Substitutability between Fixed and Mobile Telecommunications in Europe

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Abstract

Substitution between fixed and mobile telecommunications is a key aspect for future telecommunications regulation in Europe. Using a dataset of 45 European countries from 1998-2004, we analyze substitutability between fixed and mobile telecommunications services in Europe applying several panel data techniques. The econometric results show evidence that customers tend to substitute between fixed and mobile telecommunications throughout Europe. Additionally some resulting policy implications are discussed.

1 Introduction

Until the early 1990 years mobile phones were expensive and technically not very matured products. As a consequence they were mainly used by business customers who mostly needed the possibility of mobile communications. This situation changed after the implementation of GSM digital technology, because mobile phones became mass products, demand increased and prices declined significantly (Hausman, 2002; Gruber, 2005). Since 2000 the number of mobile subscriptions exceeds the number of fixed line subscriptions in Germany extensively as can be seen in the following figure. Today the amount of mobile phones in Germany exceeds the number of fixed telephone subscriptions much more than in the year 2000 and the trend still continues (Bomsel, Cave, Le Blanc and Neumann, 2003: 25).

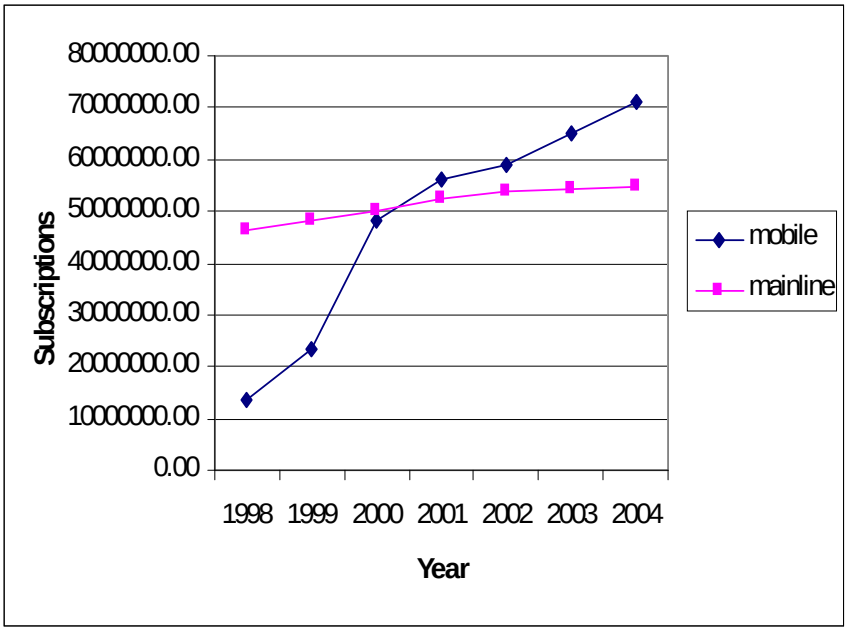

Figure 1: Fixed and mobile subscriptions in Germany from 1998-2004

The markets for fixed and mobile telecommunications are subjects of regulatory obligations (Laffont and Tirole, 2000), but the amount of regulation in these two markets is quite different. After the liberalization of telecommunications markets in Europe the former state owned telecommunications companies (the incumbents) were (partially) privatised and new competitors were enabled to enter the market. Because these new competitors needed (and until now still need) the incumbent's infrastructure (Cave and Prosperetti, 2001), markets for fixed line telecommunications are regulated quite heavily. In contrast mobile communications markets were more competitive until their beginning, compared with their fixed line counterparts (Haucap, 2003). As a result regulation in these markets is less restrictive. But today the demand on fixed and mobile markets raises a new question: Are fixed and mobile phones substitutes? If these products were substitutes, different regulatory arrangements would be hard to justify.

Unfortunately for Germany and the most European countries detailed studies about the substitutability of fixed and mobile telephony do not exist and there are only few studies for other European countries (e.g. Portugal, United Kingdom). While there is some casual evidence that fixed-line and mobile telephony are converging and becoming closer substitutes, the number of econometric studies has been rather limited. Some first evidence that fixed-mobile substitution is increasing has been provided by Yoon and Song (2003) and Ahn,

Lee and Kim (2004) for Korea and Rodini, Ward and Woroch (2003), Ward and Woroch (2004) for the USA, Hamilton (2003) for African countries and Vagliasindi, Güney and Taubman (2006) for eastern European states. However, there is virtually no econometric study of fixed-mobile substitution in Europe. The delineation of 18 electronic communications markets provided for in the current regulatory framework in Europe may be no longer adequate if fixed and mobile telephony markets are converging.

Additionally if markets converge new regulatory questions arise: How should a company be treated that exhibits significant market power in fixed line telecommunications but not in mobile communications? Until now only some papers of European regulatory authorities exist, which analyze the possible substitution effects between fixed network and mobile telecommunications due to national data material without use of econometric methods (for example Griffith and Dobardziew (2003) examine fixed mobile substitution in the Netherlands). But there is still a lack of detailed empirical studies examining fixed mobile substitution in Europe. This paper analyzes the demand for telecommunications services in 45 European countries between 1998 and 2004 with econometric methods to answer the question whether fixed and mobile telecommunications are characterized by a substitutional relationship or not. Furthermore we test whether there are statistical significant differences in fixed mobile substitution between Western and Eastern Europe. The main sources of data include the ITU World Telecommunication Indicators Database, several issues of the OECD Communications Outlook and the OECD International Regulation Database. Additionally resulting policy implications will be discussed.

The remainder of the paper is now organized as follows: The next section provides an overview of empirical studies of fixed mobile substitution, before sections 3.1 and 3.2 offer some information about the data used in our empirical study and we describe the econometric approach with respect to panel data. Section 3.3 discusses the main findings, section 4 concludes.

2 Brief Review of the related Literature

Analyzing fixed mobile substitution is mainly an empirical question, but in a recent paper Hansen (2006) discusses fixed mobile substitution in a theoretical model of mobile network competition based on the Laffont, Rey and Tirole framework (Laffont, Rey, Tirole, 1998). The empirical literature on fixed-mobile substitution is still not very extensive, so econometric studies exist merely for Portugal, South Korea, the UK, the USA and some African and Eastern European states. Sung, Kim and Lee (2000) use panel data for the period 1991-1998 for 8 South Korean provinces. They find that a 1% increase in the absolute number of mobile phones results in a 0.1-0.2% reduction of fixed-line connections. As a consequence they conclude that fixed and mobile telephones are substitutes on Korean telecommunications markets. In detail the number of mobile subscribers is positively related with the number of fixed line disconnections but negatively related to the number of new fixed line connections, which

suggests net substitution between fixed and mobile services. Yoon and Song (2003) analyze fixed-mobile substitution in South Korea using monthly traffic and revenue data from 1997 to 2002. They also conclude that fixed and mobile calls are substitutes and fixed-mobile convergence can be observed in South Korea as in other states of the world. Using traffic data from 1996-2002 for South Korean telecommunications markets, Ahn, Lee and Kim (2004) approve these results.

Horvath and Maldoom (2002) analyze survey data on over 7.000 British telephone users in a simultaneous equation model and additionally estimate some probit regressions. They show that using mobile phones decreases fixed-line usage significantly. Their findings support the conclusion that fixed and mobile phones are substitutes on British telecommunications markets. Barros and Cadima (2001) analyze time series data on fixed and mobile access in Portugal from 1981 until 1999. They identify a negative effect of mobile phone diffusion on fixed line penetration rates, but no effect in the reverse direction seems to exist. In two recent papers Rodini, Ward and Woroch (2003) and Ward and Woroch (2004) show the existance of substitutability between fixed and mobile phones in the USA using survey data. Rodini, Ward and Woroch (2003) analyze the substitutability between fixed and mobile access in the USA modelling the consumers' wireless and second fixed line subscription decision (with logit regressions) and estimate own and cross-price elasticities finding substitution effects. Ward and Woroch (2004) find comparable effects applying the Almost Ideal Demand (AIDS) Modell (Deaton and Muellbauer, 1989: 75-80). They conclude that mobile services are a substitute for fixed line usage not at the subscription but at the traffic level. It should be remarked that they only find a moderate degree of substitutability and further empirical evidence is needed to strengthen this hypotheses. Hamilton uses annual data from 1985-1997 representing 23 African countries. This econometric study shows that fixed and mobile phones in many African countries are still no substitutes. Hamilton argues that usage of mobile phones does not reduce fixed-line usage, but is primarily an improvement in social status. Compared with other findings this is a surprising result, because in countries that lack an extensive fixed line infrastructure (like many African countries), mobile phone usage is often a result of a lack of supply. In such cases mobile phones often are the only means of access to a telephone. Vagliasindi, Güney and Taubman (2006) find substitutional relationships between fixed and mobile services for eastern European states using cross section data for the year 2002 for several countries. In contrast to the other studies the authors use cross section instead of panel data and can not controll for unobserved heterogeneity. Investigating substitutional effects between fixed and mobile services in transition countries is always difficult, because the low quality of fixed networks in these countries often does not allow fixed mobile substitution. Instead mobile phones are often the only possibility to get access to telecommunications.

Beside these econometric studies some papers of Eurpean regulators also discuss the question of fixed-mobile substitution. Griffith and Dobardziev (2003) conclude for the Netherlands that there already exists some degree of substi-

tutability and these process will proceed as mobile call prices will continue to fall. For Germany Wengler and Schäfer (2003) evaluate the findings of a telephone survey consisting of 1.691 persons (first wave), 2.014 persons (second wave) and 101 persons (third wave) collected between march and april 2003. They find only a very moderate tendence for fixed-mobile substitution in Germany in 2003 and most of the survey participants argue that they do not substitute between their fixed- and mobile phones. As a consequence there is no clear empirical evidence, which kind of relationship holds between fixed and mobile telephony. The next sections provide an overview about the data and the econometric approach of our empirical study.

3 Empirical Analysis

3.1 Database

Our main database is the ITU World Telecommunications Indicators Database, additionally information has been provided by the OECD Communications Outlook. We analyze data of 45 European countries from 1998-2004. A list of the countries can be found in table A1 in the appendix. The following table provides some descriptive statistics of the variables.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
CALLMOBPEAK	166	0.8187952	0.5450369	0.03	2.81
Time and Region Dummies	301	Dummy-Variables			
FIXEDCALLPEAK	238	0.1140756	0.1209238	0	1.04
FIXPEN	262	0.4876814	0.2067048	0.0371945	1.014074
FIXEDSUBSCR	262	6894078	1.14e+07	19900	5.46e+07
FIXCONCHAR	236	87.50648	60.59784	0	601.68
FIXMONTHSUB	248	9.23746	5.994279	0.19	29.85
MAINLINE	292	6761272	1.09e+07	19325	5.45e+07
MOBPEN	264	0.4645577	0.3093904	0	1.193798
PCSTOCK	251	3589369	6152098	4000	4.00e+07

CALLMOBPEAK is the cost of a 3-minute local mobile peak call expressed in US dollars. FIXEDCALLPEAK is the price for a 3 minute peaktime fixed line call. FIXCONCHAR respectively the cost of installation refers to the one time charge involved in applying for basic telephone service for residential purposes. Where there are different charges for different exchange areas, the charge is generally for the largest urban area unless otherwise noted. This indicator is expressed in US dollars. FIXEDSUBSCR is the total number of fixed telephony subscribers in a country. FIXMONTHSUB or the residential telephone monthly subscription refers to the recurring fixed charge for a residential subscriber to the PSTN. The charge should cover the rental of the line but not the rental

of the terminal (e.g., telephone set) where the terminal equipment market is liberalized. In some cases, the rental charge includes an allowance for free or reduced rate call units. If there are different charges for different exchange areas, the largest urban area is used. This indicator is expressed in US dollars. A MAINLINE is a telephone line connecting the subscribers' terminal equipment to the public switched network and which has a dedicated port in the telephone exchange equipment. This term is synonymous with the term "main station" or "Direct Exchange Line (DEL)" which are commonly used in telecommunication documents. So it is a measure for the size of national fixed line telephony. PCSTOCK gives the number of personal computers in a state and time dummies for the period 1998-2002 account for possible time trends. FIXPEN and MOBPEN are the fixed and mobile penetration rates for each country. The region dummies EAST, NORTH, SOUTH and WEST are dummy variables to test for differences in the development of fixed and mobile subscription in different European regions, because especially the quality of fixed networks differ considerably.

3.2 Empirical Specification

Fixed mobile substitution can be analyzed on three different levels: subscribers, traffic and revenues (ITU, 2003). To analyze the substitutability between products usually short- and long-run elasticities are estimated (Taylor, 1994) and such studies belong to the traffic level. Unfortunately there is no separate information about traffic data for fixed and mobile telecommunications in Europe available. Instead of this approach we estimate the effect of several variables, particularly prices, on the stocks of fixed and mobile subscriptions. Taking into account the panel structure of our data, we can derive an adequate specification as

$$y_{it} = \alpha_{it} + \beta_1 p_{it} + \sum \beta_k x_{it,k} + \epsilon_{it}$$

where y_{it} represents the variables FIXPEN or MOBPEN and p_{it} are prices for fixed or mobile calls. As a consequence our analysis deals on the subscriber level. The term $x_{it,k}$ includes additional explanatory variables. ϵ_{it} is an error term and α and the β's are parameters to be estimated. Assuming that α_{it} is fixed over time, but differs with cross-section units, the equation can be estimated using fixed effects controlling for unobserved heterogeneity. Alternatively assuming that α_{it} can be composed into a common constant α and a unit specific random variable ν_i so that the equation $\alpha_{it} = \alpha + \nu_i$ holds, the equation can be estimated with the random effects model in this case. In the first step of our analysis we neglect unobserved heterogeneity and estimate a simple panel data model with Ordinary Least Squares (OLS). Controlling for unobserved heterogeneity we apply fixed (FE) and random effects (RE) methods in the next step. To account for possible endogeneity problems we use instrumental variable techniques in the 3. step of our analysis.

The neglection of the possible endogeneity of one ore more explanatory variables while using ordinary fixed or random effects models leads to biased results. As a consequence, panel instrumental variable methods are approriate to account for endogeneity problems. In the case of fixed effects, the two-stage least-squares within estimator is applied. While computing a random effects model, we use the two-stage least-squares one-way error component model applying feasible generalized leasts squares (FGLS). Since our panel is unbalanced, we use the consistent estimator by Baltagi and Chang (1994, 2000) of the variance components. The next section provides the main estimation results as well as their interpretations.

3.3 Empirical Results

In this section we present the estimation results of our different modelling approaches on fixed-mobile substitution. As a first test we have regressed fixed line penetration rates FIXPEN and mobile penetrtion rates MOBPEN in each country on our explanatory variables applying simple OLS in order to analyze the basic determinants of fixed and mobile access. The aim of this first step is to get some basic insights into the determinants of fixed and mobile access in Europe. The results are given in the following table.

Table 2: Simple OLS-regression

	FIXPEN	MOBPEN
CALLMOBPEAK	-0.0843234	-0.0117729
	(-2.80)	(-0.37)
FIXEDCALLPEAK	0.2094731	0.442036
	(2.51)	(5.98)
FIXCONCHAR	0.0000735	0.0005762
	(0.060)	(2.02)
PCSTOCK	2.37e-09	-2.47e-10
	(2.01)	(-0.18)
TIME Dummies	YES	YES
EAST	-0.2996216	-0.3396253
	(-9.53)	(-12.38)
SOUTH	-0.1418698	-0.213874
	(-3.02)	(-4.91)
WEST	0.0322168	-0.074906
	(-0.85)	(-2.25)
CONS	0.7564274	-0.8080203
	(17.18)	(19.75)
R^2	0.4772	0.7561
Observations	134	134

Heteroscedasticity robust t-statistics are given in parenthesis.

The estimation results provide first evidence that fixed and mobile telephone services are substitutes in the customers' cognition. In detail the costs of a mo-

bile call have a significant negative effect on mobile penetration rates. The same result holds for the variable connection charge for fixed line access (FIXCONCHAR), which is however significant in the mobile telecommunications equation. Furthermore we observe a positive impact of the number of personal computers in a country on FIXPEN but a negative effect on MOBPEN which is not statistically significant. One reason for this observation is, that both, fixed and mobile access, give the consumer the opportunity to use the World Wide Web, an effect which was also found in other studies (Rodini, Ward and Woroch, 2003: 417). We also include time dummies to account for possible time trends in our regression. Additionaly we have negative statistical effects of EAST, SOUTH and WEST regional dummies on both, fixed and mobile access using NORTH as reference variable. But these estimations have one mayor drawback, because they do not controll for unobserved heterogeneity (Wooldridge, 2002: 247-251). To take care of the effects of unobserved heterogeneity we apply fixed and random effects models (Baltagi, 2005: 12-19) in the next step of tour analysis. The results are given in table 3.

Table 3: Fixed and Random Effects Estimations

	FE	RE	FE	RE
	FIXPEN	FIXPEN	MOBPEN	MOBPEN
CALLMOBPEAK	-0.0121751	-0.0161699	-0.0196631	-0.0190601
	(-0.80)	(-1.10)	(-0.85)	(-0.93)
FIXEDCALLPEAK	0.0779093	0.0888642	0.2656595	0.2896199
	(1.43)	(1.59)	(3.22)	(3.61)
FIXCONCHAR	-0.0002906	–0.0002505	0.0001277	0.0002184
	(-2.45)	(-2.12)	(0.71)	(1.31)
PCSTOCK	-4.40e-11	-5.78e-12	8.35e-10	6.45e-10
	(-0.01)	(-0.00)	(0.16)	(0.19)
TIME Dummies	YES	YES	YES	YES
EAST	-	-0.3269377	-	-0.3747153
		(-4.35)		(-4.85)
SOUTH	-	-0.1737253	-	-0.2319757
		(-2.22)		(-2.88)
WEST	-	-0.0730004	-	-0.0906334
		(-0.89)		(-1.06)
CONS	0.5043434	-	0.6805132	-
	(8.19)		(7.29)	
F-Statistic (FE)/	1.65	488.23	83.15	1213.86
Wald χ^2 (RE)	(10,91)	(13)	(10,91)	(13)
Observations	134	134	134	134
No. of Groups	33	33	33	33

Heteroscedasticity robust t-statistics are given in parenthesis.

Testing fixed versus random effects specification of the model applying the Hausman test, the random effects model can not be rejected. The results approve our main results from the last step although controlling for unobserverd

heterogeneity. But the effects of regional dummies are consistent with our first results. Perhabs these negative effects are a response of our fixed effects which correlate with the region dummies. One mayor statistical problem are the not expected signs of the variable FIXEDCALLPEAK in the fixed-line regressions. A possible explanation is that there exists some form of endogeneity, which leads to possible biases in the estimated parameters and furthermore it is not possible to identify the effects of the endogenous variables (Baltagi, 2005: 19). A possible solution for this endogeneity problem is to use instrumental variable techniques (IV) (Mittelhammer, Judge and Miller, 2000: 424-426) and applying the consistent estimator by Baltagi and Chang (1994, 2000) of the variance components . Unfortunately it is hard to find an adequate instrument for our variable FIXPEN. One possible approach is to use first lags of FIXEDCALLPEAK as instruments to account for possible endogeneity. This approach does not work satisfactory in our case, perhaps because using lagged data results in a smaller database which makes statistical estimation and inference more difficult. In this paper the sample size is already quite small and an additional reduction would not be reasonable and as a consequence we do not report the results here. Instead of lagged variables we use Eurostat's consumer price index CPI as an instrument for the variable FIXEDCALLPEAK considering the disadvantage that it is not available for all countries in our sample. The IV estimation results are given in table 4.

Table 4: IV Estimation

	FE	RE	FE	RE
	FIXPEN	FIXPEN	MOBPEN	MOBPEN
CALLMOBPEAK	-0.0201326	-0.0211314	-0.0148551	-0.0116542
	(-1.22)	(-1.41)	(-0.61)	(-0.55)
FIXEDCALLPEAK	0.072103	0.075116	0.2831714	0.3062374
	(1.28)	(1.38)	(3.41)	(3.84)
FIXCONCHAR	-0.0003483	-0.0002902	0.0002868	0.0003943
	(-2.67)	(-2.38)	(1.49)	(2.30)
PCSTOCK	-7.56e-10	-3.49e-10	87.90e-10	-2.00e-10
	(-0.21)	(-0.13)	(0.15)	(0.07)
TIME Dummies	YES	YES	YES	YES
EAST	-	-0.3197599	-	-0.3579006
		(-4.34)		(-5.27)
SOUTH	-	-0.1714589	-	-0.1731076
		(-2.12)		(-2.30)
WEST	-	-0.0818034	-	-0.0797611
		(-1.01)		(-1.04)
CONS	0.5366251	0.6991689	0.6042949	0.7674154
	(16.46)	(10.43)	(12.56)	(11.33)
F-Statistic (FE)/	10142.65	40.98	5145.72	783.66
Wald χ^2 (RE)	(9)	(12)	(9)	(12)

Our IV estimation results do not differ significantly from the former results. We still have strong evidence that an increase in prices for fixed phone calls

and in fixed connection charges leads to an increase in mobile penetration rates. Especially the coefficients of FIXCONCHAR in the FIXPEN equation and the coefficients of FIXEDCALLMOBPEAK in the MOBPEN equation are statistically significant. But we are not able to identify the reverse effects in the fixed line equation. These findings are in contrast to Barros and Cadima (2001) who argue that fixed penetration rates are determinded by mobile penetration rates, but the reverse effect does not hold. They notice technical progress as the main driving force of mobile penetration rates. But one has to imagine that the most important condition for fixed mobile substitution are continously falling prices, which was not the case in 2001, because mobile services were to expensive to represent substitutes for fixed services in the past. Furthermore one has to take into account that mobile call prices are falling permanently. As a result we are not able to identify substitution of mobile subscriptions by fixed-line subscriptions. Moreover if mobile to fixed substitution would exist in these direction, it is reasonable that substitution takes place at the usage or traffic level and we are not able to identify such effects on the subscriber level.

The next step of our future research will be to find additional data and strong instruments for FIXEDCALLPEAK and CALLMOBPEAK in our FIXPEN equation to account for endogeneity problems, because CPI does not seem to be an adequate instrument for the variable FIXEDCALLPEAK. But in summary we think that our results show first evidence of fixed mobile substitution in the mobile direction in Europe and as a consequence are partially in line with earlier studies from South Korea and the US. But much more work is needed to deepen our understanding of telecommunications demand in Europe.

4 Conclusion and Policy Implications

This paper analyzes fixed mobile substitution on the basis of the relatinship between fixed and mobile subscription in Europe.The main problem in analyzing fixed mobile substitution in European countries is the non availability of traffic data disaggregated for fixed and mobile services. To avoid these difficulties this paper uses the numbers of fixed and mobile subscriptions in each state and estimates effects of price changes of the respectively other product on fixed and mobile penetration rates. Analyzing 45 European countries from 1998-2004 we find some evidence for substitutability of fixed and mobile services in Europe, but have some problems of endogeneity in our econometric model. An important subject for future research is to enlarge our database and to identify possible strong instruments for the price of fixed line peak calls. A second important subject is to examine the determinants of consumers subscription decision for fixed and mobile access in detail.

Regarding to regulation of telecommunications markets fixed mobile substitutability has a wide ranging impact. Most mobile telecommunications markets in Europe are not very strongly regulated, an observation which holds for most parts of the world (Nuechterlein and Weiser, 2005: 261). Exceptions are is-

sues like mobile number portability, mobile termination rates, and international roaming. In contrast fixed telecommunications markets are subjects of considerable regulatory obligations. These differences were quite reasonable when mobile communications services were very expensive and only available for a small group of customers. But today countinously falling prices and the growing substitution between fixed and mobile services raises the question if two different regulatory regimes for fixed and mobile markets are an appropriate solution. Consider the verification of significant market power. If fixed and mobile services are substitutes, it is not sufficient that a telecommunications company has significant market power (or a main share of the market) in the market for fixed line services, because customers use mobile services as subtitutes to the company's fixed line services and are not constrained to fixed line telephony. As a result it would be impossible to gain rents as a consequence of significant market power in fixed or mobile markets only. When the evolution of usage patterns suggests that mobile telecommunications services constrain fixed line companies' market power, regulatory obligations on fixed telephony markets have to be reconsiderd (Rodini, Ward and Woroch, 2003: 475). In conjunction with these developments the suitability of the definition of 18 markets in the current European regulatory framework has to be reconsidered for future telecommunications regulation .

But there are other aspects besides the convergence of fixed and mobile networks, which will affect the development of telecommunications markets fundamentaly. One of these aspects is the market success of voice telephony over internet protocoll (VoIP) (Majumdar, Vogelsang and Cave, 2005). If VoIP becomes the industry standard for voice telephony, services of classical fixed and mobile networks could be substituted by VoIP and different forms of networks will converge. An interesting subject for future research is the impact of increasing availability as well as quality and security of VoIP on the numbers of fixed and mobile subscriptions. But in Germany as well as in other European countries the availability of appropriate data is always problematical. In transition or developing countries the situation is quite different as a result of the poor fixed line infrastructure and the corresponding low growth rates. Growth rates of mobile communications are much higher than growth rates of fixed networks in these countries. As a consequence we will observe other forms of network convergence than in developed countries.The future development and regulation of telecommunications markets will remain an important field of research, particularly because of technological change which will be a key aspect for fixed mobile substitution and the meaning of telecommunications for economic growth and development (Munnell, 1992; Seth, 1992; Röller and Waverman, 2001).

5 Appendix

Table A1:

Countries	
Albania	Italy
Andorra	Latvia
Austria	Liechtenstein
Belarus	Lithuania
Belgium	Luxembourg
Bosnia and Herzegovina	Malta
Bulgaria	Netherlands
Croatia	Norway
Cyprus	Poland
Czech Republic	Portugal
Denmark	Romania
Estonia	Russia
Faroe Islands	San Marino
Finland	Slovak Republic
France	Slovenia
Germany	Spain
Gibraltar	Sweden
Greece	Switzerland
Greenland	Turkey
Hungary	Ukraine
Iceland	United Kingdom
Ireland	Yugoslavia (former)
Israel	

Variable Definitions ITU Database:

CALLMOBPEAK: Series: Cellular - cost of 3 minute local call (peak) (US$) (I153C$), Definition: Cellular - cost of 3-minute local peak call. Expressed in US dollars.

FIXCONCHAR: Series: Residential telephone connection charge (US$) (I151$), Definition: Installation refers to the one time charge involved in applying for basic telephone service for residential purposes. Where there are different charges for different exchange areas, the charge is generally for the largest urban area unless otherwise noted. This indicator is expressed in US dollars.

FIXEDCALLPEAK: Series: Cost of a local 3 minute call (peak rate) (US$) (I153$), Definition: Local call refers to the cost of a peak rate 3-minute call within the same exchange area using the subscriber's own terminal (i.e., not from a public telephone). This indicator is expressed in US dollars.

FIXMONTHSUB: Series: Residential monthly telephone subscription (US$) (I152$), Definition: Residential telephone monthly subscription refers to the

recurring fixed charge for a residential subscriber to the PSTN. The charge should cover the rental of the line but not the rental of the terminal (e.g., telephone set) where the terminal equipment market is liberalized. In some cases, the rental charge includes an allowance for free or reduced rate call units. If there are different charges for different exchange areas, the largest urban area is used. This indicator is expressed in US dollars.

MOBSUBTOT: Series: Cellular mobile telephone subscribers (Total) (I271), Definition: Refers to users of portable telephones subscribing to an automatic public mobile telephone service which provides access to the Public Switched Telephone Network (PSTN) using cellular technology. This can include analogue and digital cellular systems but should not include non-cellular systems. Subscribers to fixed wireless (e.g., Wireless Local Loop(WLL)), public mobile data services, or radio paging services are not included.

PCSTOCK: Series: Personal computers (I422), Definition: The number of Personal Computers in use in the country. Primarily ITU estimates based on a number of national and international sources.

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