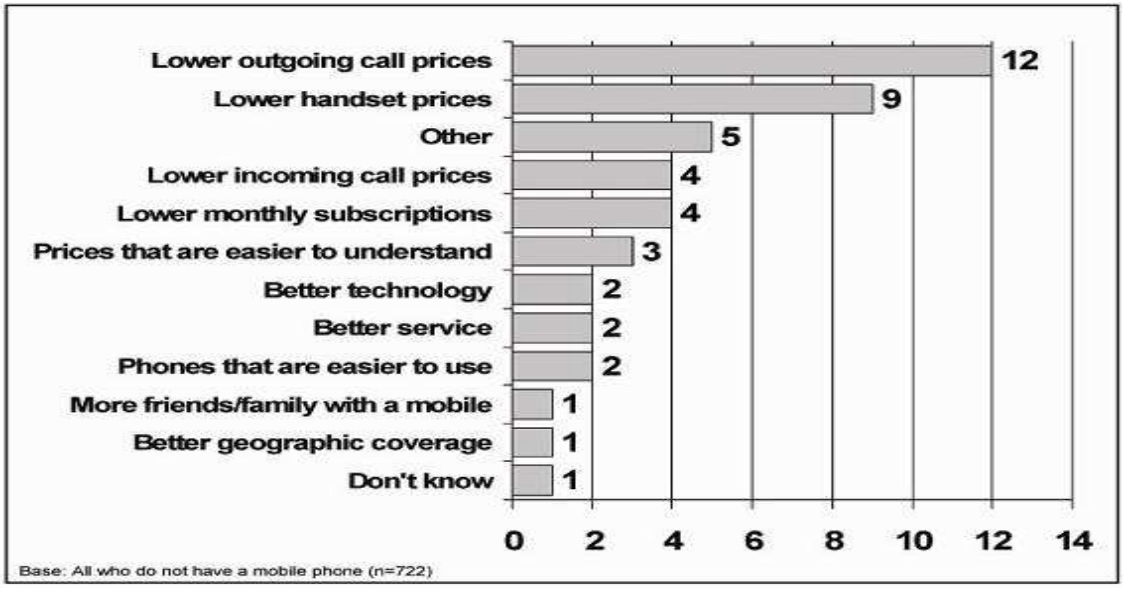
3.2.2.2. Increase in mobile penetration rate

Generally three types of customers can be thought to exist in telecommunication market; fixed telephone only, mobile telephone only and both. The primary purpose of MNOs is to gain the first type. In addition, the termination rate may also be used as a tool to increase mobile penetration rate, gaining the first type, fixed telephone only. The first type of customers' choice of mobile telephone depends on the level of termination rates and his/her calling characteristics, in what percents he makes call to mobile and to fixed operator in average per month. If FTM calls, depending on termination rates, are high enough, then the customers might prefer to be mobile user. In short, high termination rates trigger high FTM retail tariffs which may cause some fixed users to use mobile telephone. In the other point of view, mobile operators use the termination revenues from FTM calls to cross-subsidize the mobile users and to induce more consumers to enter a mobile subscription. Thus, as stated by Justus Haucap (2003), higher termination rates, therefore, indirectly lead to higher penetration rates in mobile telephone markets.

The figure 3.7 shows that the most important factor that might make non-mobile owners consider a mobile phone is the cheap outgoing calls towards mobile networks. This data illustrates that non-mobile owners might prefer to subscribe to a mobile network when the difference in mobile outgoing call prices and fixed outgoing call prices increase. In the other point of view, if mobile operators want to induce non-mobile owners to subscribe the mobile network, mobile networks should cause a price difference between outgoing call prices of mobile and fixed lines. Indeed, high termination charges are the most appropriate tool for mobile operators to cause this difference. While high termination charges may lead to high FTM outgoing call prices, may lead to relatively low on-net MTM outgoing call prices. The cross-subsidization also increases this difference (CC, 2003).

As a conclusion, increasing mobile penetration might be profitable to some extent and the strongest factor to raise the penetration rate is reducing mobile outgoing call prices than as compared to the fixed outgoing call prices. To achieve this, termination charge is the main tool of the MNOs.

Figure 3.7 - Factors which might make non-mobile owner consider getting a mobile phone



Source: CC (2003)

3.2.2.3. High Switching Costs

The costs which consumers bear when they switch from one product to another are referred to as switching costs. In mobile telephone, they market may include compatibility costs or transaction costs. The compatibility costs might arise since mobile operators tend to lock handsets to be used exclusively within its network. The purpose is to obstruct consumers from switching to another network after getting a subsidized handset. The transaction costs are associated with giving up one's mobile telephone number. The redistribution of a new telephone number to one's circle requires effort, which may be viewed as switching costs. If there are high switching costs in the market, then consumers have fewer tendencies to switch the operators. As stated above, the consumer, in the case of CUG, who is concerned about their caller's welfare, chooses to change their operators if high termination rates are set. The high switching costs, therefore, may relax the impact of CUG on termination rate. Thus, high switching costs may act as an incentive to set high termination rate. In addition, although there is not much empirical evidence for having high switching costs in mobile telephone market, one study found the presence of very strong switching costs in UK mobile market, which makes the majority of consumers reluctant to switch networks. That study shows that switching costs increase and the amount of switching consumers decreases (Grzybowski, 2004).

3.3. Comments

Theoretically, demand side substitutions could constrain monopoly profits on termination. However, the strength of this effect is an empirical question. Empirical evidence in consumer surveys so far provides the view that these constraining effects are weak. Moreover, the strength of the CUG over termination rate is limited although it does exist. Empirical evidences supports that mobile users are not very responsive to the cost of incoming calls (Bomsel et al, 2003). Moreover, research by U.K. Competition Commission (2003) finds that mobile users attach low priority to the prices or calling them, people have low awareness of which network they are calling, infrequently use call back option and have a fairly low knowledge of actual prices. The CC concludes that "there is insufficient knowledge and concern among callers to mobile phones to induce them to change their behavior to such a degree as to put pressure on call termination and force these down to competitive levels". On the other hand, incentives to set high termination charges appear strong enough. These forces and sources affect the price elasticity in FTM market. The elasticity is overall the crucial determinant for setting high termination rates. If the elasticity is low, then high FTM prices do not lead to much decrease in volume of FTM calls and, thus, setting FTM termination high will be profitable for MNOs.

Table 3.2 - FTM price elasticity

	DotEcon	Frontier Economics	Holden Pearmain	Access Economics
Own-price elasticity of FTM calls	-0.43	-0.18	-0.11	-0.08

Source: CC (2003)

Table 3.2 above shows FTM price elasticity estimated by different surveys. The FTM call volumes seem very inelastic to the FTM call prices. Therefore, setting the termination rate of FTM calls seem plausible by MNOs. In other words, MNOs can acquire significant amount of termination profit which might be used to cross-subsidize the retail mobile market users. As a conclusion, there is no force for MNOs to constrain their MTR for FTM calls, they can capture more termination profit by setting above cost FTM termination charges. Therefore, FTM termination charges may need regulation.

4. TERMINATION RATE ISSUE IN MTM MARKET

As stated, mobile operators may have an incentive to set high termination rates. In the following section, some theoretical articles are examined whether mobile operators have an incentive to set above-cost MTM termination rates and also inquire whether regulation is needed. Some economists argue that there are some forces that constrain the incentive to set high MTM termination rates. On the other hand, some argue that these forces are weak.

4.1. Literature Review on Regulation of MTM Termination Rate

In this section, the recent literature that analyses MTM call termination is reviewed. The theoretical literature on models which explain how unregulated mobile operators may possibly behave to set MTM termination charge that maximizes the profit is reviewed first. Then it is concluded that there is a dominant idea that the MTM termination charges should be regulated due to the incentive of collusion over interconnection charges to attain monopoly price. However, this dominant idea fails in more realistic assumptions.

One of the earliest articles on the interconnection issue has been written by Mark Armstrong (1998). Armstrong examines the question whether the regulator should play a role even when operators agree on access charges. He assumes: there are symmetric, i.e. same size operators who compete in linear prices, not two-part tariff, also there is no price discrimination between on-net and off-net prices. However, generally in the real world operators are asymmetric. In the asymmetric case, it is difficult to find a collusive outcome since the incumbent will have market power and possibly find it profitable to deter entry by increasing termination rate. Moreover, linear prices are also not realistic. Most of the mobile operators charge two-part tariff, a fixed monthly and usage fees. In linear pricing, the operator may use the termination rate for increasing its market share. The rise in termination rates directly increases the off-net MTM price for the rival operator and, thus,

its own off-net price becomes relatively lower than the rivals' off-net prices. This concludes two opposite things: increase in market share and net outgoing calls for the operator that causes access deficit[23]. In short, the termination rate increase may lead to access deficit, while the operator gains market share with the increase in the rival's off-net MTM price. In the two-part tariff, this countervailing incentive disappears since operators build market share without generating access deficit by decreasing fixed fee. Therefore, the collusion case may not hold in the two-part tariff. In addition, Armstrong assumes that the level of subscription is fixed, that means all possible subscribers are assumed to join one of the two networks, so the level of charges has no effect on mobile penetration. If there are potential mobile users in the market, then it is possible to be more profitable for operators to compete in these potential users than to collude on termination rates with the rival. This endogenous level of subscription without network externality may lead more intensifying competition than does Armstrong suggest. Under these assumptions, he shows that if the market is symmetric and there is a sufficient product differentiation, then networks could use access charges in excess of cost as an instrument of collusion-that is, firms can increase per-minute interconnection prices to achieve per-minute retail prices that are at monopoly levels. Thus, the outcome is far from socially desirable and retail prices are as high as they would be without competition. He concludes the regulation should always play at least a monitoring role.

The following articles have attempted to relax some assumptions of Armstrong. Jean-Laffont, Rey and Tirole (LRT) (1998a) make same assumptions and they find the same results with Armstrong (1998). However, they relax the linear tariff assumption and examine two-part tariff case. They conclude that the symmetric equilibrium profit is independent of the access charge in two-part tariff retail prices while profit is dependent of access charge in linear retail prices. Therefore, collusion over access prices cannot lead to high profits since an increase in the access charge has no impact on profit in two-part tariff case. LRT conclude that operators acquire maximum profit at cost level usage fee. In their companion article LRT (1998b), they relax the no price discrimination assumption and allow networks to charge different prices for call terminating on the subscriber's network and those terminating on a rival's network. They examine how price discrimination based on termination calls affects the social welfare and competition. The article illustrates that price discrimination may increase welfare in the case of competition between equals. The

[23] Access deficit occurs when volume of out-going calls is more than volume of incoming call.

main reason is that price discrimination based on termination calls may intensify competition. In the case of price discrimination, operators generally charge higher access charges for off-net calls than for on-net calls. This high access charges work as an incentive to build market share in order to reduce the cost of serving customers. Therefore, high access charges may trigger intense competition for market share and, thus, for low retail prices. On the other hand, in the case of entry, incumbent can squeeze the entrant by insisting on a high access charge. The high access charge translates into high off-net prices and, thus, they conclude that freely negotiated access charges raise serious anticompetitive concerns under price discrimination.

The article by Carter and Wright (1999) finds the same result with Armstrong with same assumptions that competition in the retail market can be undermined by collusion over access charges. The important difference is that they examine both the mature market (two symmetric firms) and a new entrant challenging an incumbent. They illustrate that collusion over interconnection is possible in both cases and has two effects. First, collusion over access charge leads to collude over monopoly retail price. Second, collusion over interconnection, which here means the mutual agreement over interconnection charge, is better than determining the interconnection charges *independently,* for the sake of consumers. They show that networks set high termination rates when they act non-cooperatively. When the two effects are considered, allowing networks to agree on interconnection is better for the consumer welfare, but networks have an opportunity to agree on the interconnection charge that leads to monopoly retail price. In short, agreement on interconnection is better for consumers, but without any intervention, it is possible to set monopoly retail price by collusion over the charges. Therefore, they suggest, as a conclusion, that the government should intervene and restraint negotiated interconnection charges. In addition, they take into account the network externality which ignored in Armstrong's (1998) article. Wright and Carter (1999) show that the network externality allows the incumbent to use the interconnection charges as a tool to maintain its dominant position.

The examples discussed so far generally assume that the two competing networks are symmetric. All assumptions are same with Armstrong's article, but the symmetry and linear tariff assumptions. Carter and Wright (2003) assume, due to brand reputation, that one of the two networks provides subscribers with an additional benefit of membership. They examine the effect of asymmetry in the case that two-part tariff is used in retail market. As a consequence, if two networks charge equal prices, the incumbent network

will have a larger market share. This model is interesting because it starts to examine how the interests of entrant and incumbent networks differ in setting access. Under these assumptions, it is shown that it is profit maximizing for the incumbent to set interconnection at cost level. To understand this result, consider the incentives of the incumbent to set interconnection charges different than cost. There are two cases: setting access above cost or below cost. The only reason for it to set an above-cost access price is if it can generate net interconnection revenue since with two-part pricing high per-minute prices will be offset by lower line rentals to compete in the market share. However, the incumbent faces access deficit. The entrant network will charge a higher average call price since the entrant firm faces a higher proportion of off-net calls which attract the above-cost access charge, whereas the incumbent faces a higher proportion of on-net calls which are free from the above-cost access charge[24]. Because the incumbent charges a lower price, its subscribers will make more off-net calls than the subscribers of the entrant. As a result, there is a net outflow of calls from the incumbent. In short, if the incumbent sets access price above cost, it will face a net outflow of calls as the entrant firm will face a higher interconnection cost for calls and thus set higher per-minute prices. A net outflow of calls with above-cost access prices is unambiguously bad for the incumbent since it causes a net transfer from the incumbent to the entrant, an access deficit instead of a access profit. Similarly, if the incumbent sets the access price below cost, it will face a net inflow of calls as the entrant firm will face a lower cost for calls and thus set lower per-minute prices. A net inflow of calls with below-cost access prices is also unambiguously bad for the incumbent. Thus, the incumbent will always prefer access charges set at cost.

The incentives facing the smaller entrant will generally be the opposite of those faced by the incumbent. The smaller firm will want to either have below-cost access charges in which case it faces a net outflow of calls or above-cost access charges, in which case it faces a net inflow of calls. They show that the entrant does maximize its profit with cost-based interconnection if the entrant has sufficiently low market share. Setting interconnection charge at cost is a socially optimal outcome. In this article, Carter and Wright offer the idea that the social optimum level in retail market will be acquired without any regulatory intervention. However, the important difference in this article from the reality is that most operators use price discrimination between on-net and off-net calls.

[24] These are coming from the assumption that there is no price discrimination between on-net and off-net prices.

An important article that introduces the price discrimination between on-net and off-net calls was written by Gans and King (2000b). They examine the profit maximizing interconnection charges when two-part tariff is used in retail market. They question whether the findings of LRT (1998a), where two-part tariff is assumed, hold in the case of price discrimination. Gans and King illustrate a surprising result: the level of access charge that maximizes network profit unambiguously lies below cost. This result seems plausible when the effect of tariff mediated network externality (TMNE) is considered.

Dan Eliott (2004b) expresses how this below cost access charge is relevant in the existence of TMNE. He (2004b) states that for any given relative size of networks (in the Gans and King case they are assumed to be symmetric) setting access charges above cost makes the off-net call price higher than the on-net prices that results mobile users make more on-net calls then off-net calls. It causes a positive TMNE whereby consumers gain more utility from subscribing to a network with larger market share. Therefore, networks try to acquire more market share to facilitate the subscription of the potential users. He concludes that the existence of TMNE means networks have a strong incentive to increase their market share to benefit from this externality. Thus, setting access charge above cost results in networks competing more aggressively to gain market share. On the other hand, he considers the reverse if the access charge is set below cost. In this case, off-net call prices are lower than the on-net call prices and networks lose on every incoming off-net call. In this case, users want to make more off-net calls due to low price of off-net calls relative to on-net calls. It causes a negative TMNE whereby consumers gain more utility from subscribing to a network with a lower market share since they can make more off-net calls cheaper than the on-net calls. Then, the users in the network with lower market share make net outgoing calls towards the larger network (or net incoming calls for the larger network) causing a net access deficit for the larger network. Thus, networks have an incentive to reduce market share and they compete less aggressively. In conclusion, he states setting access charge above cost make networks compete harder, while access charge below cost reduces competition. With this intuition, a very different result is presented in Gans and King's article that networks collude over below cost access charges.

The results showing a collusive outcome for interconnection under linear retail tariffs appear to dominate the policy debate about the interconnection in spite of the fact that this model is very simple. Moreover, subsequent works in this subject show that this conclusion regarding collusion disappears when the assumptions are changed to more realistic ones. Thus, more realistic models do not promote this collusive result. There still

is not a perfectly realistic model that assumes asymmetry in the presence of two-part tariff in retail market and price discrimination between on-net and off-net prices.

4.2. Remarks

Of the various arguments reviewed above, one may be particularly relevant for the case of Turkey discussed in chapter 7 below. High termination rate may be used as a tool to deter entry. An increase in termination rate means high off-net call prices for the potential entrant. This is crucial since customers mostly consider the retail prices while they are choosing their operator. In addition, potential customers of the entrant will be more likely to make the off-net calls since most of the people who will be called are captured by the incumbent. Therefore, high termination rate of the incumbent makes customers unlikely to subscribe to entrant. Setting high termination rate hinders the potential loss in the number of subscriber for incumbent.

4.3 Comments

Although there is not enough empirical evidence, realistic theoretical models conclude that MNOs have no incentive to set above cost MTR. Therefore, it is ambiguous that MTM termination rates need to be regulated in practice due to lack of empirical evidence. On the other hand, the decision of NRAs of Italy and France suggest MTM termination issue in practice. In Italy and France, FTM and MTM termination rates are different[25]. NRAs are allowed to evaluate the termination rates separately for FTM and MTM market. Indeed, while NRAs of Italy and France find it necessary to regulate FTM termination rates, NRAs does not impose any regulation on MTM termination rates and allow mobile operators to negotiate freely. However, MTM termination issue may be more problematic in the case of entry since the incumbent may increase MTR to deter new entry. As a conclusion, the MTM termination rate is unlikely to be regulated in a mature market, but MTR should be examined in detail when there is an entrant.

[25] FTM and MTM termination rates are same at all countries in Europe except Italy and France.

While chapter 3 concludes that the FTM termination charge needs to be regulated since MNOs have incentives to set high MTR, chapter 4 concludes that the regulation of MTM termination rates may not be needed since MNOs may have incentives to set MTR at cost or, even, below cost level. Although the incentives to set high MTR for MTM calls are ambiguous for MNOs, MTM termination rates are set above cost in many countries. The main reason is that mobile networks do not set different FTM and MTM termination charges in many countries. Given this, it is accepted that MNOs have incentives to maintain high FTM termination charges; thus, it is expected that MNOs will not reduce their MTM termination rates. Therefore, regulation of termination rate is possibly needed when MTR is set same for FTM and MTM calls.

There are several regulations for termination rate, which can be classified under two headings. The first one is the direct regulations or heavy-handed regulations, discussed in chapter 5, which include the direct setting of the termination rates by NRA. The second one is the light-handed regulations, discussed in chapter 6, which aim to eliminate the incentives to set high termination rates.

5. DIRECT REGULATION: COST-BASED REGULATIONS

Literature reviews do not clearly conclude what should be the level of optimal (welfare maximizing) FTM and MTM rates. However, there is a general presumption that if these tariffs should be regulated directly, they should be based on costs. This presumption is supported by the findings of Peitz (2003). Peitz (2003) examines the socially optimal interconnection charges in mature and in infant markets[26]. It is concluded that cost-based regulation for interconnection is socially optimal in mature market. On the other hand, he added that cost-based regulation for incumbent operator in infant market is also socially optimal while there is no regulatory obligation for the entrant.[27]

Several countries such as Austria, Belgium, Greece, Norway, Sweden, and England use heavy-handed regulation since it directly imposes the appropriate MTR to reach a perfect competition and social optimal level (Cullen Report, 2005).

The order of the chapter is as follows. The following section gives information about the cost elements in termination issue. The second section examines the heavy-handed or cost based regulations.

5.1. Cost Structure[28]

To clearly understand cost based regulation, cost concepts in the mobile termination market should be clarified. Therefore, the first few parts are spent for identifying cost elements in the termination issue. First, the general architecture of GSM operators is introduced. Then, the network elements of the architecture used in termination are illustrated. Later, essential concepts such as joint cost in termination and its importance in mark-up over incremental cost are determined.

[26] Mature markets are symmetric markets, whereas infant markets are asymmetric markets due to new entry.

[27] This regulation is known as ‘‘asymmetric regulation’’ discussed in section 5.2.2.

[28] This section relies heavily on CC (2003) and Europe Economics (2001).

5.1.1. GSM Network Architecture

The GSM cellular network consists of Mobile Stations (MS) and fixed networks. The MS is the handset (i.e. cellular phones). Its main function is the voice and data encoding, encryption and transmission. Handsets move freely in the network and use radio frequencies to communicate with fixed support network of GSM. Handset includes SIM card which contains details of network affiliations. The SIM card belongs to the operator, not to the subscriber, and the operator finds the location of the called party from Mobile Station Identity Number (IMSI) contained on his/her SIM card. Fixed networks in GSM architecture is shown in figure 5.1. There are some parts in the architecture.

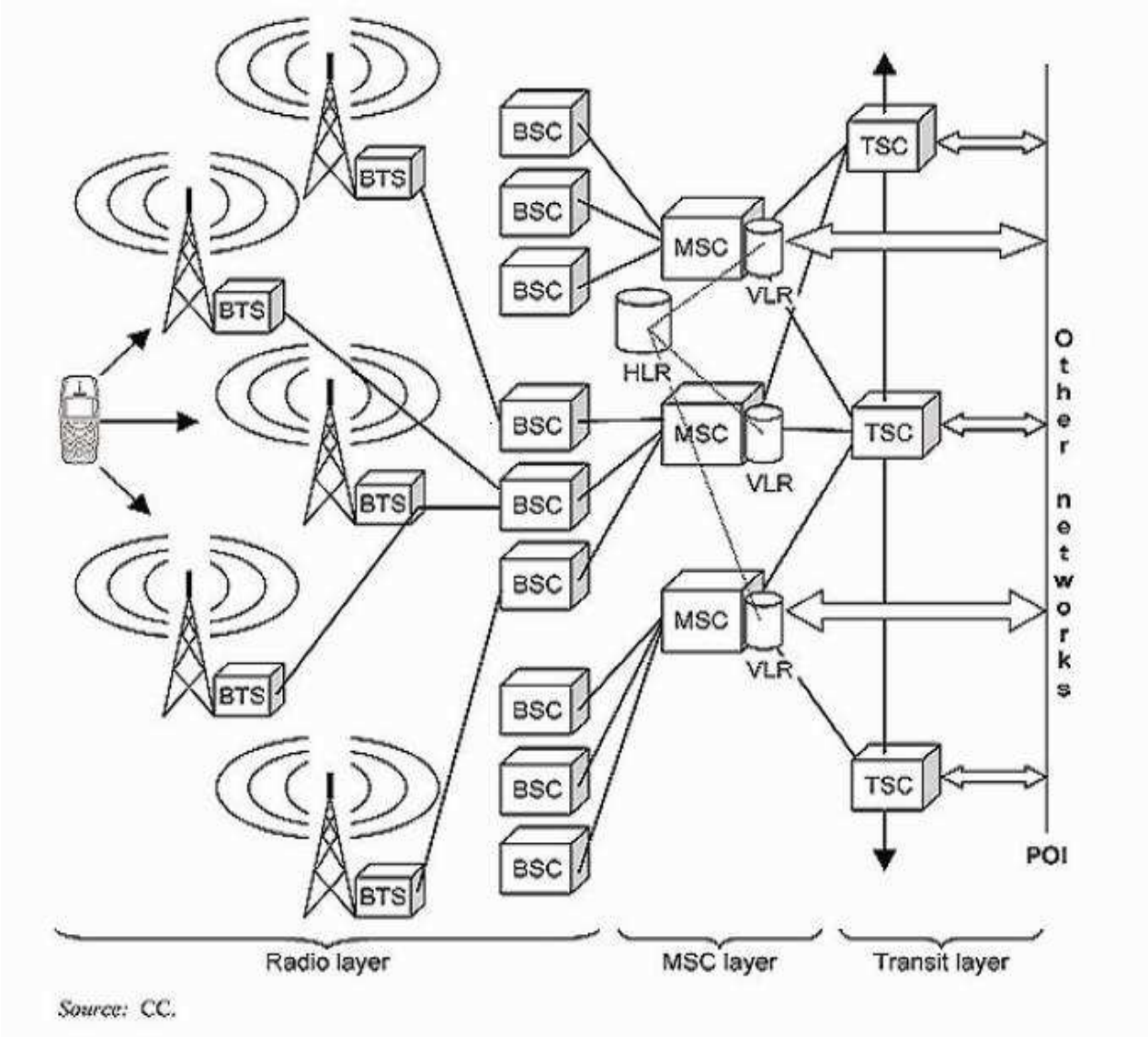
First part is the radio layer. The radio layer of the network comprises the base transceiver stations (BTS) and base station controllers (BSC). The BTSs comprise a number of transceivers (TRX—not shown in the diagram) and provide the radio coverage and the BSCs act as concentrators ensuring that calls on the network are passed to the correct BTS. Each TRX provides eight communications channels that can either be used for voice traffic, data traffic or control data. Increasing the capacity of a BTS therefore requires additional TRX to be fitted. BTSs are either connected directly to a BSC, or in some cases may be 'daisy-chained' through other BTSs. Insurance against the loss of links may be provided by providing dual links between a BTS and a BSC or by putting a number of BTSs on a loop in and out of a BSC such that if one link fails, the traffic can be routed on the remainder of the loop.

The region over which a BTS provides coverage is known as a cell. It can cover a radius of anything from a few hundred meters to 30 km or more. Very small cells are often termed small cells 'micro-cells', and large cells 'macro-cells'.

There is a limit to the amount of capacity that can be provided from a single cell site, because of the limited amount of radio spectrum available for the service and technical limitations in the design. For the GSM networks, each transceiver (of which there can be one or more at any given cell site) can provide eight communications channels and, on average, a typical transceiver will use one channel for control signals leaving sufficient capacity for seven traffic channels which can provide seven simultaneous voice calls or the equivalent data traffic. The maximum number of traffic channels depends on how much radio spectrum is available but is typically around 60 in the UK. Hence, it may be possible for a single cell to provide sufficient coverage but be incapable of providing sufficient capacity due to spectrum constraints. In this case, additional BTSs are installed in nearby

locations, effectively splitting the original cell into two or more smaller cells. If no suitable additional sites are available, then congestion will occur within the cell at busy times, making it impossible to establish new calls.

Figure 5.1 - The Architecture of GSM operator



Source: CC.

Coverage from cells is usually overlapped so that a mobile phone traveling from one cell to another will not lose coverage while the call is handed over to the new cell. In some circumstances coverage from two cells can overlap by as much as 100 %. For example, where a macro-cell has been installed to cover a town but where there is an additional capacity requirement in the town centre, a micro-cell may be installed within the macro-cell, not to increase coverage, but to provide additional capacity.

The second one is mobile switching centre layer (MSC). The MSC layer comprises a number of MSCs and a series of data-bases known as HLRs, the number of which is

determined by the number of registered subscribers, and visitor location registers (VLRs) of which there is typically one per MSC. The HLR is a permanent database holding administrative information relating to all subscribers to the mobile network. There are usually one or two HLRs per network. For each subscriber, two numbers are jointly stored in HLR. The first one is Mobile Station International ISDN Number (MSIDN), the number dialed to reach the subscriber. It is the number that identifies the network operator and services the mobile user subscribes. The second one is the International Mobile Identity Number (IMSI). Beside this permanent information, The HLR also stores the current location of mobile telephones that are switched on and in coverage so that calls to them can be more quickly and efficiently routed. HLR contains this information in the form of the address of Visitor Location Register at which the subscriber is currently registered. VLR holds the precise information about the location of each handset within the area covered by the MSC/VLR. The MSCs themselves consist of a switch, to route calls around the network, and a computer to search for and process information from the VLRs (in particular when incoming or outgoing calls are requested).

The third one is transit layer which is made up of a number of TSCs. Each TSC is linked to at least two neighboring TSCs, usually forming a loop. The role of the transit layer is primarily to carry calls between MSCs but it is also used to carry incoming calls from the POI to the MSCs and out-going calls from the MSCs to the POI. It forms the long-haul backbone of the GSM network.

Not all networks use a transit layer. Some directly interconnect with other networks at the MSC and have fully interconnected MSCs to transit calls around the network. The decision whether to use a transit layer or to connect to MSCs is a commercial matter.

The last crucial part is point of interconnection (POI). The POI is the point at which the network connects with other networks, be they fixed telecommunications networks or other mobile networks. The POI can be on the transit layer (at a TSC) or may be directly at an MSC. It is common for interconnected parties to have two (or more) interconnect points for resilience.

5.1.2. Cost Drivers in Mobile Network

The important question about the cost of the network elements is that which service of the mobile network causes the cost. Therefore, there is a desire to establish cost

causality for different costs. Identifying cost drivers, which are the factors that cause variation in the total cost of provision of a service, can be helpful. If the cost drivers are identified, then the cause of the cost is identified.

Here I examine an important cost driver for termination service: Coverage.

5.1.2.1. Coverage

Coverage can be thought as permitting a subscriber to access to the network at a given place. In other definition, coverage is the capability or option to make a single call from any point of the network at a point in time. Increasing coverage means increasing the area within which a connection is possible. Therefore, any cost on network element related with area (km^2) covered can be thought as a cost caused by coverage.

To provide coverage requires the ability for the subscriber's handset to connect with the operator's network for location. Some spectrum will need to be available in the geographical area to be covered and a BTS located with sufficiently powerful transceiver that communication between the BTS and handset over the frequency is possible. There will also to be a backhaul[29] between the BTS and BSC, and a link to the switching network. These roughly shows the elements which are used for coverage.

To understand the cost of coverage, the extra costs should be examined when coverage is extended. To extend the coverage, new BTS should be added to create new cells and a backhaul is necessary to link the new BTS to a BSC. A BSC can handle approximately 100 BTSs, so significant increase in the area to be covered may result in an increase in the number of BSCs required, and increase in the cost of transmission between BSCs and MSCs. Extra MSC is not required for new BSCs or BTSs, however, extra 'radio waves' come towards the MSC due to the new BSC. This concludes extra antennas. In short, coverage leads to costs of BTSs, BSCs, antennas, and leases on land. These costs will constitute the majority of coverage costs. There will also be some costs for transmission and MSCs, but these will be relatively small.

This coverage costs will largely depend on the land mass covered. They may be twice as large in Austria as in the Netherlands. In addition, some factors also cause a difference between coverage costs of networks: Using 900 or 1800 MHz frequency, the

[29] The cabling and trenching of the physical routes linking concentrator (BSC) and switching centers (MSC) is included in backhaul.

geographic structure of the terrain covered, and the leases to locate equipments. First, operating with 900 or 1800 MHz causes a difference in coverage costs between two types of operators. It is known that, the higher the radio frequency employed, the shorter the transmission range that will be achieved for equivalent parameters (for example, transmitter power, antenna size and height, terrain, etc). This means that GSM cells operating at 900 MHz can cover greater areas than those operating at 1800 MHz. It follows that when initially rolling out a network to provide a particular level of coverage, an 1800 operator is more likely to need more cells for a given land area. Thus, 1800 operators' coverage costs will be higher then 900 operator.

Second, the terrain covered by a network may cause difference in the coverage costs. Assume two countries, A and B, with same land mass, but A is covering more mountainous region then B. This may result that A has more coverage cost then B since the BTS can not receive the radio-waves clearly. Mountains will block the radio-waves from handsets to BTS. Therefore, mountainous regions require many more BTSs as is normally required to cover a given region. Third, leases to locate equipment may differ significantly between countries. The lease for lands is especially important cost for the operators.

5.1.3. Costs in Termination

In this section, the costs which are incurred in termination service are examined. There are two types of costs: incremental cost and joint cost of termination.

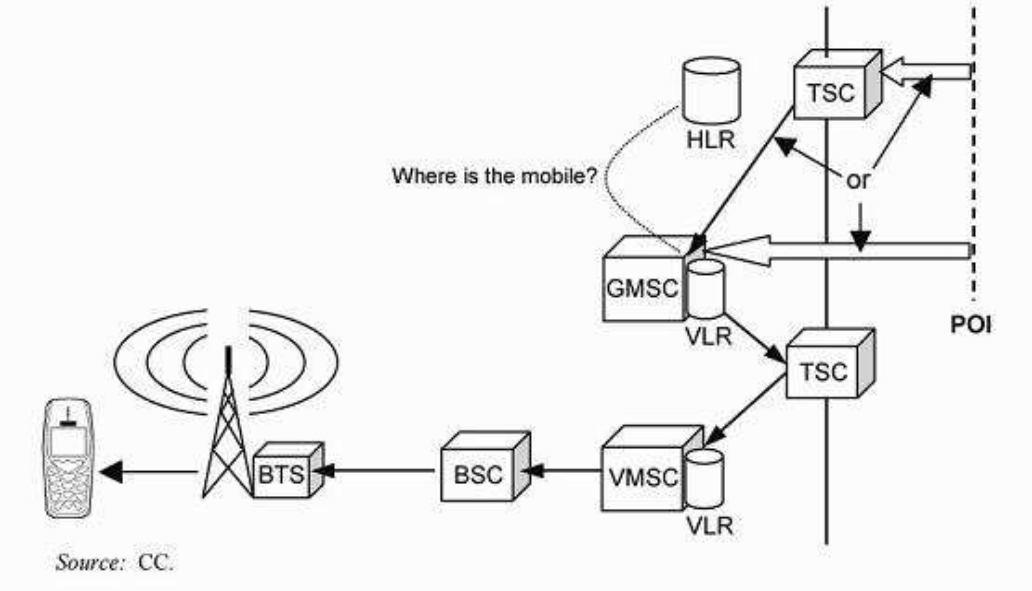
5.1.3.1. Incremental Cost

Incremental cost is the cost incurred providing a service given that all other services are already being produced. In other words, incremental costs include the costs of providing only termination service. Thus, examining the costs over the network elements due to termination is sufficient to realize the incremental cost of termination. Understanding the incoming calls' route on the physical network is obviously very helpful to identify the used network elements in termination process. The route of incoming calls in the network is illustrated below to see which network elements are used in termination.

5.1.3.1.1. Routing of incoming calls from another network

The routing of a call to a mobile from another network is illustrated in figure 5.2. A caller from a fixed or another mobile network dials a mobile number. The call will pass from the originating network to the nearest POI to the originating call as the originating network has no knowledge of the location of the mobile. The call is then passed to a MSC, either directly or via transit layer. The MSC to which the call is first passed is known as GSMC which interrogates the HLR to identify where the mobile telephone is. The HLR does not usually hold the mobile telephone numbers but does hold the address of the VLR that the called mobile telephone owner is currently registered. Hence the HLR enquires with this VLR. Once the appropriate VLR is identified, HLR sends this information to GSMC. Then, GSMC contacts VSMC, the MSC with the appropriate VLR. Nest VMSC instructs the appropriate BSC and BTS to 'page' the mobile, i.e. to broadcast a signal, telling the mobile that there is a call for it. Once the VMSC receives a response to the page from the mobile, a radio channel to the mobile is established and telephone rings.

Figure 5.2 - Routing of Incoming Calls from another Network



As stated above, to terminate the call HLR, VLR, MSC, BTS and BSCs are used. Therefore, the costs caused by termination on these elements should be included in cost of termination.

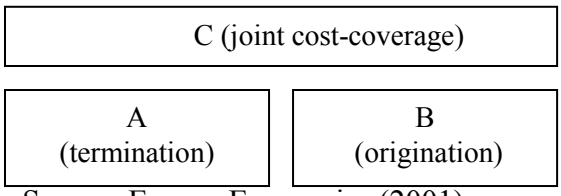
5.1.3.2. Joint Cost: Coverage

Joint costs are the costs incurred producing multiple activities that are invariant to changes in the quantity produced of one activity alone. For termination, the most important joint cost will be coverage. It has been stated that the coverage cannot be purchased as a stand-alone service, but rather mobile subscribers acquire an option to purchase bundles of coverage and traffic[30] if and when required. Similarly, mobile subscribers acquire the option for their potential callers to purchase coverage and traffic as a bundle. Under this approach, coverage is not a service purchased separately. The view of the European Commission is that the coverage is bundled with other services to create services that users actually buy: call termination, call origination.

If services defined as call origination and call termination are bundled services that include coverage, then the costs of coverage are joint costs between termination and origination services. The same geographic coverage network is used for both origination and termination. The incremental cost of termination and origination does not include coverage costs; however, coverage network is needed to provide a stand-alone termination or origination service. Thus, coverage is a joint cost between origination and termination in the case of defining these services as bundles including coverage (Europe Economics, 2001).

The total joint and incremental cost can be thought as a stand-alone cost which is the cost incurred providing a service in isolation. In other words, this is the cost of providing all necessities for termination in the case that no other service is produced. Figure 5.3 illustrates the stand-alone, incremental and joint cost concept in mobile termination.

Figure 5.3 - Incremental and Stand-alone cost



Source: Europe Economics (2001)

[30] Traffic includes the number of calls and the number of call minutes.

Suppose there are only two service origination and termination that MNO offers. The minutes of terminated and originated calls are assumed to be equal. The incremental cost of termination is A, and those of origination is B. In addition, the joint cost, coverage, is denoted by C. The stand-alone termination cost is A+C and also the stand-alone origination cost is B+C.

The level of joint cost is significant. Indeed, the Europe Economics report states that Oftel estimated the incremental cost of termination on GSM 900 network at 5.3 pence per minute in the 1998 model; the European Commission calculates the stand-alone cost for call termination implied by the model as 12.2 pence per minute. This is 125 percent more than the incremental cost level. This difference between stand-alone and incremental will be even higher for some networks. For networks that have a relatively low penetration, the incremental cost may be negligible. On the other hand, to provide carry calls needs coverage network element. In this case, incremental cost per minute of call termination will be zero while the stand-alone cost per minute will be the total cost of the network.

There is important argument about the allocation of joint costs. In other words, it is difficult to determine how much of the joint cost is caused by the particular service. Therefore, the cost of particular service is indeterminate within a range between incremental and stand-alone cost. This is problematic for exact cost determination for particular service. Therefore, some mark-up should be added to the incremental cost to cover the joint costs. There are two approaches for determination of mark-up for covering joint costs by particular services: EPMU and Ramsey mark-up[31].

5.2. Cost-Based Regulation

5.2.1. LRIC and Appropriate Mark-up

In this section, the difference between marginal cost and incremental cost is essential. There are two differences between the concept of marginal and incremental costs. First, marginal cost is defined as the cost of producing one more unit of output, whereas the cost of increasing output by a given quantity is incremental cost, which

[31] EPMU and Ramsey mark-ups are discussed in section 5.2.1.1.

approximates marginal cost if average across the increment. For example, increment can be defined as 20 units, and then the incremental cost covers the cost of producing 20 units while the marginal cost covers only the one additional unit. When applied to interconnection, marginal cost will cover the cost of terminating one additional call and incremental cost will recover the additional costs of terminating a given number of calls. Increment for termination service is often defined as all units of the termination service, which might be all call terminated minutes. By this definition, incremental cost includes the costs of providing just termination service while the other services are already serving.

Second, another crucial difference between marginal and incremental cost is that marginal cost includes merely the costs related to call volume. On the other hand, incremental cost not only covers costs related to call volumes but also covers cost of annual repair of network elements used in termination, cost of billing interconnection, cost of planning and founding network elements used in termination service. Therefore, marginal cost and incremental costs differ (Kibar 2005).

Using the explanations above, Long Run Incremental Cost (LRIC) can be defined as a total cost the firm would avoid in the long run if it ceased to provide the service as a whole. LRIC of termination can be calculated as the annual cost avoided by the network operator in providing every service, excluding call termination. Given X minutes of call termination per year, LRIC of termination could be divided by X to estimate of the average incremental cost of a one minute call termination.

The LRIC remedy would solve the high termination rate problem since LRIC would be possible to directly regulate termination charges. In general, this remedy would have an essential benefit on the callers since the termination rates are set at cost level. On the other hand, it is problematic in some ways. First, it is difficult to calculate exactly the incremental cost. To achieve the calculation, cost models for mobile networks should be available. Second, LRIC does not give a margin to the firm to cover up some fixed and joint costs. Thus, the termination charges based on LRIC are an option to be legitimated in the absence of the fixed and joint costs which exist in the mobile telephone market. Some portion of the fixed and joint costs should be allocated by a termination since an appropriate mark-up should be added to LRIC of the termination. For this purpose, the appropriate mark-up over LRIC can be determined. Two kinds of mark-up may be thought primarily: Equal Proportional Mark-Up (EPMU) and Ramsey Mark-Up.

5.2.1.1. Comparison of EPMU and Ramsey mark-up

EPMU supports the idea of adding equal mark-ups to different services tariffs (i.e. origination tariff). This view comes from the logic that all services of mobile telephony have same demand elasticities. On the other hand, Ramsey mark-up states that all services have different demand elasticities; thus, different mark-ups should be set for services. In depth, Ramsey mark-up says that high mark-ups should be given to the services with less elastic demand and low mark-ups to the services with more elastic demand. There was a debate on the determination of the mark-up. The U.K. investigation Competition Commission concludes that there was insufficient evidence to conclude that the elasticities of different mobile services differed, and hence applied EPMU to allocating fixed and joint costs between services. In addition, although Oftel accepts that Ramsey mark-up is useful to maximize social welfare in the presence of joint and fixed costs, Oftel reached the conclusion that this was not appropriate. The main reason of EPMU's acceptance by the authorities is that Ramsey mark-up can be thought as practically unfeasible because of the detailed information about total and marginal costs as well as demand elasticities that is especially needed (Dan Elliot, 2004a). Demand elasticities of the services are estimated by the technical models; however, Oftel believes that the models are over-simplified. On the other hand, there is no logical reason why the own price elasticity of different services have the same elasticity. For instance, there is no reason to expect an equal elasticity in mobile subscription and FTM or mobile originated calls. They are two different services, and demands depend on the characteristics of the consumers who use the specific service. However, it is really difficult to estimate the service demand elasticities; thus, there is no concrete evidence supporting any of the two approaches.

On the other hand, when the real world application is examined, EPMU is used. Cullen Report (2005, table 33) shows that all countries which used a mark-up over LRIC prefer to use EPMU rather than Ramsey. Greece, Italy, Sweden and U.K. accept a LRIC regulation with an appropriate mark-up over the incremental cost and all of them prefer EPMU.

5.2.2. Asymmetric Regulation

Asymmetric regulation means imposing cost-based regulation on the operator with SMP while not intervening in the determination of the rates of the other operators, which do not have SMP. Indeed, Dewenter and Haucap (2003) show regulating only the operator with SMP at the marginal cost level induce smaller operators to increase their termination rates. With these discounts, smaller operators may capture the significant number of customers in the market and this promotes efficient competition.

This kind of regulation may be very plausible for the market, which has a new entrant. A newcomer struggles against the operator which has a market share and a reputation among consumers. This is a more difficult situation for the new comer than starting from scratch with other competitors. If an entrant is initially disadvantaged against an incumbent[32], it may be optimal to regulate incumbent's termination at marginal cost level while allowing the entrant to charge freely. New entrant may prefer charging above cost since it should provide some discounts to the customers such as ensuring handsets or offering low retail tariffs. Therefore, this will not cause any welfare loss.

In addition, substantial termination mark-up is an essential incentive for potential entrants. Higher termination mark-up eliminates some of the uncertainty problems for the entrant firm at the decision period of the entry. For example, if there exists uncertainty with respect to entry cost, higher post-entry profits make entry more likely and entry does increase competition. Due to the reasons stated above, termination mark-up for the entrant seems plausible. Termination mark-up not only increases the entrant profits but also increases consumer welfare due to cheap offerings of the entrant to gain market share. Martin Peitz (2005) show that an effective instrument to increase consumers' surplus in the short run is asymmetric access price regulation that gives a positive access mark-up to the entrant and is cost-based for the incumbent.

On the other hand, economists argue that asymmetric regulation may distort the competition in the long run. One of those economists, Stephen C. Littlechild (Vodafone, 2004), has argued that customers will base their demand calls on the average price of mobile calls if they are unaware which mobile network they are calling (i.e. customer ignorance discussed in section 3.2.2.1.). Operators take account the impact of price increase only to the weighted average of the prices. From this perspective, non-regulated non-SMP operator's impact on the average price is weak relative to SMP operator since it

[32] Entrants have a disadvantage since they provide lower utility to consumers in some concepts such as reliability of network and reputation of quality.

has a small market share. However, as non-SMP operator enlarges its market share, then the impact over the consumer welfare would be more significant. Its higher termination charge becomes increasingly burdensome on other operators and their customers who have to pay these charges. Thus, as the total demand of the market reduces due to increase in weighted average of the termination price, the incumbent firm, regulated at the marginal cost level, loses its demand significantly and, therefore, profit. This will distort the competition.

As a result of the reasons discussed above, asymmetric regulation seems plausible in the short run when the market has SMP and non-SMP (or entrant) operators simultaneously but may distort competition in the long run. Therefore, once a non-SMP or entrant has gained competitive strength so that it competes more or less on equal terms with incumbent, asymmetric regulation should be replaced by symmetric regulation.

In the following paragraph, the termination rate regulation issue is discussed as an example of asymmetric regulation. The result stated above is applied by AGCOM[33] in Italy.

Italy is one of the countries that uses asymmetric regulations. There are four MNOs in Italy: Telecom Italia Mobile (TIM), Vodafone, Wind, and H3G[34]. TIM and Vodafone were designated as having SMP in 2003 and, thus, AGCOM states that the weighted average termination charges of the two SMP operators' should not exceed 14.95 € cents/min until June 1, 2005 and should not exceed 12.6 € cents/min after June 1, 2005. On the other hand, Wind, one of the non-SMP operators, was not subject to any regulation until June 1, 2005 and AGCOM imposes a cap that Wind should set its termination charge no more than 14.95 € cents/min. In addition, all three mobile operators (TIM, Vodafone, and Wind) have the same target weighted average termination charges for 2007 of 8.7 € cents/min. This very similar regulation stated above: use cost based regulation for SMP and leave non-SMP operators free to set termination charges until the non-SMP operator enlarges its market share to the particular level. AGCOM regulates two SMP operators, TIM and Vodafone, while leaving a non-SMP operator, Wind between years 2003 and 2005. Between 2005 and 2007, all three operators are regulated, but Wind's termination charge is higher. However, in the long run, all three operators will be regulated similarly. (Cullen Report, 2005)

[33] AGCOM is NRA of Italy.

[34] H3G is also known by *3*.

Table 5.1 - Mobile operators' market share in Italy

Mobile Operators	March 2004	December 2004
TIM	44.9%	41%
Vodafone	36.5%	37.5%
Wind	17.6%	19%
H3G	1%	2.5%

Source: Vodafone Italy (2004) and Espicom (2005)

The fourth operator H3G entered the market at the end of year 2003, and AGCOM considers it would not be needed to impose any obligation to H3G until 2007. This regulation allows new entrant to enlarge its market share and, thus, strengthen the operator to compete more aggressively. The effect of the regulation may be seen by examining customer based market shares of the operators. The new entrant H3G experienced a rapid growth and reached 2.6 million subscribers, adding 600,000 subscribers alone in December 2004 (Espicom, 2005). Although there might be some other reasons for the rapid growth, AGCOM's asymmetric regulation on termination rates is one of the significant reasons.

6. OTHER (LIGHT-HANDED) APPROACHES TO REGULATION

6.1. Yardstick

The basic problem in the termination market is that the market is monopolized by the called mobile operator. Thus, remedies should consider eliminating the monopoly power by creating a competition in the market. One of the ways to do this is tying termination rates to the retail tariffs. The recent application is applied by Australian regulator ACCC. ACCC decided in July 2001 that any discount that mobile operators offer to their customers would have to be passed also on termination. The advantage of this remedy is that benefits from competition with respect to subscription and call origination would be passed on to users that place calls to mobile. The above-cost prices for mobile termination are more likely to be a problem when the service is supplied to FTM rather than MTM calls. ACCC supported this because, in the case of MTM calls where uniform traffic patterns exist, reciprocal access prices between mobile carriers are equally a revenue stream and a cost. Therefore, unless traffic patterns are unbalanced or mobile carriers engage in price discrimination in termination rates, no competitive advantage exists in sustaining above cost mobile termination rates for MTM termination. Accordingly, ACCC took the view that it was sufficient to focus on termination rates for FTM calls due to tendency of mobile operators in cross-subsidization. The purpose of the cross subsidization is to capture high revenue from fixed users by termination and use the revenue to aggressively behave in the competition of mobile user subscriptions. ACCC observed that MTM prices had declined %3.8, %12.3 and %6.7 between periods 1998-1999, 1999-2000 and 2000-2001, respectively. Thus, ACCC thought that continuous competition in the provision of retail mobile telephony services would lead to price decreases for the termination service. To the extent that decrease in retail price could be translated into the prices set for the mobile termination service and this could help to ensure the price of termination was driven down (ACCC, 2004).

However, some economists such as Tommaso Valletti argue that using benchmark retail price remedy negatively affects mobile operators. He hesitated that operators would be more reluctant to fight against each other to attract mobile customers. Thus, this

remedy risks distorting the competitive aspect of mobile telephony (Valletti, 2003). Indeed, the overview of ACCC (2004) states that the decrease in the retail prices stop and even increase after the remedy came into force between 2001 and 2003. As a result, the benchmarking approach has not led to desirable outcome of lower termination charges.

6.2. Multiple SIM Cards

Call termination problem exists, as stated above, because operators do not compete *directly* over this service. The best solution would not be to intervene by setting the charges but rather to take steps to eliminate bottleneck. Giving customers the opportunity to choose two operators, for origination and for termination, would create direct competition in both markets. Then mobile operators should compete for customers for two different services; hence the failure observed due to monopoly on termination disappears. This remedy could be plausible since, under CPP, customers would still be responsible to pay for outgoing calls and hence will choose the operator that offers the cheapest rates close to their profile. In addition, the customer will also be inclined to separately choose the cheapest package offered by competing operators to terminate calls since s/he will anticipate that more people will be willing to call him/her. However, to achieve this remedy, some technological difficulties should be solved. For example, handset would have to contain two SIM cards. Moreover, some operators could also offer two services as a bundle to attract customers. Then, operators offering the bundle might have an advantage in the competition against the operators offering single service. Thus, some controls on bundling would be needed in order to prevent MNOs from neutralizing this remedy (Valletti, 2003).

6.3. Receiver Party Pays

The main reason behind the monopoly in termination is the Caller Party Pays (CPP) regime. Adoption of CPP means that mobile operators can charge other operators for

termination, and these other operators have to pay these charges. Therefore, it is plausible that each mobile operator should wish to charge a monopoly price for access by subscribers of other networks. Thus, the change of CPP regime may solve the termination problem and no regulation would be needed. The alternative of CPP is the Receiver Party Pays (RPP) regime.

Figure 6.1 - Payment of Mobile Termination Rate under RPP

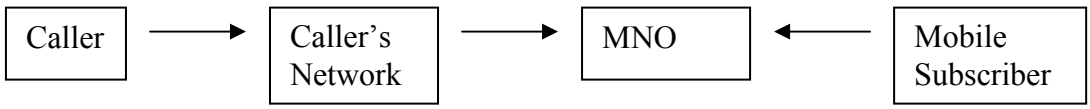


Figure 6.1 shows the general payment scheme in RPP regime. When the caller makes a call to the mobile subscriber, the caller pays the origination part to his network. In addition, the termination part of the call is paid by the mobile subscriber, who receives the call, to his MNO. In some different RPP versions, origination prices are also paid by mobile subscribers. Therefore, all systems in which a receiver party pays some or all of the cost of receiving incoming calls can be defined as RPP regime.

As a conclusion, termination rates are paid by the receiver. This means that termination rates in RPP regime directly influence the utility of the mobile subscriber. Under the RPP regime, a mobile operator's higher termination charges will decrease demand among its own subscribers. Doyle and Smith (1999) showed that RPP regime could result in low termination rate and concluded that this remedy enabled effective competition without relying on heavy-handed regulation[35]. The empirical evidence also supported the findings of Doyle and Smith. The ITU survey conducted by Dr. Tim Kelly (2001) shows that FTM interconnection rates in 13 European countries, all using CPP, ranged from 15.6 US cents/min to 30 US cents/min with mean of 20.6 US cents/min. On the other hand, the rate in the US was 2 US cents/min and zero in Canada[36]. The average over all countries responding to the ITU survey was given as 10.5 US cents/min for CPP and 0.5 US cents/min for RPP. As quoted in Littlechild (2004), the recent evidence was cited by Federal Communications Commission (FCC) in US in 2003. FCC stated an average of termination rates in European mobile telephones as 16 US cents/min versus 0.5

[35] Heavy-handed regulation is the regulation that regulator directly intervenes the price of termination and set the market price.

[36] USA and Canada use RPP regime.

US cents/min. In light of evidence, RPP would make termination charge regulation unnecessary. Moreover, mobile operators could not increase FTM termination rates without any threat on the mobile retail market. This will eliminate the cross-subsidization incentive for mobile operators. Hence, this regime eliminates the unequal distribution of income between mobile and fixed users (Littlechild, 2004).

Moreover, the RPP regime has some disadvantages. First, the mobile subscriber has an incentive to turn off his mobile phone. For example, the ITU case study on China, in which still RPP is being used, shows the significance of the incentive. In China, the mobile phone is used to originate calls while the pager is used to help the subscriber decide whether or not a call is essential. In this way, subscriber can save some money by avoiding receiving and paying for unimportant calls. In addition, after Mexico switched from RPP to CPP on April 1999, there was a significant increase (28.7%) in incoming mobile traffic. Second, RPP negatively affects the penetration rate of mobile telephony. Zehle (1998) stated that there was no quantifiable correlation between penetration and whether CPP or receiver party pays (RPP) tariff is applied; however, in the longer term RPP is likely to lead to lower penetration rate (Littlechild, 2004).

As seen in table 6.1, while mobile penetration rates in countries using CPP regime ranges from %62 to 93%, this range in countries using RPP regime is only from 37% to 43% of population in 2003.

Due to the reasons stated above, many countries use CPP regime instead of RPP regime. However, some economists show that those reasons begin to lose validity. Crandall and Sidak (2004) observe US mobile market as an example for RPP. US conditions have now changed, and mobile operators have began to take steps to reduce the obstacles to receiving mobile calls. These steps include providing “buckets” of free minutes that may apply to incoming as well as outgoing calls, making the first minute of any incoming call free to the receiver and reducing the charge for receiving calls. As a response to low penetration rate in RPP, Crandall and Sidak advocate the penetration rate in the US would equal the penetration rates realized in most CPP countries between 2008 and 2014. They support this result by showing rapid growth rate in mobile penetration increased each year until 2002 in US and Canada. The apparent primary advantage of CPP relative to RPP has been higher penetration rates, but if that perceived advantages disappears, then what would be the reaction of CPP countries? (Crandall and Sidak, 2004)

Table 6.1 - Penetration and Usage of Mobile Telephony in Selected Countries

Country	Penetration (% of Population)	Share of Prepaid (% of Subscribers)	Minutes of Use per Subscriber per Month	Revenue per Minute ($)
CPP				
Australia	68		173	0.16
Finland	85		146	0.24
France	63		156	0.20
Germany*	72	54	72	0.29
Italy	93		121	0.20
Japan	62	3	170	0.30
South Korea	68	1	296	0.10
United Kingdom	85	69	132	0.22
Range	*62-93*	*1-69*	*72-296*	*0.10-0.30*
MPP				
Canada	37		270	0.11
United States	49	5	458	0.12
Range	*37-43*	*5*	*270-458*	*0.11-0.12*

Sources: Linda Mutschler, *Global Wireless Matrix 4Q02*, Global Securities Research, Merrill Lynch, Apr. 2, 2003; Linda Mutschler, *The Next Generation VII*, Global Securities Research, Merrill Lynch, Feb. 21, 2003.

Note: * MTRs are not regulated in Germany.

Source: Crandall and Sidak, 2004

6.4. Bill and Keep

In bill-and-keep, mobile operators have free reciprocal termination charges; in other words, termination charges are zero. Bill-and-keep eliminates not only the risk of miscalculation of termination rates but also the costs for calculating termination rates since this remedy does not require spending any money on building cost models and estimating demand parameters (which are difficult to find). In addition, this remedy might be useful in the presence of call externality. Ulrich Berger illustrated that bill-and-keep is a welfare improving method compared to cost-based access pricing[37].

[37] He modeled two symmetric networks compete in non-linear and discriminatory prices in the presence of call externality.

On the other hand, the relevance of bill-and-keep in a very asymmetric market is ambiguous. It is possible that number of off-net calls terminated on the operator having the least market share and those terminated on SMP operator is different. In other words, the imbalance of off-net call volume is highly probable in asymmetric markets. The new entrant's more incoming than outgoing off-net calls may correspond to net incoming off-net call traffic. Net incoming off-net call traffic may lead to some cost and zero revenue in termination for entrant. Thus, termination costs impose significant loss on the entrant. As a result, competition on the market would not be fair.

Bill-and-keep also is not very relevant in the presence of cost differences between the operators. In fact, termination costs are different in fixed and mobile operators and, thus, bill-and-keep may lead to a problem when it is used in fixed and mobile interconnection issue. Here are two essential reasons for the problem. First, there is an unbalance between FTM and MTF call minutes. For example, while total FTM calls in minute are 210 million, MTF calls are 70 million minutes last year in Turkey. Thus, the number of calls, originated from FNOs, terminated on mobile networks is higher than the number of calls, originated from MNOs, terminated on fixed network. Second, costs of terminating a call on mobile network are higher than the costs of terminating a call on fixed network. Thus, if bill-and-keep chooses as a remedy for fixed and mobile interconnection, then it imposes significant loss for mobile operators.

As stated above, bill-and-keep may not be relevant in fixed and mobile interconnection due to cost difference. On the other hand, the question appears whether applying bill-and-keep only for MTM calls is appropriate. France chooses to apply bill-and-keep remedy only for MTM interconnection. From the birth of mobile market to January 2005 in France, there had been no monetary transaction between mobile operators which means mobile termination rates are zero in MTM calls. On the other hand, FTM termination is regulated and ART[38] imposed reductions of MTR to 14.9 € cent/min by January 2004. However, this remedy raises tensions between fixed operators and ART. As a conclusion, ART removed using only bill-and-keep on MTM calls in January 2005 and imposed same MTR for FTM and MTM calls which will be calculated by LRIC models.

The previous paragraphs illustrate that bill-and-keep may be problematic in both applying for FTM and MTM interconnections as well as for only the MTM interconnection. In addition, some theoretical articles support that bill-and-keep may not be

[38] ART is the NRA of France.

a socially optimal remedy. As stated in section 4.1, Gans and King (2000) shows that bill-and-keep may lead to soften competition. Moreover, Dessein (2003) models two symmetric operators competing with non-linear tariffs. Dessein concludes that networks may increase profits by agreeing on an interconnection charges below cost and welfare is increased by setting the interconnection charges above cost. This theoretical results show that bill-and-keep is not a socially optimal remedy for MTR.

6.5. Mobile Number Portability (MNP) and Its Effect on Termination Charge

Mobile number portability ensures that mobile customers can keep their telephone number, even the prefix, if they switch their mobile network operator. In the absence of MNP, the customers should give up their mobile numbers and must adopt new one if they switch their network. In that situation, customers may face some problems due to switching their phone number such as informing the change in number, printing new business cards, and missing valuable calls from people that do not have the new number. Customers might not prefer to change their mobile operator because of those switching costs. In addition, high switching costs might trigger increased termination rates. Customers would prefer to switch their operators in the presence of high termination rates when they are concerned about not only their own utility but also that of their callers. However, high switching costs hinder this customer preference. As a result, mobile operators might set high termination rate in the presence of high switching costs. MNP can be used to relieve the impact of high switching costs. MNP eliminates the high switching cost problem since consumers may switch the operator but keep their number. Based on these considerations, many regulatory authorities of countries (table 6.2) have imposed mandatory MNP to reduce customers' switching costs.

On the other hand, MNP has an effect on consumer ignorance, a condition which has largely been ignored by the authorities. MNP increases consumer ignorance. (Consumer ignorance here refers to the fact that consumers may not know exactly their operator and which termination rate) Apparently MNP makes it more difficult for customers to distinguish between different networks when placing a call. In the presence of MNP, the number prefix does not automatically indicate the network assignment of a given

number. Therefore, callers do not identify the operator which they call. As a result, consumers may be unaware of the exact charges for placing calls to mobile network. This unawareness enables mobile operators to increase termination rates if consumers only take account of the average price. As the operator increases its own termination rate, whole market demand, including rivals' consumers, diminish, but the operator captures all marginal revenue from the termination rate increase.

Table 6.2 - Introduction of MNP in selected countries

Year	Countries where MNP available
1997	Singapore
1999	UK, Hong Kong, Netherlands
2000	Spain, Switzerland
2001	Australia, Sweden, Denmark, Norway
2002	Italy, Portugal, Germany
2003	Belgium, USA, Ireland, France, Finland, Luxembourg
2004	Austria, Greece, Hungary, Cyprus, Lithuania, Slovenia
Jan 1, 2005	Estonia

Source: European Commission (2004)

In Europe, number portability is seen as a key tool for effective competition in retail market since number portability eliminates switching cost. On the other hand, full tariff transparency disappears since the first three digits of the called number no longer indicate the network operator of reliably the called subscriber. Therefore, tariff transparency should be sustained in the case of MNP to utilize the positive effect of MNP on retail market. The importance of transparency in termination charges is emphasized in European Universal Directive (2002/22/EC):

> The impact of number portability is considerably strengthened when there is transparent tariff information, both for end-users who port their numbers and also for end-users who call those who have ported their numbers. National regulatory authorities should, where feasible, facilitate appropriate tariff transparency as part of the implementation of number portability.

Transparency refers to the fact that callers know the exact price they pay for their calls. In Europe, several methods increase transparency. One provides that the operator with significant market power charges the same fees for all off-net prices. The second

method provides that all mobile operators agree on a unique termination charge. These two methods are not enforced by most European countries. Instead, most European countries prefer the third method, which necessitates the declaration of the price of the call made towards the ported number by voice mail if this price is higher than the price of the call made towards the operator, which is the first owner of the ported number. While some countries such as Denmark and Italy give this voice mail service freely, other countries such as Portugal, England, Greece, and Germany charge this voice mail service[39]. Still other countries, Sweden, Ireland, Germany, and Italy, declare the real price of call to the ported number by SMS. While this SMS service is free in Italy, the other countries charge this service without any restriction. (Telekomünikasyon Kurumu, 2004)

[39] In general, this charge is no more than the local call price.

7. MTR IN TURKEY

7.1. Evolution of the Interconnection Regime in Turkey[40]

Cellular mobile telecommunication services began to operate in 1994 on the GSM-900 standard through revenue sharing agreements between Turk Telecom and two mobile operators, Turkcell and Telsim. In that period, there was no competition between the mobile operators since mobile call tariffs were determined by Turk Telecom. In addition, MNOs did not interconnect directly to each other's network and used Turk Telecom's network as a transit network between their mobile networks. There was only an interconnection between Turk Telecom and the mobile operators. Turk Telecom charged 1.4 US cents/min for any call between Telsim and Turkcell. In 27 April 1998, two mobile operators bought 25-year licenses and the revenue sharing agreement was thus annulled. The pressure of the Turk Telecom on the retail mobile price was removed, and operators began to compete for subscribers. They invested more in infrastructure to increase the quality and the number of people reaching mobile user. For the latter, new interconnection agreements were required, both between two mobile operators and between mobile operators and Turk Telecom. In 24 April 1998, Inter-network Contact and Cooperation Agreement was signed between mobile operators and Turk Telecom.

The termination charge level for calls from Turk Telecom to mobile operators was defined as Unit Base Tariff (UBT)-6 US cents/min. GSM operators were responsible to determine UBT level and GSM operators generally set UBT as a retail price of their GSM-PSTN[41] call prices. For one minute, Turk Telecom's outgoing call to a mobile operator, sharing of the termination revenue is as follows: First, %17 Value Added Tax, %25 Private Communication Tax, and %15 Treasury Fund were subtracted from UBT. Then, Turk Telecom keeps 6 US cents and transfers the remaining portion of UBT to the mobile operator. Lastly, GSM operators should pay %15 of net earnings to the Ministry of Treasury. If the taxes are neglected, then termination rates of mobile operators for the

[40] This section draws on Atiyas (2004), and Kibar (2005)

[41] PSTN is used for fixed networks, Turk Telecom, and GSM is used for mobile operators in this chapter.

incoming calls from Turk Telecom may be roughly defined as UBT-6 US cents/min. In year 1998-1999, a one minute call from Turk Telecom to GSM operators was approximately 35 US cents/min. When it is calculated by the above algorithm, then Turk Telecom gains net 6 US cents/min and GSM operators gain 7.69 US cents/min. On the other hand, termination on Turk Telecom was 1.4 US cents/min for calls in area and 2.5 US cents/min for calls out of area[42]. In addition, GSM-PSTN retail call tariff is 35 US cents/min. After %17 Value Added Tax, %25 Private Communication Tax and %15 Treasury Fund were subtracted as well as Turk Telecom's termination costs' paid, GSM operators captured 13.6 US cents/min for calls in area and 12.5 US cents/min for calls out of area.

With the Agreement, GSM operators were responsible to determine UBT level. The only constraint on determining UBT was that it should be lower than the Maximum GSM-PSTN call charge set by the Telecommunication Authority[43]. Setting high UBT is obviously beneficial for mobile operators since PSTN-GSM call market demand was quite likely inelastic in Turkey. In addition, GSM set retail prices for GSM-PSTN calls. Therefore, GSM operators had the advantage to gain relatively more on both PSTN-GSM and GSM-PSTN calls (net gains stated above might support this view). Turk Telecom might believe that mobile operators captured relatively higher profit than did Turk Telecom. Thus, Turk Telecom might not be pleased by the low gain compared to the mobile operators' gain, which caused a high asymmetry in the distribution of incomes.

The unusual response of Turk Telecom in the trial, when sued by Electrical Engineers Association against Turk Telecom in 14 October 1998, reflected Turk Telecom's dissatisfaction about the income distribution. The Electrical Engineers Association sued for canceling the item about the interconnection charges in Inter-network Contact and Cooperation Agreement. Electrical Engineers Association claimed that Turk Telecom caused the public to suffer losses by accepting the Agreement. In 4 October 2000, the 9th Ankara Administration Court decided that distribution of incomes as stated in the Agreement was contrary to the benefit of the Public since there was not a 'symmetric'

[42] For calls terminated on Turk Telecom, if the area code of the interconnection central and the area code of the call's termination point are same, then the price for calls in area is charged. If those are different, then price for calls out of area is charged.

[43] Telecommunication Authority equally set Maximum GSM-PSTN, Maximum PSTN-GSM and Maximum GSM-GSM retail prices once a year. Real market retail prices could not be higher than those Maximum prices.

payment between calls terminating in GSM. Thus, the court concluded that the interconnection item in the Agreement would be annulled. Although Turk Telecom lost the trial, it responded unusually because it did not attempt to appeal for the decision. This might be because Turk Telecom wishes to capture more profit from termination issue with GSM operators.

The 'symmetric' payment decision in the trial caused a debate since the term, 'symmetric' payment, was not clearly defined. Turk Telecom interpreted the 'symmetric' payment as having same amount of money from termination after the taxes were subtracted from retail price. On the other hand, mobile operators advocated that this distribution was unwarranted. In fact, Muzaffer Akpınar, General Director of Turkcell, stated it was obvious that same earnings were unreasonable when the high costs of mobile operators, compared to fixed operators, were considered. As a result, Telsim and Turkcell sued for canceling the symmetric payment decision. On 29 December 2000, the 7th Ankara Trading Court decided that UBT-6 cents approach should continue to be used until any new agreement would be signed between Turk telecom and GSM operators. After that decision, mobile operators continued to set UBT as discussed in Inter-network Contact and Cooperation Agreement and did not make a symmetric payment to Turk Telecom.

The asymmetric payment between calls terminated on fixed and mobile networks seems plausible when one takes into consideration the practice in other countries. In the European Union, weighted termination rates of SMP mobile operators were approximately 14 times higher than the weighted average fixed termination rates[44] (European Commission, 2004).

The ratio in Turkey, 12, was very close to the European ratio. The average of the PSTN-GSM termination rate between 2000 and 2002 was 17 US cents, which means that UBT was higher than 23 US cents/min on average. On the other hand, the termination rate of Turk Telecom was 1.4 US cents/min for calls in area.

Although the asymmetric payment in termination between MNOs and Turk Telecom seems appropriate comparing with Europe as shown above, Turk Telecom's gain of 6 US cents/min from originating PSTN-GSM calls is unreasonable. In general, origination costs are lower than termination costs and termination charge of Turk Telecom was 1.4 US cents/min for calls in area. 1.4 US cents/min for calls in area is reasonable

[44] The weighted average of mobile termination charges for SMP operators in 25 European countries is 13.73 € cent/min and the weighted average of fixed termination charges for incumbent operator (single transit) is 1 € cent/min.

since European Union suggested 0.99-1.98 US cents/min price range for single transit fixed termination rates. Therefore, it was expected that origination prices would be less than 1.4 US cents/min, not 6 US cents/min. The main reason for setting 6 US cents/min was that Turk Telecom could not calculate its costs in public and, therefore, it could not be justified whether the prices of Turk Telecom were cost based or not. This high origination charge may be important since it leads to high retail prices and affects the volume of PSTN-GSM calls. This in turn indirectly influences the termination revenue of GSM operators. In other words, if origination is lower and, thus, retail prices, then the volume of PSTN-GSM minutes increases while the termination rate of GSM operators is constant. This PSTN-GSM termination revenue, as discussed in the previous chapters, may be used for cross-subsidization which might be welfare improving in the low penetration rate period of the mobile sector. Therefore, the high origination prices in PSTN-GSM calls may indirectly diminish the termination revenue for cross-subsidization.

Although Turk Telecom captures significantly high origination prices for PSTN-GSM calls, the company would get high termination revenue in symmetric payment case and, thus, insisted on symmetric payment issue. To show that symmetric payment is applicable and reasonable, Turk Telecom made a symmetric interconnection agreement with the new entrant, Aycell[45], in 26 July 2002. However, this agreement is not very convincing since part of Aycell belongs to Turk Telecom. As a conclusion, the asymmetric payment decision was continued to use, but debate over this issue was not concluded.

There were several trials between Turk Telecom and mobile operators about the asymmetric termination transfers in the period 2000-2002. The most important decisions were taken by 19th Presidency of Law Department of Supreme Court on 19 November 2002 and Council of State on 13 December 2002. The 19th Presidency of Law Department of Supreme Court concluded that the decision which had been taken by 7th Ankara Trading Court could not be in use since Inter-network Contact and Cooperation Agreement was an administrative agreement. In addition, the Council of State had to stop the application of UBT approach in the termination issue between Turk Telecom and the mobile operators, Turkcell and Telsim. One year later, the Council of State confirmed that there was a gap about the interconnection issue and stated, on June 2003, that this gap should be solved in the light of existing laws. The existing laws about the related issue were included in Access and Interconnection Ordinance came into force on 23 May 2003. Related items

[45] Aycell entered the market in December 2001.

were articles 16, 20, and 21. Article 16 of the Ordinance stated that mobile operators with SMP and Turk Telecom should determine their interconnection charges on cost base. In addition, the Ordinance emphasized in articles 20 and 21 that the operators could negotiate on termination rates and set rates freely, but they should be compatible with the limitations of the Commission's views and laws. If they could not reach an agreement in 3 months after the request for interconnection, then Telecommunication Authority would intervene with the request of any negotiator and determine that the termination rates that should be applied by the operators. The ordinance supports that two sides mutually decide and agree on termination rates, in oppose to the previous approach. Then, Turk Telecom and the mobile operators began to negotiate as stated in article 20 and came to an agreement in the three months period.

The articles of 20 and 21 could not be used until GSM operators would be identified as SMP operators. In 21 August 2003, Turkcell and Telsim were identified as SMP operators. After this decision, not only Turk Telecom's termination rates but also Turkcell and Telsim's termination rates began to be examined.

After the decision, articles 20 and 21 were applicable and negotiations for termination rates began. Turk Telecom renewed its agreement with mobile operators on 23 September 2003. Turk Telecom agreed to pay two different prices to different mobile networks: 210.000 TL/min (13.48 € cent/min) as a termination charges for terminating calls at Turkcell, Telsim, or Aycell, and 280.000 TL/min (17.9 € cent/min)[46] for terminating at Aria which entered the market in March 2001. On the other hand, mobile operators agreed to pay 50.000 TL/min (3.2 € cent/min) for calls in area and 70.000 TL/min (4.5 € cent/min) for calls out of area terminating at Turk Telecom.

When these charges are compared with European averages, it can be seen that GSM-PSTN termination charges are very high. The weighted average of single transit PSTN termination rate was 0.96 € cent/min, and that of double transit was 1.66 € cent/min.[47] On the other hand, mobile termination rates for SMP operators in Turkey (13.48 € cent/min) was below the European average of mobile termination rates for SMP operators (15.93 € cent/min). In the light of these prices, it can be concluded that GSM operators in Turkey obtained lower termination revenue from PSTN-GSM calls for cross-

[46] 1 € =1.557.870 TL in September 2003.

[47] ''Single transit'' term, used in Europe, is the same concept with ''calls in area'' term, used in Turkey. ''Double transit'' is the same concept with ''calls out of area''.

subsidization relative to GSM operators in Europe. Moreover, the PSTN operator in Turkey seems to obtain relatively higher termination revenue from GSM operators than PSTN operators in Europe since PSTN operators in Europe are regulated at cost level. As a conclusion, it can be said that these new charges are less beneficial for GSM operators when compared to the charges in Europe (European Commission, 2003).

The interesting point is that these charges were not imposed by any regulatory authority and GSM operators agreed mutually with Turk Telecom. Yunus Kibar (2005) states that GSM operators signed this agreement because they had anxieties about whether symmetric payment decision approved by Council of State in 2002 would be in use if they do not come to an agreement. GSM operators may possibly choose this agreement under the threat of using symmetric payment decision.

Up to now, historical events mostly related with termination of PSTN-GSM and GSM-PSTN calls are discussed. The next few paragraphs are concerned with the events related to GSM-GSM calls.

The termination charge for GSM-GSM calls was 1.4 US cents/min which mobile operators had paid to Turk Telecom for transition between 1994 and 1998. In 1998, mobile operators did not exactly know their costs to terminate calls since they had used Turk Telecom's lines; thus, agreement on 1.4 US cents/min seemed plausible.

This interconnection charge was renewed in 2001 and two mobile operators agreed to increase termination charges to 20 US cents/min. This change caused a new debate since the renewed agreement was signed just before the new operator Aria entered the market. While some economists argued that Turkcell and Telsim used their market power to deter the new entrance, other economists supported that Turkcell and Telsim realized their termination costs and revised their charges by the costs.

It can be thought that Turkcell and Telsim may increase termination rates due to the effect of TMNE discussed in section 2.3.2. By increasing termination charges from 1.4 US cents/min to 20 US cents/min, off-net GSM-GSM retail prices would increase. Moreover, Turkcell offered a new calling package BizBize Cell. While the package increased the off-net call prices from 16 US cents/min to 22 US cents/min, the on-net call prices were reduced from 18 US cents/min to 7 US cents/min. This may deter the new entry due to TMNE (Atiyas, 2004).

The Competition Commission inquired into Turkcell and Telsim's abuse of their market power by increasing termination charges 13-14 times to make the entrance more difficult. However, Competition Commission declared on 4 November 2004 that there was

no abuse. This supports the idea that termination rates increased since Turkcell and Telsim realized their real costs and revised their charges by the costs.

These charges lasted until 2003, when the Access and Interconnection Ordinance came into effect which required that existing agreements be revised in the light of the Ordinance. With Access and Interconnection Ordinance, the related articles about the interconnection charges in Inter-network Contact and Cooperation Agreement changed. In the light of article 20 in the ordinance, the mobile operators negotiated but they could not come to an agreement on termination rates in the 3 months period. Thus, Telecommunication Authority intervened and determined the rates. According to Telecommunication Authority's determination, Aria and Aycell set termination rates for the incoming calls from other mobile operators at 233,750 TL/min (14.28 € cent/min)[48]. On the other hand, termination rates for calls terminating at Turkcell and Telsim networks were set at 178,750 TL/min, or about 10.92 € cent/min. The levels of charges were below the European Union average, which was 15.93 € cent/min for SMP operators and 18.6 € cent/min for non-SMP operators (European Commission 2003, figure 22).

As a requirement of the ordinance, the Standard Interconnection Reference Charges (SIRC) for mobile operator with SMP should be announced. On 10 September 2004, Telecommunication Authority (TA) declared SIRC as below:

Table 7.1 - Standard Interconnection Reference Charges

Application Date	Termination and Origination Rates for Turk Telecom		Mobile Termination Rates for SMP operators (TL/min)
	For calls in Area (TL/min)	For calls out of Area (TL/min)	
01.10.2004	41.000	59.000	156.000
01.01.2005	34.000	51.000	148.000
01.10.2005	20.000	37.000	140.000

Source: Telecommunication Commission

[48] 1 €=1.637.011 TL in October 2003.

SIRC was not binding for operators if they agree on the rates. However, if they did not reach an agreement and applied to TA for reconciliation, then the TA would propose what SIRC to agree on.

When those prices are compared with the European averages in 2004, it can be seen that still PSTN in Turkey captures more termination price per minute than PSTN in Europe and MNOs in Turkey gain less per minute termination revenue than those in Europe. Standard termination price of Turk Telecom was set approximately 2.25 € cent/min for calls in area and 3.23 € cent/min for calls out of the area[49], while Europe average is 0.91 € cent/min for single transit and 1.54 € cent/min (European Commission 2004, figure 28 and 29). On the other hand, mobile termination for SMP in Turkey was 8.5 € cent/min[50], while Europe average was 13.73 € cent/min. Therefore, reference interconnection prices may not be fair.

7.2. Is Light-Handed Regulation Suitable to the Turkish Context?

In this section, light-handed regulations discussed in chapter 6 are examined in case of Turkey. In other words, this section questions whether any light-handed regulation is appropriate for Turkey instead of cost-based regulation. For this purpose, each light-handed regulation is briefly discussed for Turkish case.

Yardstick regulation seems inappropriate for the Turkish case due to lack of sufficient competition. Yardstick regulation aims to pass the benefits of competition in retail market to the termination market. This remedy is very much related with the intensity of competition in retail mobile market. This remedy is used by Australia and the market shares of the top three operators are close to each other as seen in table 7.2. On the other hand, Turkcell dominates the market share in Turkey. In short, market shares show that Australia has a more competitive mobile retail market than does Turkey. Therefore, yardstick regulation may not be plausible.

[49] These prices were valid between October 2004 and January 2005.

[50] 1 €=1.824.873 TL in September 2004.

Table 7.2 – Mobile operators market share in Australia and Turkey in 2003

	Australia				Turkey			
	Telstra	Optus	Vodafone	Hutchison	Turkcell	Telsim	Aria	Aycell
Market share by subscriber number (%)	45.8	34	18.1	2.1	68	18.3	7.2	6.4

Source: ACCC 2004 (Table 2.4)

Moreover, changing CPP regime to RPP regime seems inappropriate for the Turkish case. When countries pass to RPP from CPP, it is more likely to have a significant reduction in volume of calls terminated on mobile networks. This is because people are used to not paying for calls they receive in CPP regime but are charged for receiving calls in RPP. For this reason, they are more likely to switch off the phone calls. The Turkish people, like anybody else, does not want to pay for what was once free, thus changing from CPP to RPP causes Turks to turn off their mobile phones. Furthermore, no country has moved from CPP to RPP, while at least 27 counties have changed from RPP to CPP since 1991 (Littlechild, 2004). This data illustrates that countries using CPP in the beginning may probably be afraid of a significant number of phones switched off. Therefore, it seems inappropriate for Turkey to move to RPP.

Another light-handed remedy is bill-and-keep. As states in section 6.4, bill-and-keep regime may cause problem in asymmetric markets, and Turkey has a very asymmetric network as markets shares stated in table 7.2 show. In addition, bill-and-keep is problematic when costs differ. This cost difference is seen in PSTN-GSM and GSM-PSTN calls. Terminating calls on GSM are more costly than on PSTN, and volume of PSTN-GSM calls is higher (210 million minutes last year) than that of GSM-PSTN calls (70 million minutes) in Turkey. Therefore, bill-and-keep makes a loss for GSM operators in the termination issue. As a conclusion, bill-and-keep seems inappropriate for Turkey.

Thus, it seems inappropriate to apply light-handed regulation for Turkey due to lack of sufficient competition, imbalance in GSM-PSTN and PSTN-GSM call volumes.

8. Conclusion

This thesis mainly discusses a very hot concept in telecommunication, mobile termination rate. After acceptance of The New Regulatory Framework, it reveals that mobile operators have monopoly power in termination service. With this identification, the debate on whether MTR needs to be regulated rises.

MTR would need to be regulated if mobile operators set high termination charges. Therefore, the regulatory decision mainly relates to the question of whether mobile operators have the incentive to set high MTR. Incentives to set high MTR differ for FTM and off-net MTM calls. Thus, MTR should be separately examined to determine whether MNOs have incentives or, indirectly, whether MTR needs to be regulated in both FTM and off-net MTM markets.

Some argue that mobile operators do not have any incentive to set high FTM termination rate since there are some market forces constraining the incentive. Consumer surveys and market data support the opposite view by illustrating that these constraints exist but are weak. Therefore, it seems plausible to regulate MTR in FTM market.

The same argument also arises for MTR in MTM market. Although there is no empirical evidence, realistic theoretical models provide that mobile operators do not have the incentive to set MTR high for off-net MTM calls. This view may be plausible when operators are symmetric; however this may not be very applicable in the case of entrance because incumbent may increase MTR to deter new entry.

When two markets, i.e. FTM and off-net MTM, are separately examined, it is concluded that MTR for FTM calls certainly needs to be regulated, but MTR for off-net MTM calls is less likely to be so. However, when one takes into consideration the practice in Europe, almost all countries impose a regulation on MTR in off-net MTM calls due to high MTR. The main reason is that mobile networks do not set different MTR for FTM and off-net MTM calls. Given this, it is accepted that MNOs have incentives to maintain high FTM termination charges and, thus, it is expected that MNOs will not reduce their MTM termination charges.

On the other hand, some countries such as France, Italy, and Germany apply different MTR for FTM and off-net MTM calls. In those countries, MTM termination charges are not regulated whereas FTM termination rates are regulated. This supports the

idea that MTM termination rates does not need to be regulated if termination rates are set separately for FTM and off-net MTM calls.

Based on these conclusions, the interconnection issue in Turkey has been examined. Interestingly, the conclusions stated above do not hold in Turkish case.

Table 8.1- Comparison of PSTN-GSM and GSM-PSTN termination rates in Turkey with those in Europe

	PSTN-GSM termination charges (€ cents)	
	Turkey	Europe
2000-2002	18	19.67
2003	13.48	15.93

	GSM-PSTN termination charges	
	Turkey (in area)	Europe (single transit)
2000-2002	1.4 US cents	0.99-1.98 US cents
2003	3.2 € cents	0.96 € cents

When termination rates in Turkey are compared with termination rates in Europe, it is seen that mobile termination rates in Turkey are not as high as those in Europe. In the case of PSTN-GSM interconnection, Europe allows mobile operators to obtain appropriate termination revenue to cross-subsidize, and agreements are usually more beneficial for mobile operators in the early stages of mobile penetration. However, as examined in chapter 7, agreements in Turkey operate in the opposite direction; usually the PSTN operator seems to have obtained relatively higher benefit than do mobile operators. In the first interconnection agreement between Turk Telecom and GSM operators, Turk Telecom received 6 US cents/min for originating PSTN-GSM calls, very high relative to Europe averages. In Europe, authorities seem to have had a consensus about imposing regulation over PSTN-GSM termination charges only after mobile penetration rates reached an appropriate level. On the other hand, in 2003 GSM operators in Turkey reached an agreement with Turk Telecom, and GSM operators accepted setting mobile termination rates at 210.000 TL/min (13.48 € cent/min), which is below the European averages (15.93 € cents) as seen in table 8.1. This is interesting since mobile operators accepted to charge a price lower than Europe average without any regulatory obligation. This was despite the fact that GSM operators accept Turk Telecom to increase its GSM-PSTN termination rates to levels which were much higher than the European average of fixed networks termination charges. Based on these facts, one could conclude that in the Turkish context PSTN-GSM termination does not need to be regulated, whereas PSTN termination may need to be

regulated. When PSTN termination rates are compares as seen in table 8.1, it can be seen that PSTN termination rates in Turkey (3.2 € cents) is significantly higher than those in Europe (0.96 € cents) in 2003. This interesting situation may reflect a political factor since Turk Telecom is a very important component of the government's privatization program. The government may be motivated by the idea that if Turk Telecom makes high profits, it can be sold at a higher price. Therefore, allowing Turk Telecom to set high termination charges to capture more profit would increase value of company.

Table 8.2 - Comparison of GSM-GSM termination rates in Turkey with those in Europe

	GSM-GSM termination rates	
	Turkey	Europe
1998-2001	1.4 US cents	19 US cents
2001-2003	21 € cents	19.06 € cents
2003	10.92 € cents(for SMP) and 14.28 € cents (for non-SMP)	15.93 € cents (for SMP) and 18.6 € cents (for non-SMP)

GSM-GSM interconnection became a problem after the new entry in 2001 since Turkcell and Telsim increased termination charges from 1.4 US cents/min to 20 US cents/min (approximately 21€ cents). Some argue that this increase may deter the new entry due to TMNE. On the other hand, some advocate that this charge was set because Telsim and Turkcell realized their termination costs. When European average of mobile termination rates for all operators was considered in 2001 (19.06 € cent/min), 20 US cents/min does not seem very high. Therefore, the second approach may be more plausible. On the other hand, in September 2003, GSM operators did not agree on GSM-GSM termination rates, and thus different termination charges are imposed for SMP (Turkcell and Telsim) and non-SMP operators (Aria and Aycell) as illustrated in table 8.2. Termination charge of non-SMP operators is 30 % higher than that of SMP operators in Turkey while average termination rates of non-SMP operators is 16 % higher than the charges of SMP operators in 2003. This may cause an extra benefit for non-SMP operators. It seems plausible to suggest that these rates were set to increase market share of Aycell as soon as possible. Again, the reason may be political since Turk Telecom is

the partial owner of Aycell, i.e., someone who buys Turk Telecom also becomes a partial owner of Aycell.

As a conclusion, Turkey has a very different regulatory perspective when compared to Europe. While in Europe PSTN-GSM termination charges are regulated and GSM-GSM charges are less likely to be regulated, the opposite seems to have occurred in Turkey.

Public opinion in Turkey is such that mobile operators set high termination rates and Turk Telecom's charges are low. However, my study concludes that mobile termination rates are relatively low, whereas Turk Telecom sets higher termination charges. Therefore, a more aggressive regulation approach should be directed to call termination over Turk Telecom network.

BIBLIOGRAPHY

1. ACCC. "Mobile Services Review: Mobile Terminating Access Service." (2004).

2. Amarach Consulting. "ComReg Fixed & Mobile User Research." (2003). http://www.comreg.ie/_fileupload/publications/ComReg03127b.pdf

3. Armstrong, Mark. "Mobile Telephony in the U.K." Regulation Initiative Discussion Paper, no:15, London Business School (1997)

4. Armstrong, Mark. "Network interconnection in telecommunications." The Economic Journal, 108 (1998) 545-564.

5. Armstrong, Mark. "The theory of access pricing and interconnection.", in *Handbook of Telecommunications Economics*, ed., M.E.Cave, S.K.Majumdar and I. Vogelsang, Vol.1,Amsterdam:Elsevier Science, pg. 295-384, (2002)

6. Atiyas, İzak. "Competition and regulation in the Turkish telecommunications industry." mimeo, (2004).

7. Berger, Ulrich. "Bill-and-keep vs. Cost-based access pricing revisited", Vienna University of Economics.

8. Bomsel, Oliver, M. Cave, G.L. Blanc, and K.H. Neumann. "How mobile termination charges shape the dynamics of the telecom sector." University of Warwick, (2003).

9. Buigues, Pierre A. "The competition policy approach." in *The Economics of Antitrust and Regulation in Telecommunications*, ed. Pierre A. Buigues and Patrick Rey. Edward UK: Elgar Publishing, (2004).

10. Carter, Michael, and J. Wright. "Asymmetric network interconnection." Review of Industrial Organization, 22 (2003) 27-46.

11. Carter, Michael, and J. Wright. "Interconnection in network industries." Review of Industrial Organization, 14 (1999) 1-25.

12. Competition Commission (United Kingdom), "Competitive Pressure on charges for calls to mobile phones", ch.4 (1999). http://www.competition-commission.org.uk/rep_pub/reports/1999/fulltext/422c4.pdf

13. Competition Commission (United Kingdom). "Vodafone, O2, Orange and T-Mobile: Reports on references under section 13 of the Telecommunications Act 1984 on the charges made by Vodafone, O2, Orange and T-Mobile for terminating calls from fixed and mobile networks." (2003).

14. ComReg. "Residential Telecommunications Survey Quarterly Report." (2004). http://www.comreg.ie/_fileupload/publications/ComReg0430c.pdf

15. Crandall, Robert W., and J.G. Sidak. "Should regulators set rates to terminate calls on mobile networks?" Yale Journal on Regulation, 21 (2004).

16. Cullen International, ''West Europe Coast Country Analysis.'' (March 2005)

17. Dessein, Wouter. "Network competition in non-linear pricing." RAND Journal of Economics, 34, no.4 (2003), 593-611.

18. Dewenter, Ralf, and J. Haucap. "Mobile termination with asymmetric networks." University of the Federal Armed Forces, (2003).

19. Directive 2002/22/EC of the European P arliament and of the Council of 7 March 2002 on a Common Regulatory Framework for Electronic Communications Networks and Services (Universal Service Directive), 2002, EC.

20. DotEcon. "Fixed-Mobile substitution: A report prepared for BT." (2001). http://www.dotecon.com/publications/fmsub3.pdf

21. Doyle, Chris, and J.C. Smith. "Market structure in mobile telecoms: Qualified indirect access and the receiver pays principle." Information Economics and Policy, 10 (1999) 471-488.

22. Elliott, Dan. "The importance of price elasticities in the regulation of mobile call termination." in *Regulating Mobile Call Termination*, The Vodafone Policy Series,no.1 (2004a).

23. Elliott, Dan. "Two-way access charges and on-net / off-net differentials." Frontier Economics. (2004b). http://www.frontier-economics.com/publications/en/88.pdf

24. Espicom. ''Market intelligence report: Italy'', 2005. http://www.espicom.com/web3.nsf/structure/tel_bksmitaly?OpenDocument

25. Europe Economics. "Cost structures in mobile networks and their relationship to prices." (2001).

26. European Commission, ''9th Report on the Implementation of the Telecommunications Regulatory Package''. (2003)

27. European Commission. "European Electronic Communications Regulation and Markets 2004, 10th Report." (2004).

28. Gans, Jashua S., and S.P. King. "Mobile network competition, customer ignorance and fixed-to-mobile call prices." Information Economics and Policy, 12 (2000a) 301-327.

29. Gans, Jashua S., and S.P. King. "Using 'bill and keep' interconnect arrangements to soften network competition." Economics Letters, 71 (2000b) 413-420.

30. Grzybowski, Lukasz. "Estimating switching costs in the mobile telephony in the UK." (2004).

31. Haucap, Justus. "The economics of mobile telephone regulation." University of the Federal Armed Forces, (2003).

32. Hausman, Jerry. "Mobile Telephone", in *Handbook of Telecommunications Economics*, ed., M.E.Cave, S.K.Majumdar and I. Vogelsang, Vol.1,Amsterdam:Elsevier Science, pg. 564-595, (2002)

33. Houpis, George, T.M. Valletti. "Mobile termination: what is the 'right' charge?" (2004)

34. IRG (Independent Regulators Group). "Principles of implementation and best practice on the application of remedies in the mobile voice call termination market." (2004).

35. ITU statistics,http://www.itu.int/ITU-D/ict/statistics/at_glance/KeyTelecom99.html (2003)

36. ITU survey by Tim Kelly, "Economics aspects of fixed to mobile interconnection." (2001)

37. Kibar, Yunus Ş. "Telekomünikasyon sektöründe serbestleşme sürecinde erişim ve arabağlantı hizmetlerinin ücretlendirilmesi, yaklaşımlar, sorunlar ve çözüm önerileri." Telekomünikasyon Kurumu Thesis (2005).

38. Laffont, Jean-Jacques, P. Rey, and J. Tirole. "Network competition: I. Overview and non-discriminatory pricing." The RAND Journal of Economics, 29 (1998a) 1-37.

39. Laffont, Jean-Jacques, P. Rey, and J. Tirole. "Network competition: II. Price discrimination." The RAND Journal of Economics, 29 (1998b) 38-56.

40. Littlechild, Stephen C. "Mobile termination charges: Calling party pays versus receiving party pays." (2004).

41. Littlechild, Stephen C. "Price controls on mobile termination charges." in *Regulating Mobile Call Termination*, The Vodafone Policy Series, no.1 (2004)

42. OFTEL. "Consumers' use of mobile telecoms services", November 2002.

43. OFTEL. "Consumers' use of fixed telecoms services", April 2002.

44. OFTEL. "Consumers' use of fixed telecoms services", January 2003a.

45. OFTEL. “Review of mobile wholesale voice call termination Markets.” EU Market Review (2003b).

46. OPTA. “The regulation of mobile terminating tariffs.” (2001).

47. Peitz, Martin. “Asymmetric access price regulation in telecommunications markets.” European Economic Review, 49 (2005) 341 – 358.

48. Peitz, Martin. ‘‘On access pricing in telecoms: theory and European practice.’’ Telecommunications Policy, 27 (2003), 729-740.

49. Telekomünikasyon Kurumu. “Numara taşınabilirliği: teknik çözümler ve uygulamalar ile ülke incelemeleri raporu.” (2004).

50. Thompson, Harley, O. Renard, and J. Wright. “Mobile termination.”

51. Valletti, Tommaso. “Obligations that can be imposed on operators with significant market power under the new regulatory framework for electronic communications.” (2003).

52. Vodafone. “Regulating mobile call termination”, The Vodafone Policy Series, no:1 (2004).

53. Vodafone Italy. Presentation in Vodafone Analyst and Investor Day, 2004. http://www.vodafone.com/assets/files/en/analyst_2004_Italy.pdf.

54. Wright, Julian. “Access pricing under competition: An application to cellular networks.” The Journal of Industrial Economics, 50 (2002) 289-315.

55. Wright, Julian. “Competition and termination in cellular networks”, University of Auckland (2000).