Düsseldorf Institute
for Competition Economics

DISCUSSION PAPER

No 49

How Large is the Magnitude of Fixed-Mobile Call Substitution? – Empirical Evidence from 16 European Countries

Anne-Kathrin Barth,
Ulrich Heimeshoff

April 2012

HEINRICH HEINE
UNIVERSITÄT DÜSSELDORF

IMPRINT

DICE DISCUSSION PAPER

Published by
Heinrich-Heine-Universität Düsseldorf, Department of Economics, Düsseldorf Institute for Competition Economics (DICE), Universitätsstraße 1, 40225 Düsseldorf, Germany

Editor:

Prof. Dr. Hans-Theo Normann
Düsseldorf Institute for Competition Economics (DICE)
Phone: +49(0) 211-81-15125, e-mail: normann@dice.hhu.de

DICE DISCUSSION PAPER

ISSN 2190-9938 (online) – ISBN 978-3-86304-048-2

How Large is the Magnitude of Fixed-Mobile Call Substitution? - Empirical Evidence from 16 European Countries

Anne-Kathrin Barth* Ulrich Heimeshoff**

April 26, 2012

Abstract

This paper investigates the degree of fixed-mobile call substitution (FMCS). We use quarterly data from 2004 to mid 2010 on 16 mainly Western European countries. By applying dynamic panel data techniques, we are able to estimate short- and long-run elasticities. The own-price and cross-price elasticities found give strong empirical evidence for substitutional effects towards mobile services. In particular, the estimated cross-price elasticities of the mobile price on the fixed line call demand are relatively large compared to other studies.

Keywords: Dynamic Panel Model, Fix-Mobile Substitution, Telecommunication Markets

*Duesseldorf Institute for Competition Economics (DICE), e-mail: anne-kathrin.barth@dice.uni-duesseldorf.de

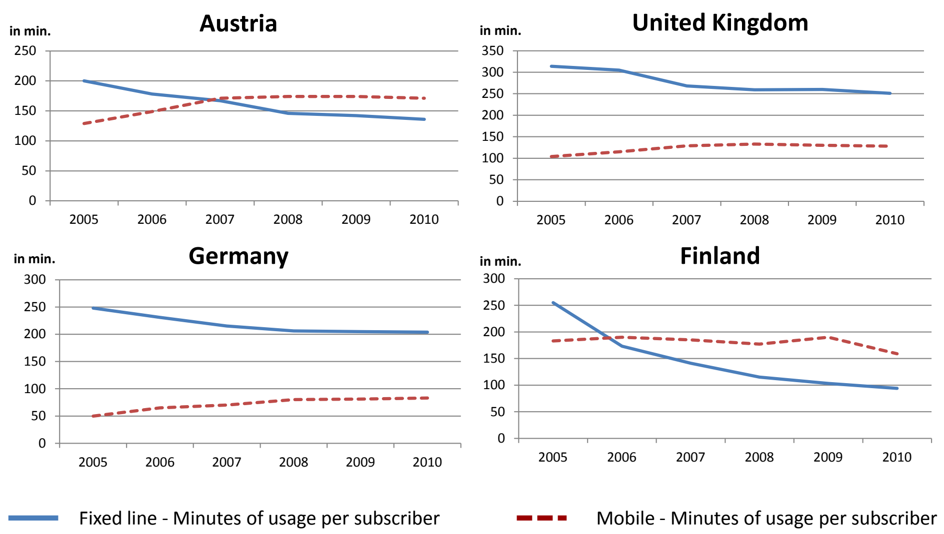
**Duesseldorf Institute for Competition Economics (DICE), e-mail: ulrich.heimeshoff@dice.uni-duesseldorf.de

We are very grateful to Julia Graf, Miguel Vidal and the participants of the DICE Brown Bag Seminar in November 2011 for helpful comments and suggestions. All remaining errors are solely the responsibility of the authors.

1 Introduction

After the implementation of GSM digital technology in the beginning of the 1990s, mobile devices became mass products, prices dropped and penetration rates heavily increased (Hausman, 2002; Gruber, 2005). Next to the fact that the number of mobile subscribers is larger than the number of fixed line subscriptions since the early 2000s, we observe that fixed and mobile voice traffic volumes are converging. Whereas mobile call volumes are rising, fixed line voice traffic volumes have continuously declined over the past decade. Figure 1 exemplifies the development of the average fixed and mobile voice traffic per subscriber for four different European countries from 2005 to 2010. It is obvious that the progress of convergence varies between countries. For instance, in Austria and Finland the mobile voice traffic has already exceeded the fixed line traffic for several years. On the contrary, in other countries as in Germany and the UK fixed line phones are still used more often to place calls than mobile devices.

Figure 1: Development of average fixed and mobile voice traffic per subscriber and year (in minutes)



Source: Analysys Mason 2011

Fixed and mobile telecommunications markets are monitored by national regulatory authorities (Laffont and Tirole, 2000), but the degree of regulation is quite different.

On the one hand, fixed markets are regulated quite heavily. On the other hand, mobile markets are regulated less restrictive as they were more competitive from their very beginning (Haucap, 2003). However, the recent observations lead to the question if this asymmetric regulation of fixed and mobile markets is still appropriate.
The number of econometric studies which analyses the substitutional relationship between fixed and mobile networks is limited and their results are quite ambiguous. The main reason tends to be that most of the studies use quite old data, i.e. up to 2003. In contrast, studies using more recent data as Briglauer et al. (2011), Grzybowski (2011) and Barth/Heimeshoff (2011) unanimously conclude that the two services are substitutes, at least in developed countries. These findings substantiate that fixed-mobile substitution is already prevailing. Consequently, the research focus lies not anymore on the question if the two technologies are substitutes or not, but on the question to what extent fixed and mobile networks are substitutable and if the magnitude found is strong enough to justify regulatory adjustments.
Especially studies on the traffic level rarely exist, all finding different degrees of substitutability. Additionally, there is to the best of our knowledge no econometric paper analyzing FMCS in a multiple countries setting. Therefore, present results should be interpreted with caution as these are likely biased due to problems with unobserved heterogeneity.
The purpose of this paper is to help closing this research gap. We address fixed-mobile call substitution within 16 mainly Western European countries. Using quarterly data from 2004 to mid 2010, the paper analyzes to what extent fixed and mobile phone calls are substitutes. Our paper is structured as follows: Section 2 provides an overview of the empirical literature related to fixed-mobile substitution. In section 3, the dataset and its descriptive statistics will be explained. The following section 4 introduces our model specification and describes our estimation approach. Section 5 explains our main results. Finally, section 6 concludes.

2 Literature Review

Fixed-mobile substitution (FMS) can be analyzed on different levels: subscribers, traffic and revenues (ITU, 2010). Hence, empirical research on penetration models as well as studies estimating access or calling demand are relevant for the analysis of FMS (Vogelsang, 2010, p. 8). To analyze the substitutability between products, usually own-and cross-price elasticities are estimated (Taylor, 1994). The following two subsections separately discuss the existing literature on the access and traffic level.

2.1 Access Level

The results concerning FMS on access level (FMAS) show a rather mixed picture. While some studies find fixed and mobile services to be complements at the subscription level, other agree on substitutability.

In their study using data from 1991 to 1998 for 8 South Korean provinces, Sung, Kim, and Lee (2000) find that a 1% increase in the number of mobile phones results in a 0.1-0.2% reduction of fixed line connections. Therefore, they conclude that the two technologies are substitutes on South Korean telecommunications markets.

In contrast, Gruber and Verboven (2001) induce from their study on 140 countries from 1981-1995 that the diffusion of mobile phones tends to be larger in countries with higher fixed network penetration. Thus, they argue that fixed and mobile networks are complements.

Analyzing time series data on fixed and mobile access in Portugal from 1981 until 1999, Barros and Cadima (2001) identify a negative effect of mobile phone diffusion on fixed line penetration rates, but not vice versa. Their results indicate fixed-to-mobile access substitution.

Rodini, Ward, and Woroch (2003) make use of US household survey data for the time period 1999 to 2001. They investigate the substitutability between fixed and mobile access in the USA modeling the consumers wireless and second fixed line subscription decision and applying logit regressions. By estimating own- and cross-price elasticities, they find moderate substitution effects.

Employing annual data on 23 African countries for the time period 1985-1997, Hamilton (2003) shows that fixed and mobile phones in many African countries are still no substitutes. Hamilton argues that the usage of mobile phones does not reduce the demand for fixed line services, but is primarily an improvement in social status.

Based on data from 56 countries between 1995-2000, Madden and Coble-Neal (2004) examine FMS in a dynamic demand model and assess significant substitution effects between mobile and fixed line subscription rates.

Vagliasindi, Güney, and Taubman (2006) observe substitutional relationships between fixed and mobile services for Eastern European countries in 2002. But in contrast to other studies, the authors use a cross section instead of panel data.

Garbacz and Thompson (2007) analyze FMS in 53 low developed countries for 1996-2003 finding asymmetric substitutional effects. While fixed connections tend to be substitutes in the mobile market, mobile phones might be complements in the fixed line market.

Using cross sectional survey data for 2003, Narayana (2008) includes subscription prices as well as usage prices as explanatory variables in his regression and finds that both prices are correlated and that the usage price has, compared to the subscription price, a much larger and more significant effect on the mobile and fixed line subscription. Moreover, Narayana finds much stronger substitutional effects in both directions than other studies.

Heimeshoff (2008) studies FMS on the access level and estimates cross-price elasticities in 30 OECD countries between 1990 and 2003 by applying 2SLS IV estimation. He finds one-way substitution meaning that mobile networks can be a substitute to fixed line services, but not vice versa.

Ward and Woroch (2010) estimate cross-price elasticities between fixed and mobile subscription by making use of the same US household survey as Rodini et al. (2003). In addition, they incorporate data of US low-income subsidy programs (Lifeline Assistance) which cause large changes in the fixed line prices. Although they use the identical survey data, the elasticities found are much larger than those for second fixed lines in Rodini et al. (2003).

Based on data of the European Union for 2006 to 2009, Gryzbowski (2011) structurally estimates the demand for mobile access conditional on having fixed-line access and the demand for fixed-line conditional on having mobile access. He concludes that mobile and fixed line networks are perceived as substitutes in Western European countries and as complements in Central and Eastern Europe.

In our previous paper (Barth and Heimeshoff (2011)), we have estimated the effect of several variables, particularly prices, on the stocks of fixed and mobile subscription rates. Applying dynamic panel approaches and using data of the EU27 from 2003-2009, our results indicate modest substitution effects towards mobile telecommunication networks.

To sum up, studies merely exist for South Korea, Portugal, the USA, and some African and Eastern European countries. In addition, recent papers address FMS in India, the OECD and the European Union. Furthermore, the results are not as clear as expected.

A possible reason might be that the estimation of cross-price elasticities is typically less robust than own-price effects (Bonfrer et al., 2006).
However, the results give some evidence that fixed and mobile services are already perceived to be substitutes in developed countries, but not (yet) in low-income countries. This finding is not surprising as in many African and other low-developed countries an extensive fixed line infrastructure is missing. Thus, mobile phones are often the only possibility of having access to telecommunication services.
Another reason for the different findings could be that the majority of empirical studies uses quite old data, up to 2003 at latest. It is likely that the substitution effects of fixed and mobile networks are much stronger nowadays, e.g. due to further price reductions in mobile markets. Our previous work aims to help filling this research gap by using data until 2009. However, we only find moderate, but highly significant one-way access substitution in favor of mobile networks. But we expect the substitution effects to be much larger on the traffic level. The next subsection will discuss the existing research related to the traffic level.

2.2 Traffic Level

The findings on the traffic level are much clearer. All studies focus on single developed countries and find substitutional effects on the traffic level.
Horvath and Maldoom (2002) study survey data of over 7,000 British telephone users (repeated cross section in three waves: 1999, 2000, 2001) in a simultaneous equations model and additionally estimate some probit regressions. They prove that using mobile phones decreases fixed line usage significantly. Their findings support the conclusion that fixed and mobile phones are substitutes in British telecommunications markets.
By analyzing monthly traffic and revenue data from 1997 to 2002 for South Korea, Yoon and Song (2003) show that fixed and mobile calls are substitutes and fixed-mobile convergence can be observed in South Korea. Sung (2003) reports that mobile calls are substitutes for fixed line toll calls by using Korean regional panel data for 1993-1997. Using traffic data from 1996 to 2002 for South Korean telecommunications markets, Ahn, Lee, and Kim (2004) approve these results.
Ward and Woroch (2004) make again use of the US bill-harvesting data and report comparable effects applying the Almost Ideal Demand System-Model (AIDS) (Deaton and Muellbauer, 1980). They conclude that mobile services are substitutes for fixed

line usage at the traffic level, but not at the access level. However, the effect is only of moderate strength.

Adopting least squares and 2SLS regression based again on the similar US survey data, Ingraham and Sidak (2004) analyze the effect of long-distance fixed line call prices on mobile demand and report a small, but highly significant cross-elasticity of +0.022.

Briglauer et al. (2011) estimate short- and long-run cross-price elasticities for fixed line domestic calling in response to mobile price changes in Austria for 2002-2007. Therefore, they use monthly data on call minutes and take average revenues per minute as price data. While they observe small and sometimes insignificant estimates for short-run elasticities, their results for long-run cross-price elasticities suggest strong substitution effects.

To conclude, there are only a few studies analyzing FMS on the traffic level. Additionally, all paper use, except for Briglauer et al. (2011), again quite old data.

Overall, it can be concluded that there is to the best of our knowledge no empirical study on the traffic level incorporating multiple countries. Using cross sectional data instead of panel data is disadvantageous due to the lacking possibility to control for unobserved heterogeneity. Therefore, results are likely to be biased.

Thus, we would like to extent this strand of literature by using panel data on 16 mainly Western European countries[1] and recent data from 2004 to mid 2010 on quarterly basis. The following sections provide an overview of the dataset and the applied econometric approach of our empirical study.

3 Data

Our dataset consists of the following resources: We use data of the Telecoms Market Matrices of Analysys Mason for the outgoing national fixed line traffic, telecoms usage prices and prepaid customers. Information on penetration rates and the GDP is found in Merill Lynch's Wireless and Wireline Matrices. In addition, data on mobile-only customers comes from the "Eurobarometer: E-Communications Household Surveys". We also incorporate data on fixed-to-mobile and fixed-to-fixed termination rates out of the "Progress Reports on the Single European Electronic Communication Market". The surveys and reports are both provided by the Directorate-General Information Society of the EU Commission. Furthermore, we use the OECD statistics for demographic

[1] The countries in our study are summarized in table 3 in the appendix

information and BEREC's MTR Snapshot for data on mobile termination rates. Table 1 illustrates the descriptive statistics for all variables used in our analysis[2].

Table 1: Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
$traffic_{fix}$	388	11191.74	12317.79	390.80	44919.00
p_{fix}	388	0.07	0.03	0.01	0.15
p_{mob}	388	0.21	0.07	0.09	0.46
$pen_{wireless}$	388	1.13	0.21	0.64	1.86
$pen_{wireline}$	388	0.38	0.11	0.19	0.64
mtr	388	0.13	0.06	0.04	0.31
ftf	352	0.01	0.01	0.00	0.02
ftm	356	0.14	0.06	0.04	0.35
gdp	388	791.25	782.52	145.75	2829.56
$perc_{mobonly}$	388	0.28	0.18	0.00	0.81
$perc_{prepaid}$	388	0.49	0.18	0.07	0.91
$perc_{under40}$	388	0.50	0.02	0.43	0.54
pop	388	28.28	25.38	5.22	82.87
$trend$	388	14.29	7.14	1	26

$Traffic_{fix}$ describes the total amount of national outgoing fixed line voice traffic (in mio.). P_{fix} and p_{mob} represent the prices of fixed and mobile network calls per minute. These prices are constructed by dividing the total voice revenues of all operators in a specific country by the total minutes of usage. $Pen_{wireless}$ and $pen_{wireline}$ refer to the penetration rates of the mobile and fixed line network in a specific country, respectively. Mtr describes the mobile termination rates, ftf the fixed-to-fixed termination rates and ftm the fixed-to-mobile termination rates. The control variable gdp stands for the GDP (in bn.). The variable $perc_{mobonly}$ depicts the percentage of households having mobile, but no fixed line access. $Perc_{prepaid}$ describes the percentage of prepaid contracts and $perc_{under40}$ the percentage of the population aged under 40. Pop measures the population in a specific country (in mio.). $Trend$ is a linear time trend. The time trend can be interpreted as a continuous improvement in the service quality, the increase in the availability of services, and the enhanced network performance as well as decreasing prices (see Grzybowski, 2005). We also incorporate seasonal dummies d_{Q2} - d_{Q4} and quarterly time dummies $d_2 - d_{26}$. All price variables (p_{fix}, p_{mob}, mtr, ftf, ftm and gdp), the population size pop and the fixed line traffic volume $traffic_{fix}$

[2]Additionally, the definition of the variables used can be found in table 4 in the appendix

are measured in logarithms in order to interpret them as elasticities. Furthermore, all price variables are measured in USD adjusted by purchasing power parities to add in international comparison.

4 Model Specification

Our empirical model is based on the Houthakker-Taylor model (also see Dewenter and Haucap (2008)). Following Taylor (1994)[3], we assume that an individual subscriber's demand for telephone calls q depends on the price of a call (π), the price of a substitute (p), the number of the network subscribers (N) and the income of the consumer (μ). Additionally, the demand is driven by K - 4 other factors ($x_{k,t}$) with k $\in [5, K]$ which include the number of the subscribers in other networks, the age of the subscriber and the type of the contract.

Let q_t^* denotes the desired number of calls during period t for given prices, level of subscribers, income and other variables. Thus, we postulate:

$$q_t^* = \alpha_0 + \alpha_1 \pi_t + \alpha_2 p_t + \alpha_3 N_t + \alpha_4 \mu_t + \sum_{k=5}^{k=K} \alpha_k x_{k,t}. \quad (1)$$

Now, q_t denotes the actual number of calls made during the period. It is assumed that whenever q and q^* diverge, a proportion of θ is eliminated within each period. In particular:

$$q_t - q_{t-1} = \theta(q_t^* - q_{t-1}), \quad (2)$$

where: $0 < \theta \leq 1$.

After some rearrangement, we obtain:

$$q_t = \alpha_0 \theta + (1-\theta) q_{t-1} + \alpha_1 \theta \pi_t + \alpha_2 \theta p_t + \alpha_3 \theta N_t + \alpha_4 \theta \mu_t + \sum_{k=5}^{k=K} \alpha_k \theta x_{k,t}. \quad (3)$$

[3]Taylor (1994) expects the individual subscriber's demand to also depend on the price of access to a telephone network. Unfortunately, we do not have information on access prices in our dataset. However, Briglauer et al. (2011) find that access prices are not significant in their demand estimation for calls. Furthermore, they conclude that their results are robust applying 3 different specifications which include 1) access plus call prices 2) only call prices or 3) average prices. Hence, it is reasonable to assume that the lacking access prices will not cause significant biases in our estimation.

From equation (3), we infer that the one-period effect of a marginal change in variable i on q is equal to $\alpha_i\theta$. Thus, the short- and long-run derivatives of q with respect to the variable i are equal to $\alpha_i\theta$ and α_i.
Looking at the full system of subscribers, we postulate for the aggregate demand for calls:

$$Q_t - Q_{t-1} = \psi(Q_t^* - Q_{t-1}).$$

Similarly to equation (1), we assume:

$$Q_t^* = \alpha_0 + \alpha_1\pi_t + \alpha_2 p_t + \alpha_3 N_t + \alpha_4 Y_t + \sum_{k=5}^{k=K} \alpha_k x_{k,t},$$

where Y_t denotes the aggregated income. Consequently, we formulate:

$$Q_t = \alpha_0\psi + (1-\psi)Q_{t-1} + \alpha_1\psi\pi_t + \alpha_2\psi p_t + \alpha_3\psi N_t + \alpha_4\psi Y_t + \sum_{k=5}^{k=K} \alpha_k\psi x_{k,t}.$$

Taking the panel structure of our data into account, our equation studies the effects of certain variables on the national outgoing fixed line voice traffic.

$$\begin{aligned} traffic_{fix_{it}} &= \alpha_0\psi + (1-\psi)traffic_{fix_{it-1}} + \alpha_1\psi p_{fix_{it}} + \alpha_2\psi p_{mob_{it}} + \alpha_3\psi pen_{wireline_{it}} \\ &+ \alpha_4\psi gdp_{it} + \sum_{k=5}^{k=K} \alpha_k\psi x_{k,it} + \epsilon_{it} \end{aligned}$$

We expect $traffic_{fix_{it-1}}$ to have a positive influence on the current fixed line voice traffic volume for the simple reason that if the voice volumes were higher in the last quarter, it will be higher today due to consumer habits. We assume that the fixed line usage depends on the current fixed line price. We expect the own-price elasticity to have a negative impact on the fixed line usage, meaning that an increase in the own price leads to a decrease in the voice traffic volumes. In order to find substitutional effects, the current mobile price $p_{mob_{it}}$ must have a positive effect on $traffic_{fix}$. The network effects measured by $pen_{wireline_{it}}$ and the gpd are assumed to have an positive influence. The term $x_{k,it}$ includes all additional explanatory variables such as the wireless penetration rate and the population size. Additionally, the percentage of the population aged under 40, the percentage of mobile-only and of prepaid customers are included in our regression. ϵ_{it} is an error term and α and the βs are parameters to be estimated.

Due to the structure of our panel dataset, the well-known Arellano-Bond-estimator is not applicable, because it is designed for short panels characterized by a large cross section dimension. Applying extensive simulation studies, Judson and Owen (1999) show that it is reasonable to apply standard fixed effects techniques for long panels, whereas the Arellano-Bond GMM-type estimator may be seriously biased in panels characterized by long time dimensions. We follow their suggestions and estimate a dynamic fixed effects panel model using the Newey-West-procedure to avoid distortions in standard errors due to autocorrelation and hetereoskedasticity (see Wooldridge, 2010, p. 310-315).

Preventing spurious regressions, we apply panel unit root tests for all variables in our data set. We find that only the variables $pen_{wireless}$, $pen_{wireline}$, ftf, gdp and $perc_{mobonly}$ are non-stationary and all integrated of order one. Hence, cointegration relationships cannot be present in our dataset, because our dependent variable $traffic_{fix}$ on the left hand site is I(0).[4] As will be discussed in the next section, we also take possible endogeneity problems into account by using instrumental variable techniques.

5 Empirical Results

To solve possible endogeneity problems, we instrument the first lag of our dependent variable, the penetration rates and the usage prices. Hence, we use further lags of the variables as well as termination rates as instruments. Termination rates are an important (variable) cost factor for the operators which occur particularly for off-net calls. The national regulatory authorities in each country determine the termination charges which can therefore be considered as exogenous. This assumption can be criticized as the decision of the regulator may be affected by other factors such as changes in volumes. Nevertheless, termination rates are the only cost shifter which directly influences the variable costs and can be observed by econometricians. By applying overidentification tests, we test for the exogeneity of our instruments and we cannot reject the null hypothesis stating exogeneity of our instruments. We lag all termination

[4]For further information see Hamilton (1994). The corresponding test statistics can be found in table 5 of the appendix

rates by one quartal since reductions in termination rates are not directly passed on to the customers (Briglauer et al., 2011, p. 13). Table 2 illustrates our results using a linear time trend (column 2) or quarterly time dummies (column 3).[5,6]

For both regressions, we identify statistically significant effects at a 5% or higher significance level from the lagged national outgoing fixed line traffic ($traffic_{fix_{it-1}}$), the current fixed line price ($p_{fix_{it}}$), the current mobile price ($p_{mob_{it}}$), the percentage of mobile-only users ($perc_{mobonly_{it}}$) and the percentage of prepaid customers ($perc_{prepaid_{it}}$). All significant variables have the expected signs.

Regarding the second column: The lag of the national outgoing fixed line traffic volume has a large positive effect (+ 0.7062) on the current traffic volume which is significant at a 1% significance level. The own-price elasticity is negative as expected. In the short run, an 1% increase in the fixed line price leads to a 0.1378% decrease in the traffic volume, whereas the traffic volume declines by 0.1378/(1 - 0.7062) $\approx$ 0.4692% in the long run. The cross-price elasticity is positive: A decrease in the current mobile price ($p_{mob_{it}}$) causes a decrease in the fixed line traffic volume. In the short run, a 1% reduction of the mobile price indicates a 0.1250% decline in the fixed line traffic volume. In the long run, the cross-price elastictity is given by (0.1250/(1 - 0.7062) $\approx$ 0.4254. One should note that this finding is a quite strong indicator of fixed-mobile substitution on the traffic level, especially in the long run. In addition, the percentages of the population using only mobile services and/or prepaid contracts have the expected negative effect on the current fixed line traffic. The results are robust when using time dummies instead of a linear trend (column 3).

Overall, our findings provide evidence for short- and long-run fixed-mobile call substitution. The effects found are larger than in other studies. The main reason might be the actuality of our dataset. In addition, we apply the Sargan/Hansen's j test. With p-values of 0.5668 and 0.6666, we cannot reject the null hypothesis stating the validity of our specifications. The following section concludes.

[5] The first stage F-statistics and the corresponding p-values can be found in table 6 in the appendix. Furthermore, the pairwise correlations between all variables used are summarized in table 8.

[6] We also estimate our model without penetration rates. The results can be found in table 7 in the appendix.

Table 2: Empirical Results

Variable	with time trend	with time dummies
$traffic_{fix_{it-1}}$	0.7062***	0.6587***
	(0.0921)	(0.0995)
$p_{fix_{it}}$	- 0.1378**	- 0.1661**
	(0.0624)	(0.0661)
$p_{mob_{it}}$	0.1250**	0.1256***
	(0.0520)	(0.0483)
$pen_{wireless_{it}}$	0.1137	0.1566*
	(0.0939)	(0.0928)
$pen_{wireline_{it}}$	0.1755	0.0843
	(0.2328)	(0.2092)
gdp_{it}	- 0.0321	- 0.1407
	(0.0708)	(0.0935)
$perc_{mobonly_{it}}$	- 0.3036***	- 0.3559***
	(0.1043)	(0.1085)
$perc_{prepaid_{it}}$	- 0.3922**	- 0.5212***
	(0.1766)	(0.1813)
$perc_{under40_{it}}$	- 2.2370	- 1.2126
	(1.6979)	(1.4815)
pop_{it}	- 0.0424	- 0.4778
	(0.5719)	(0.6148)
d_{Q2}	- 0.0331***	
	(0.0054)	
d_{Q3}	- 0.0626***	
	(0.0078)	
d_{Q4}	0.0639***	
	(0.0134)	
trend	- 0.0059*	
	(0.0033)	
time dummies	no	yes
ψ	0.2938	0.3413
R^2	0.9399	0.9465
N	275	275
Hansen's j	2.0270	1.5690
p-value	0.5668	0.6664

$*$,$**$,$***$ indicate statistically significant on the 10%-, 5%-, and 1%-level
Heteroscedasticity robust standard errors in parenthesis

6 Conclusion

Our paper analyses FMCS in 16 mainly Western European countries employing quarterly data from 2004 to mid 2010. We use fixed line voice traffic volumes in each country and estimate the effects of the fixed and mobile prices on the national outgoing fixed line voice traffic volume. Due to our dynamic setup, we are able to estimate short- and long-run elasticities. We find the own-price elasticities to be in a range between -0.1378 and -0.1661 in the short run, and between -0.4692 and -0.4867 in the long run. The cross-price elasticities of the mobile price are lower within the range of +0.1250 and +0.1256 in the short run and between +0.4254 and +0.3680 in the long run. Possible endogeneity problems in our econometric model are solved by instrumenting prices and penetration rates with own lags and a set of different termination rates. Our elasticities are all statistically significant on a 5% significance level and diverge from other papers analyzing cross elasticities for fixed line call demand. Ingragam and Sidak (2004) report a small, but significant cross-price elasticity of +0.022. Ward and Woroch (2004) find cross-elasticities to lie in between +0.22 and +0.33. Briglauer et al. (2011) find no significant short-run cross-price elasticity, but the long-run cross-price elasticity is with +0.50 almost equally large compared to our findings. To sum up, our study supports the general assumption that fixed-mobile call substitution is prevailing with time.

Our results have an ample impact with regard to regulation. Although we show that fixed and mobile markets are converging and becoming closer substitutes, regulatory obligations in the two markets are still quite different. In conjunction with the estimation results the suitability of the definition of separate fixed and mobile markets in the current European regulatory framework may need to be reconsidered for future telecommunications regulation.

References

[1] Ahn, Hyungtaik, Jonghwa Lee, and Yongkyu Kim (2004): Estimation of a Fixed-Mobile Substitution Model in Korean Voice Telephony Markets, Working Paper, Seoul.

[2] Analysys Mason (2011a): Telecoms Market Matrix - Western Europe, London.

[3] Analysys Mason (2011b): Telecoms Market Matrix - Central and Eastern Europe, London.

[4] Barros, Pedro Pita and Nuno Cadima (2001): The impact of mobile phone diffusion on the fixed-link network, Working Paper, Lisboa.

[5] Barth, Anne-Kathrin and Ulrich Heimeshoff (2011): Does the growth of mobile markets cause the demise of fixed networks? Evidence from the European Union, DICE Discussion Paper, Vol. 42, Duesseldorf.

[6] BEREC (2010): MTR Benchmark Snapshot, BoR (10)30 Rev1, Latvia.

[7] Bonfrer, Andre, Ernst R. Berndt, and Alvin Silk (2006): Anomalies in Estimates of Cross-Price Elasticities for Marketing Mix Models: Theory and Empirical Test. NBER Working Paper 12756, Cambridge, USA.

[8] Briglauer, Wolfgang, Anton Schwarz, and Christine Zulehner (2011): Is Fixed-Mobile Substitution strong enough to de-regulate Fixed Voice Telephony? Evidence from the Austrian Markets, in: Journal of Regulatory Economics, Vol. 39, 50-67.

[9] Deaton, Angus S. and John Muellbauer (1980): An Almost Ideal Demand System, in: American Economic Review, Vol. 70(3), 312-26.

[10] Dewenter, Ralf and Justus Haucap (2008): Demand Elasticities for Mobile Telecommunications in Austria, in: Journal of Economics and Statistics (Jahrbuecher fuer Nationaloekonomie und Statistik), Vol. 228(1), 49-63.

[11] EU Commission (2010a): E-Communications Household Survey Report, Brussels.

[12] EU Commission (2010b): Progress Report on the Single European Electronic Communications Market 2009 (15th Report), Volume 2, Brussels.

[13] Garbacz, Christopher and Herbert G. Thompson (2007): Demand for telecommunication services in developing countries, in: Telecommunications Policy, Vol. 31, 276-289.

[14] Gruber, Harald (2005): The Economics of Mobile Telecommunications, Cambridge University Press: Cambridge.

[15] Gruber, Harald and Frank Verboven (2001): The evolution of markets under entry and standard regulation - the case of global mobile telecommunications, in: International Journal of Industrial Organization, Vol. 19, p. 1189-1212.

[16] Grzybowski, Lukasz (2005): Regulation of Mobile Telephony across the European Union: An Empirical Analysis, in: Journal of Regulatory Economics, Vol. 28, 47-67.

[17] Grzybowski, Lukasz (2011): Fixed-to-Mobile Substitution in the European Union, Working Paper, University of Cape Town, South Africa.

[18] Hamilton, Jacqueline (2003): Are Main Lines and Mobile Phones Substitutes or Complements? Evidence from Africa, in: Telecommunications Policy, Vol. 27, 109-133.

[19] Hamilton, James D. (1994): Time Series Analysis, Princeton University Press, Princeton.

[20] Haucap, Justus (2003): The Economics of Mobile Telephone Regulation, Discussion Paper, Hamburg.

[21] Hausman, Jerry (2002): Mobile Telephone, in: Cave, Martin, Sumit Majumdar and Ingo Vogelsang (Eds.) (2002): Handbook of Telecommunications Economics, Vol. 1, Elsevier: Amsterdam et al., 564-604.

[22] Heimeshoff, Ulrich (2008): Fixed-Mobile-Substitution in OECD Countries: An Empirical Analysis on the Subscriber Level, 137-158, Unpublished Dissertation, Friedrich-Alexander University Erlangen-Nuernberg, Nuernberg.

[23] Horvath, Reka and Dan Maldoom (2002): Fixed-Mobile Substitution: A Simultaneous Equation Model with Qualitative and Limited Dependent Variables, DotEcon DP No. 02/02.

[24] Ingraham, Allan T. and J. Gregory Sidak (2004): Do States Tax Wireless Services Inefficiently? Evidence on the Price Elasticity of Demand, in: Virginia Tax Review, Vol. 24, 249-261.

[25] International Telecommunication Society (ITU) (2010). World Telecommunication/ICT Indicators Database (13th Edition). Geneva.

[26] Judson, Ruth A. and Ann L. Owen (1999): Estimating dynamic panel data models. A guide for macroeconomists, in: Economics Letters, Vol. 65, 9-15.

[27] Laffont, Jean-Jacques and Jean Tirole (2000): Competition in Telecommunications, MIT Press: Cambridge, MA.

[28] Madden, Gary and Grant Coble-Neal (2004): Economic determinants of global mobile telephony growth, in: Information Economics and Policy, Vol. 16, 519-534.

[29] Merrill Lynch (2011a): Global Wireless Matrix, USA.

[30] Merrill Lynch (2011b): Global Wireline Matrix, USA.

[31] Narayana, Muttur Ranganathan (2008): Substituability between Mobile and Fixed Telephones: Evidence and Implications for India, CIRJE Discussion Paper, Tokyo.

[32] OECD (2011): OECD statistics, OECD Publishing , Paris.

[33] Rodini, Mark, Michael R. Ward, and Glen A. Woroch (2003): Going Mobile: Substitutability between Fixed and Mobile Access, in Telecommunications Policy, Vol. 27, 457-476.

[34] Sung, Nakil (2003): Fixed-Mobile Call Substitution: Evidence from Korean Long-Distance Markets, Working Paper, University of Seoul, Seoul.

[35] Sung, Nakil, Chang-Gun Kim, and Yong-Hun Lee (2000): Is a POTS Dispensable? Substitution Effects Between Mobile and Fixed Telephones in Korea, Working Paper, Seoul.

[36] Taylor, Lester D. (1994): Telecommunication Demand in Theory and Practice, Kluwer: Dordrecht et al.

[37] Vagliasindi, Maria, Izzet Güney, and Chris Taubman (2006): Fixed and Mobile Competition in Transition Economies, in: Telecommunications Policy, Vol. 30, 349-367.

[38] Vogelsang, Ingo (2010): The relationship between mobile and fixed line communications. A survey, in: Information Economics and Policy, Vol. 22, 4-17.

[39] Ward, Michael R. and Glen A. Woroch (2004): Usage Substitution between Mobile Telephone and Fixed Line in the US, Working Paper, Arlington.

[40] Ward, Michael R. and Glen A. Woroch (2010): The effect of prices on fixed and mobile telephone penetration: Using price subsidies as natural experiment, in: Information Economics and Policy, Vol. 22, 2010, p. 18-32.

[41] White, H.,1980, A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity, Econometrica, 48, 817-838.

[42] Wooldridge, Jeffrey M. (2010): Econometric Analysis of Cross Section and Panel Data, MIT Press: Cambridge, MA, 2 Ed.

[43] Yoon, Chang-Ho and Young-Woong Song (2003): Telecom Development in Korea: Substitution and Integration of Fixed-Mobile Services and Regulatory Implications, in: Communications & Strategies, Vol. 5, 257-270.

7 Appendix

Table 3: Countries included in the empirical study

Country	Period	Country	Period
Austria	Q1 2005 - Q2 2010	Hungary	Q1 2005 - Q2 2010
Belgium	Q1 2004 - Q2 2010	Italy	Q1 2005 - Q2 2010
Czech Republic	Q1 2005 - Q2 2010	Netherlands	Q1 2005 - Q2 2010
Denmark	Q1 2005 - Q2 2010	Poland	Q1 2005 - Q2 2010
Finland	Q1 2004 - Q2 2010	Portugal	Q1 2004 - Q2 2010
France	Q1 2004 - Q2 2010	Spain	Q1 2004 - Q2 2010
Germany	Q1 2004 - Q2 2010	Sweden	Q1 2004 - Q2 2010
Greece	Q1 2004 - Q2 2010	UK	Q1 2004 - Q2 2010

Table 4: Definition of the variables used

Variable	Description of variables
$traffic_{fix}$	National outgoing fixed line voice traffic volume (in mio.)
p_{fix}	Fixed line price per minute calculated as fixed line voice revenue (without interconnect payments) divided by total outgoing fixed line traffic, given in USD PPP
p_{mob}	Mobile price per minute calculated as mobile voice revenue (without interconnect payments) divided by total outgoing mobile traffic, given in USD PPP
$pen_{wireless}$	Mobile penetration rate
$pen_{wireline}$	Fixed line pentration rate
mtr	Mobile termination rates, given in USD PPP
ftf	Fixed-to-fixed termination rates, given in USD PPP
ftm	Fixed-to-mobile termination rates, given in USD PPP
gdp	Gross national product, given in USD PPP (in bn.)
$perc_{mobonly}$	Percentage of the population using only mobile, but no fixed line telephony
$perc_{prepaid}$	Percentage of prepaid customers among all mobile subscribers (excludes customers who have not used their mobile account for more than three months)
$perc_{under40}$	Percentage of the population aged under 40
pop	Population (in mio.)

Table 5: Maddala - Wu Unit Root Tests

Variable	Test statistic & p-value	Variable	Test statistic & p-value
$traffic_{fix}$		ftf	
χ^2	164.1328	χ^2	16.5843
$Prob > \chi^2$	0.0000	$Prob > \chi^2$	0.9888
p_{fix}		ftm	
χ^2	101.7945	χ^2	57.0201
$Prob > \chi^2$	0.0000	$Prob > \chi^2$	0.0042
p_{mob}		gdp	
χ^2	69.9723	χ^2	10.1392
$Prob > \chi^2$	0.0001	$Prob > \chi^2$	0.9999
$pen_{wireless}$		$perc_{mobonly}$	
χ^2	14.1420	χ^2	41.7303
$Prob > \chi^2$	0.9973	$Prob > \chi^2$	0.1165
$pen_{wireline}$		$perc_{prepaid}$	
χ^2	26.0979	χ^2	58.9761
$Prob > \chi^2$	0.7593	$Prob > \chi^2$	0.0025
mtr		$perc_{under40}$	
χ^2	63.8101	χ^2	182.6028
$Prob > \chi^2$	0.0007	$Prob > \chi^2$	0.0000
pop			
χ^2	76.1572		
$Prob > \chi^2$	0.0000		

Table 6: Instrumental variables: 1st Stage F-statisics and p-values

Variable	F-statistic	P-value
Regression with linear time trend (column 2)		
$traffic_{fix_{it-1}}$	74.83	0.0000
$p_{fix_{it}}$	38.03	0.0000
$p_{mob_{it}}$	37.32	0.0000
$pen_{wireless_{it}}$	30.49	0.0000
$pen_{wireline_{it}}$	76.85	0.0000
Regression with time dummies (column 3)		
$traffic_{fix_{it-1}}$	66.50	0.0000
$p_{fix_{it}}$	36.47	0.0000
$p_{mob_{it}}$	40.71	0.0000
$pen_{wireless_{it}}$	31.46	0.0000
$pen_{wireline_{it}}$	69.91	0.0000

Table 7: Empirical Results without penetration rates

Variable	with time trend	with time dummies
$traffic_{fix_{it-1}}$	0.7927***	0.7621***
	(0.0665)	(0.075)
$p_{fix_{it}}$	- 0.0920**	- 0.1046**
	(0.0469)	(0.0501)
$p_{mob_{it}}$	0.0860**	0.0916**
	(0.0417)	(0.0423)
gdp_{it}	0.0138	0.1034
	(0.0678)	(0.0897)
$perc_{mobonly_{it}}$	- 0.2561***	- 0.2782***
	(0.0940)	(0.0947)
$perc_{prepaid_{it}}$	- 0.2510*	- 0.3378**
	(0.1348)	(0.1433)
$perc_{under40_{it}}$	- 2.6886**	- 2.4674**
	(1.2567)	(1.1427)
pop_{it}	- 0.2320	- 0.8232
	(0.4972)	(0.5595)
d_{Q2}	- 0.0348***	
	(0.0055)	
d_{Q3}	- 0.0595***	
	(0.0081)	
d_{Q4}	0.0748***	
	(0.0104)	
trend	- 0.0042**	
	(0.0020)	
time dummies		yes
R^2	0.9384	0.9435
N	284	284
Hansen's j	0.7779	0.0044
p-value	0.3778	0.9474

$*,**,***$ indicate statistically significant on the 10%-, 5%-, and 1%-level
Heteroscedasticity robust standard errors in parenthesis

Table 8: Pairwise Correlation

	$traffic_{fix}$	p_{fix}	p_{mob}	$pen_{wireless}$
$traffic_{fix}$	1.0000			
p_{fix}	0.4863*	1.0000		
p_{mob}	0.1033*	0.4369*	1.0000	
$pen_{wireless}$	- 0.1090*	- 0.0489	- 0.4651*	1.0000
$pen_{wireline}$	0.4522*	- 0.5514*	- 0.0249	- 0.3896*
gdp	0.9788*	- 0.4640*	0.0423	- 0.0808
$perc_{mobonly}$	- 0.4930*	0.5492*	- 0.1783*	0.2490*
$perc_{prepaid}$	0.1704*	0.3853*	0.4435*	0.1688*
$perc_{under40}$	- 0.2938*	0.4582*	0.2834*	- 0.4698*
pop	0.9561*	- 0.3646*	0.1078*	- 0.1170*
	$pen_{wireline}$	**gdp**	**$perc_{mobonly}$**	**$perc_{prepaid}$**
$pen_{wireline}$	1.0000			
gdp	0.3648*	1.0000		
$perc_{mobonly}$	- 0.6993*	- 0.4279*	1.0000	
$perc_{prepaid}$	- 0.1107*	0.1448*	- 0.0910	1.0000
$perc_{under40}$	0.1142*	- 0.2873*	0.0311	0.0349
pop	0.2954*	0.9728*	- 0.3823*	0.2151*
	$perc_{under40}$	**pop**		
$perc_{under40}$	1.0000			
pop	- 0.2014*	1.0000		

* significant on 5% level or higher

PREVIOUS DISCUSSION PAPERS

49 Barth, Anne-Kathrin and Heimeshoff, Ulrich, How Large is the Magnitude of Fixed-Mobile Call Substitution? - Empirical Evidence from 16 European Countries, April 2012.

48 Herr, Annika and Suppliet, Moritz, Pharmaceutical Prices under Regulation: Tiered Co-payments and Reference Pricing in Germany, April 2012.

47 Haucap, Justus and Müller, Hans Christian, The Effects of Gasoline Price Regulations: Experimental Evidence, April 2012.

46 Stühmeier, Torben, Roaming and Investments in the Mobile Internet Market, March 2012.
Forthcoming in: Telecommunications Policy.

45 Graf, Julia, The Effects of Rebate Contracts on the Health Care System, March 2012.

44 Pagel, Beatrice and Wey, Christian, Unionization Structures in International Oligopoly, February 2012.

43 Gu, Yiquan and Wenzel, Tobias, Price-Dependent Demand in Spatial Models, January 2012.

42 Barth, Anne-Kathrin and Heimeshoff, Ulrich, Does the Growth of Mobile Markets Cause the Demise of Fixed Networks? – Evidence from the European Union, January 2012.

41 Stühmeier, Torben and Wenzel, Tobias, Regulating Advertising in the Presence of Public Service Broadcasting, January 2012.
Forthcoming in: Review of Network Economics.

40 Müller, Hans Christian, Forecast Errors in Undisclosed Management Sales Forecasts: The Disappearance of the Overoptimism Bias, December 2011.

39 Gu, Yiquan and Wenzel, Tobias, Transparency, Entry, and Productivity, November 2011.
Published in: Economics Letters, 115 (2012), pp. 7-10.

38 Christin, Clémence, Entry Deterrence Through Cooperative R&D Over-Investment, November 2011.

37 Haucap, Justus, Herr, Annika and Frank, Björn, In Vino Veritas: Theory and Evidence on Social Drinking, November 2011.

36 Barth, Anne-Kathrin and Graf, Julia, Irrationality Rings! – Experimental Evidence on Mobile Tariff Choices, November 2011.

35 Jeitschko, Thomas D. and Normann, Hans-Theo, Signaling in Deterministic and Stochastic Settings, November 2011.
Forthcoming in: Journal of Economic Behavior and Organization.

34 Christin, Cémence, Nicolai, Jean-Philippe and Pouyet, Jerome, The Role of Abatement Technologies for Allocating Free Allowances, October 2011.

33 Keser, Claudia, Suleymanova, Irina and Wey, Christian, Technology Adoption in Markets with Network Effects: Theory and Experimental Evidence, October 2011.

32 Catik, A. Nazif and Karaçuka, Mehmet, The Bank Lending Channel in Turkey: Has it Changed after the Low Inflation Regime?, September 2011.
Forthcoming in: Applied Economics Letters.

31 Hauck, Achim, Neyer, Ulrike and Vieten, Thomas, Reestablishing Stability and Avoiding a Credit Crunch: Comparing Different Bad Bank Schemes, August 2011.

30 Suleymanova, Irina and Wey, Christian, Bertrand Competition in Markets with Network Effects and Switching Costs, August 2011.
Published in: B.E. Journal of Economic Analysis & Policy, 11 (2011), Article 56.

29 Stühmeier, Torben, Access Regulation with Asymmetric Termination Costs, July 2011.

28 Dewenter, Ralf, Haucap, Justus and Wenzel, Tobias, On File Sharing with Indirect Network Effects Between Concert Ticket Sales and Music Recordings, July 2011.
Forthcoming in: Journal of Media Economics.

27 Von Schlippenbach, Vanessa and Wey, Christian, One-Stop Shopping Behavior, Buyer Power, and Upstream Merger Incentives, June 2011.

26 Balsmeier, Benjamin, Buchwald, Achim and Peters, Heiko, Outside Board Memberships of CEOs: Expertise or Entrenchment?, June 2011.

25 Clougherty, Joseph A. and Duso, Tomaso, Using Rival Effects to Identify Synergies and Improve Merger Typologies, June 2011.
Published in: Strategic Organization, 9 (2011), pp. 310-335.

24 Heinz, Matthias, Juranek, Steffen and Rau, Holger A., Do Women Behave More Reciprocally than Men? Gender Differences in Real Effort Dictator Games, June 2011.
Forthcoming in: Journal of Economic Behavior and Organization.

23 Sapi, Geza and Suleymanova, Irina, Technology Licensing by Advertising Supported Media Platforms: An Application to Internet Search Engines, June 2011.
Published in: B. E. Journal of Economic Analysis & Policy, 11 (2011), Article 37.

22 Buccirossi, Paolo, Ciari, Lorenzo, Duso, Tomaso, Spagnolo Giancarlo and Vitale, Cristiana, Competition Policy and Productivity Growth: An Empirical Assessment, May 2011.

21 Karaçuka, Mehmet and Catik, A. Nazif, A Spatial Approach to Measure Productivity Spillovers of Foreign Affiliated Firms in Turkish Manufacturing Industries, May 2011.
Forthcoming in: The Journal of Developing Areas.

20 Catik, A. Nazif and Karaçuka, Mehmet, A Comparative Analysis of Alternative Univariate Time Series Models in Forecasting Turkish Inflation, May 2011.
Forthcoming in: Journal of Business Economics and Management.

19 Normann, Hans-Theo and Wallace, Brian, The Impact of the Termination Rule on Cooperation in a Prisoner’s Dilemma Experiment, May 2011.
Forthcoming in: International Journal of Game Theory.

18 Baake, Pio and von Schlippenbach, Vanessa, Distortions in Vertical Relations, April 2011.
Published in: Journal of Economics, 103 (2011), pp. 149-169.

17 Haucap, Justus and Schwalbe, Ulrich, Economic Principles of State Aid Control, April 2011.
Forthcoming in: F. Montag & F. J. Säcker (eds.), European State Aid Law: Article by Article Commentary, Beck: München 2012.

16 Haucap, Justus and Heimeshoff, Ulrich, Consumer Behavior towards On-net/Off-net Price Differentiation, January 2011.
Published in: Telecommunication Policy, 35 (2011), pp. 325-332.

15 Duso, Tomaso, Gugler, Klaus and Yurtoglu, Burcin B., How Effective is European Merger Control? January 2011.
Published in: European Economic Review, 55 (2011), pp. 980-1006.

14 Haigner, Stefan D., Jenewein, Stefan, Müller, Hans Christian and Wakolbinger, Florian, The First shall be Last: Serial Position Effects in the Case Contestants evaluate Each Other, December 2010.
Published in: Economics Bulletin, 30 (2010), pp. 3170-3176.

13 Suleymanova, Irina and Wey, Christian, On the Role of Consumer Expectations in Markets with Network Effects, November 2010.
Published in: Journal of Economics, 105 (2012), pp. 101-127.

12 Haucap, Justus, Heimeshoff, Ulrich and Karaçuka, Mehmet, Competition in the Turkish Mobile Telecommunications Market: Price Elasticities and Network Substitution, November 2010.
Published in: Telecommunications Policy, 35 (2011), pp. 202-210.

11 Dewenter, Ralf, Haucap, Justus and Wenzel, Tobias, Semi-Collusion in Media Markets, November 2010.
Published in: International Review of Law and Economics, 31 (2011), pp. 92-98.

10 Dewenter, Ralf and Kruse, Jörn, Calling Party Pays or Receiving Party Pays? The Diffusion of Mobile Telephony with Endogenous Regulation, October 2010.
Published in: Information Economics and Policy, 23 (2011), pp. 107-117.

09 Hauck, Achim and Neyer, Ulrike, The Euro Area Interbank Market and the Liquidity Management of the Eurosystem in the Financial Crisis, September 2010.

08 Haucap, Justus, Heimeshoff, Ulrich and Luis Manuel Schultz, Legal and Illegal Cartels in Germany between 1958 and 2004, September 2010.
Published in: H. J. Ramser & M. Stadler (eds.), Marktmacht. Wirtschaftswissenschaftliches Seminar Ottobeuren, Volume 39, Mohr Siebeck: Tübingen 2010, pp. 71-94.

07 Herr, Annika, Quality and Welfare in a Mixed Duopoly with Regulated Prices: The Case of a Public and a Private Hospital, September 2010.
Published in: German Economic Review, 12 (2011), pp. 422-437.

06 Blanco, Mariana, Engelmann, Dirk and Normann, Hans-Theo, A Within-Subject Analysis of Other-Regarding Preferences, September 2010.
Published in: Games and Economic Behavior, 72 (2011), pp. 321-338.

05 Normann, Hans-Theo, Vertical Mergers, Foreclosure and Raising Rivals' Costs – Experimental Evidence, September 2010.
Published in: The Journal of Industrial Economics, 59 (2011), pp. 506-527.

04 Gu, Yiquan and Wenzel, Tobias, Transparency, Price-Dependent Demand and Product Variety, September 2010.
Published in: Economics Letters, 110 (2011), pp. 216-219.

03 Wenzel, Tobias, Deregulation of Shopping Hours: The Impact on Independent Retailers and Chain Stores, September 2010.
Published in: Scandinavian Journal of Economics, 113 (2011), pp. 145-166.

02 Stühmeier, Torben and Wenzel, Tobias, Getting Beer During Commercials: Adverse Effects of Ad-Avoidance, September 2010.
Published in: Information Economics and Policy, 23 (2011), pp. 98-106.

01 Inderst, Roman and Wey, Christian, Countervailing Power and Dynamic Efficiency, September 2010.
Published in: Journal of the European Economic Association, 9 (2011), pp. 702-720.

Heinrich-Heine-University of Düsseldorf

Düsseldorf Institute for
Competition Economics (DICE)

Universitätsstraße 1 _ 40225 Düsseldorf
www.dice.hhu.de

ISSN 2190-9938 (online)
ISBN 978-3-86304-048-2