

Haucap, Justus; Heimeshoff, Ulrich; Lange, Mirjam R. J.

Working Paper

The impact of tariff diversity on broadband diffusion: An empirical analysis

DICE Discussion Paper, No. 156

Provided in Cooperation with:

Düsseldorf Institute for Competition Economics (DICE), Heinrich Heine University Düsseldorf

Suggested Citation: Haucap, Justus; Heimeshoff, Ulrich; Lange, Mirjam R. J. (2014) : The impact of tariff diversity on broadband diffusion: An empirical analysis, DICE Discussion Paper, No. 156, ISBN 978-3-86304-155-7, Heinrich Heine University Düsseldorf, Düsseldorf Institute for Competition Economics (DICE), Düsseldorf

This Version is available at:

<https://hdl.handle.net/10419/100086>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

DISCUSSION PAPER

No 156

The Impact of Tariff Diversity on Broadband Diffusion – An Empirical Analysis

Justus Haucap,
Ulrich Heimeshoff,
Mirjam R. J. Lange

August 2014

IMPRINT

DICE DISCUSSION PAPER

Published by

düsseldorf university press (dup) on behalf of
Heinrich-Heine-Universität Düsseldorf, Faculty of Economics,
Düsseldorf Institute for Competition Economics (DICE), Universitätsstraße 1,
40225 Düsseldorf, Germany
www.dice.hhu.de

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

All rights reserved. Düsseldorf, Germany, 2014

ISSN 2190-9938 (online) – ISBN 978-3-86304-155-7

The working papers published in the Series constitute work in progress circulated to stimulate discussion and critical comments. Views expressed represent exclusively the authors' own opinions and do not necessarily reflect those of the editor.

The Impact of Tariff Diversity on Broadband Diffusion - An Empirical Analysis

Justus Haucap* Ulrich Heimeshoff † Mirjam R. J. Lange ‡

August 2014

Abstract

This paper provides an empirical analysis how tariff diversity affects fixed-line broadband uptake, utilizing a new data set with 1497 fixed-line and 2158 mobile broadband tariffs from 91 countries across the globe. An instrumental variable approach is applied to estimate demand, controlling for various industry and socio-economic factors. The empirical results indicate that, firstly, lower prices, more tariff diversity and higher income increase broadband penetration. Secondly, inter-platform competition and mobile broadband prices are not found to have a significant effect on fixed-line broadband penetration. This suggests that low prices and the diversity of broadband offerings are more important drivers of fixed broadband adoption than competition between various technologies (cable networks, fixed-line telephone networks, mobile networks).

JEL Classification numbers: L86, L96.

Keywords: Broadband prices; Tariff diversity; Broadband demand; Broadband penetration, Broadband uptake; Price discrimination; Inter-platform competition

*Heinrich-Heine-University of Düsseldorf, Düsseldorf Institute for competition Economics (DICE), Universitätsstr. 1, 40225 Düsseldorf, Germany.

E-Mail: haucap@dice.hhu.de.

† E-Mail: heimeshoff@dice.hhu.de.

‡ E-Mail: lange@dice.hhu.de.

We are grateful to the participants of the DICE PhD Seminar and the 2014 ITS Regional Conference in Brussels for helpful comments and suggestions. All remaining errors are solely the responsibility of the authors.

1 Introduction

Around the globe, policy makers see broadband penetration as a key driver for economic growth (see, e.g. OECD 2008). Broadband directly or indirectly spurs innovation, productivity, and, thereby, a country's national competitiveness. Therefore, the number of high-speed Internet connections has become an important indicator for a country's growth potential (e.g. Crandall, Hahn & Tardiff 2002, OECD 2003, ITU 2003, ITU 2006). A timely deployment and uptake of broadband infrastructure has, therefore, become a major policy objective for many governments.

In fact, the perspective that broadband infrastructure deployment has positive effects on growth is also supported by empirical evidence. Ever since the by now seminal study of Röller & Waverman (2001) found that telecommunications infrastructure is one of the key drivers of economic growth, many other studies have come to very similar findings, demonstrating the robustness of Röller & Waverman's empirical findings across time as well as across countries and regions. Koutroumpis (2009), for example, has analyzed the impact of broadband penetration on countries' GDP and found that a 10% increase in broadband coverage results in an increased growth rate of 0.25% for OECD member states. Qiang, Rossotto & Kimura (2009) have suggested that the effect of increased broadband penetration is even larger: According to this study, each additional percentage point of broadband penetration results in a 0.121% increase in the GDP growth rate in high-income countries and even 0.138% in low- and middle-income countries. More recently, the prominent study by Czernich, Falck, Kretschmer & Woessmann (2011) has found that a 10% increase in broadband penetration has even raised annual per capita growth by 0.9-1.5% between 1996-2007 in 25 OECD member states. Further studies that demonstrate how broadband penetration positively affects economic growth include Pradhan, Bele & Pandey (2013), Sassi & Goaid (2013), Jung, Na & Yoon (2013), Chavula (2013), Lee, Levendis & Gutierrez (2012), Gruber & Koutroumpis (2011), Thompson & Garbacz (2011), Shiu & Lam (2008), and Lam & Shiu (2010). The empirical literature on the impact of broadband on individual firms' productivity, which induces the macroeconomic growth effects in the end, has been nicely summarized in more detail by Cardona, Kretschmer & Strobel (2013).

As a natural consequence, broadband policy now has a prominent role on many government agendas (see, e.g., ITU & UNESCO 2013). In Europe, Asia and North America substantial efforts have been undertaken to foster the diffusion of broadband infrastructure, access, and services. In Europe, for example, various action plans that aim at making the European Union the "most competitive and dynamic knowledge based economy" (European Council 2000) have been launched over the

last decade. More recently, the US government's National Broadband Plan and the European Commission's Digital Agenda for Europe focus on extending internet connectivity and on reducing prices for broadband access. Given that Europe is still lagging behind its main Asian competitors as well as the US (see, e.g., Briglauer & Gugler 2013), the European Commission's "Europe 2020 Strategy" has outlined a number of objectives to ensure that "by 2020, (i) all Europeans have access to much higher internet speeds of above 30 Mbps and [that] (ii) 50% or more of European households subscribe to internet connections above 100 Mbps" (European Commission 2010, p. 20).

Given these ambitious objectives, there has been considerable interest in understanding the key factors that drive broadband diffusion. A growing body of empirical literature, which will be reviewed in more detail in section 2 of this paper, has been analyzing what affects broadband deployment and uptake either at a single-country or at a cross-country level, in order to single out the factors that drive broadband penetration. In short, most papers have focused on (a) broadband price levels, (b) income, (c) socio-demographic characteristics, (d) Government policy and regulation, and (e) the degree of inter- and intra-platform competition. This paper will also take these factors into account, but in addition to previous studies the present analysis also accounts for the degree of tariff *diversity*. To the authors' knowledge the focus on tariff diversity is new and, hence, one of the main novelties of this paper. While it is rather clear that price *levels* should have an impact on broadband uptake, it is, however, for a theoretical perspective less clear *ex ante* how tariff diversity should affect broadband penetration. On the one hand, classical industrial economics theory suggests that price discrimination in final consumer markets should lead to an expansion of output (i.e., increased broadband penetration in the case at hand), as it allows suppliers to serve low-value customers without lowering the price for high-value customers at the same time. Moreover, price discrimination can be used by firms to make consumer, who are willing to switch to another operator, stay with their initial internet provider. Esteves (2014) shows that with behavior-based price discrimination final consumer prices can be reduced which should ultimately result in increased demand. On the other hand, however, accounting for more recent theories of boundedly rational consumer behavior the prediction becomes less clear. As e.g. Spiegler (2006) has argued, consumers may become confused over "too much variety" or "too many tariffs". In fact, there has been a burgeoning literature which demonstrates that consumer decisions are prone to mistakes in telecommunications markets (see, e.g., Bolle & Heimehl 2005, Lambrecht & Skiera 2006, Haucap & Heimeshoff 2011). Based on these findings, Eliaz

& Spiegler (2006), Brown, Hossain & Morgan (2010), Piccione & Spiegler (2012), and Herweg & Mierendorff (2013) have developed models which suggest that firms may sometimes deliberately choose to obfuscate consumers in order to increase their profits. As a consequence, consumers may become frustrated and more reluctant to sign a contract. In fact, the success of (simple) flat-rate tariffs in telecommunications markets may suggest that simple tariffs may be more helpful in fostering penetration than more diverse and complicated offerings. From a theoretical perspective it is, therefore, not entirely clear how tariff diversity affects broadband uptake: While classical industrial economic theory would suggest a positive relationship between tariff diversity (as a measure for price discrimination) and broadband uptake, the more recently advanced behavioral economics view may suggest a negative one (seeing tariff diversity as a measure for customer obfuscation strategies).

The purpose of this paper is to provide an empirical assessment for how tariff diversity influences broadband uptake, while accounting for other factors that affect broadband penetration such as price *levels*, income, demographic factors, and public policy. The analysis accounts for two main dimensions of fixed-line broadband offerings, namely speed and price. To make price levels across different speed levels comparable tariffs are standardized by the offered download speed so that tariffs are expressed in the price per Megabit per second (Mbps). In addition, other tariff characteristics may further differentiate the service and affect “quality” such as the underlying technology, network stability, or service offers. The characteristics are unfortunately not directly observable or quantifiable for the authors, even though they may potentially affect consumers’ willingness to pay and, therefore, equilibrium prices.

The empirical analysis is based on a newly available data set that includes around 1500 broadband-only-offers (without any further bundled services) from 91 countries for the third quarter of 2012. Hence, the second major novelty of this paper is, apart from its research focus on tariff *variety*, the use of an entirely new data set. For the econometric analysis, an instrumental variable approach is used to estimate the demand for fixed-line broadband internet access, controlling for industry-specific and socio-economic effects.¹ As expected, the empirical analysis reveals that lower prices and higher income, alternatively OECD membership, foster broadband uptake. In addition, an increase in tariff diversity provides a further impetus for broadband penetration, supporting the classical perspective that price discrimination induces output expansion. Beyond these effects, neither inter-platform competition (cable

¹Under the category “fixed-line broadband” all fixed-line technologies are subsumed, i.e., are xDSL, Cable, Fibre, Satellite, and fixed wireless.

vs. telephone networks) nor mobile broadband prices have any direct additional influence on broadband penetration.

The remainder of the paper is now organized as follows: Section 2 reviews the relevant academic literature, before section 3 introduces the underlying data, the estimation strategy employed and the empirical results. Section 4 finally discusses the findings and concludes.

2 Literature Review

There is a steadily growing body of literature on drivers and impacts of broadband penetration. Two approaches have been used to address the issue: Firstly, a mostly descriptive approach which aims at identifying drivers for broadband uptake through a largely qualitative analysis (OECD 2001, Wu 2004) and, secondly, empirical analyses based on econometric models that estimate broadband demand, thereby explaining observed differences. The number of these empirical papers on broadband deployment, uptake, and policy has grown quite noticeably most recently. The studies have examined various economic, demographic, geographic, and policy variables which may plausibly explain cross-country differences in broadband penetration (see, e.g., Kim, Bauer & Wildman 2003, Garcia-Murillo 2005, Distaso, Lupi & Manenti 2006, Cava-Ferreruela & Alabau-Muñoz 2006, Lee & Brown 2008, Turkman, Blazic & Turk 2008, Lee, Marcu & Lee 2011, Galperin & Ruzzier 2013, Lin & Wu 2013). The key findings of these studies will be briefly discussed below.

Price: Several studies have stressed that the broadband price *level* is a significant factor in determining broadband demand in any given country. Among these studies are, for example, Distaso et al. (2006), Cava-Ferreruela & Alabau-Muñoz (2006), Denni & Gruber (2007), Wallsten & Hausladen (2009), Bouckaert, van Dijk & Verboven (2010), Lee et al. (2011), and Briglauer (2014) to name just a few. To provide an example, Galperin & Ruzzier (2013) have recently shown in their study of broadband in Latin America and the Caribbean (LAC) that broadband demand may actually be quite elastic. According to Galperin & Ruzzier an average price reduction of 10% results in an increase in broadband demand of almost 22% in the penetration rate in LAC, equivalent to almost 8.5 million additional broadband connections. In addition, Lin & Wu (2013) have shown in their analysis of broadband adoption in the OECD from 1997 to 2009 that broadband price levels have been especially important for late adopters. Overall, the empirical evidence that low price levels foster broadband penetration is overwhelming.

income: Nearly all of the studies referred to above also include income levels in their analysis and nearly all of them find, somewhat unsurprisingly, that income (GDP per capita) is a driving factor for fixed broadband demand. For example, Gruber & Koutroumpis (2013) have clearly found a positive and significant impact of income on broadband demand in both their panel data analysis of 30 OECD countries from 1999 to 2003 as well as in their panel data analysis of 167 countries from 2000 to 2010, respectively. In a more detailed study of the broadband diffusion process, Lin & Wu (2013) have shown that disposable household income is especially of importance for broadband adoption in the early adoption phase. In general, income has been identified as an important factor for broadband adoption across OECD countries.

competition: competition for broadband customers can basically take two forms: (i) service-based competition over the same infrastructure through open access provisions at various network layers, referred to as intra-platform competition, and (ii) facility-based competition between different technological platforms that can be used to provide broadband access, referred to as inter-platform competition. Generally speaking, the vast majority of studies has found that especially inter-platform competition has positive effects on broadband diffusion (see, e.g., Cava-Ferreruela & Alabau-Muñoz 2006, Distaso et al. 2006, Höffler 2007, Denni & Gruber 2007, Bouckaert et al. 2010, Nardotto, Valletti & Verboven 2013). Quite recent studies have, however, also produced different findings: Briglauer, Ecker & Gugler (2013) as well as Briglauer (2014) have found a non-linear relationship between inter-network competition and broadband diffusion, while both Calzada & Martínez-Santos (2014) and Gruber & Koutroumpis (2013) have found no evidence for inter-platform competition accelerating broadband diffusion. With respect to intra-platform competition, the results differ even more: While Lee et al. (2011) have found unbundling and service-based competition to foster broadband uptake, Denni & Gruber (2007), Distaso et al. (2006), Cava-Ferreruela & Alabau-Muñoz (2006), and Höffler (2007) found only small or insignificant effects. Moreover, Wallsten & Hausladen (2009), Bouckaert et al. (2010), and Briglauer et al. (2013) have even found that facilitating intra-network competition through access regulation negatively affects broadband penetration as it reduces incentives for broadband investment. Hence, the overall findings with respect to intra-platform competition are completely mixed, while inter-platform competition appears, by and large, to spur broadband penetration if a significant effect can be found.

In addition to these three factors (price levels, income, competition) a number of **other variables** have been examined in the literature such as demographic fac-

tors (e.g., age, education, and population density) or network characteristics such as the broadband speed available. Lee & Brown (2008), for example, have found that broadband speed and bandwidth (measured as bits per inhabitant), contribute to broadband adoption in OECD countries.² Lin & Wu (2013) find that, apart from price levels and income, content and education are the main driving forces in the first (early adoption) stage. Trkman et al. (2008) suggest that education and population density are influential demographic factors of fixed broadband deployment in European Union countries. Cava-Ferreruela & Alabau-Muñoz (2006) argue that the “predisposition” to use new technologies appears to be a key driver for broadband supply and demand.

All of these studies have significantly contributed to a deeper understanding of the determinants of fixed broadband adoption. However, to the best of the authors’ knowledge not a single study has accounted for the extent of price differentiation so far. This study now contributes to the existing literature by adding tariff diversity as another potential factor to determine broadband demand.

3 Empirical Analysis

3.1 Data and Econometric Specification

The empirical analysis is based on a newly available data set that includes around 1500 broadband-only-offers (without any further bundled services)³ from 91 countries for the third quarter of 2012. The data on broadband tariffs is provided by Google and was gathered by visiting operator websites in the course of July 2012.⁴ All tariffs are aggregated on a country-level and prices are converted from local currency into US dollars, using purchasing power parity (PPP) exchange rates, which are taken from World Bank for the year 2011.⁵ Data for social, economic, and demographic indicators was gained from World Bank as well as ITU World Telecommunication Indicators Database. Out of 91 included countries 26 are OECD members and 65 are OECD non-member states.⁶

²Lee & Brown (2008) use two different data sets provided by the OECD and the ITU covering different time spans, from 1999-2006 and 2002-2006, respectively.

³Bundled services could be voice telephony, pay TV, mobile services and so on. If a broadband-only offer was not available, tariff offers of broadband combined with voice telephony were captured. Triple play offers (broadband+voice+TV) were excluded entirely.

⁴The full data set is available under: <http://policybythenumbers.blogspot.de/2012/08/international-broadband-pricing-study.html>

⁵For Iran, Lybia, Syria and Taiwan no data was available for 2011, therefore the latest information from 2009 was implemented.

⁶Table 4 states all included countries in this study.

3.1.1 Prices

Price levels

According to economic theory of a downward sloping demand curve (for ordinary goods and services), a negative impact of price on broadband diffusion is expected. The price variable is measured by a tariff's monthly charge. Since fixed-line broadband tariffs are differentiated with respect to speed and price, we standardize them by their advertised download speed, thus a fixed-line broadband tariff's price is measured by monthly charge (in US\$ PPP) per Mbps. The prices are aggregated on a country-level by calculating the average of all tariffs offered in a country. To reduce the impact of outliers the upper and lower two percent of all offers are excluded.

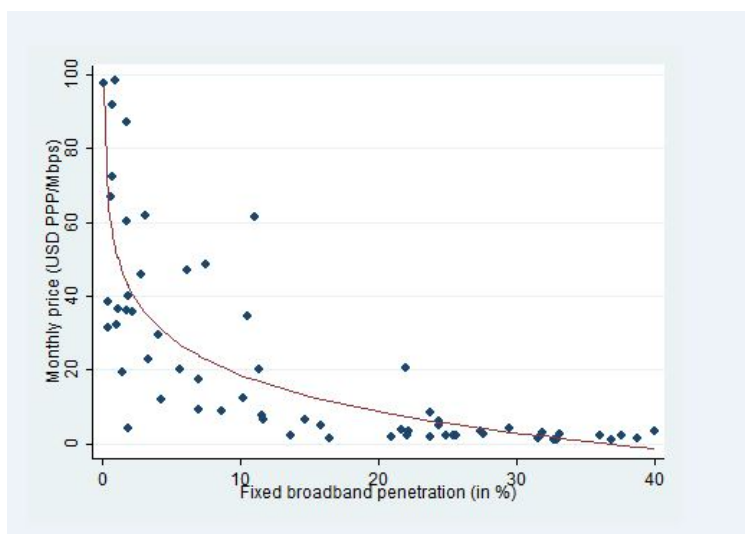


Figure 1: Relationship between price and fixed broadband subscribers

As illustrated by Figure 1 there is a negative relationship between price and diffusion rate. Hence, countries with higher broadband coverage are characterized by lower prices, maybe as suggested by ITU (2003) as a result of flourishing competition and innovative pricing schemes to attract a wide variety of customers.

The price for mobile broadband price is also included in the analysis. It is expected that fixed and mobile broadband are substitutes rather than complements, i.e., fixed broadband demand depends negatively on its own-price, whereas demand for fixed-line broadband increases with higher mobile broadband prices. Furthermore, the following relationship between own-price and cross-price elasticities is assumed

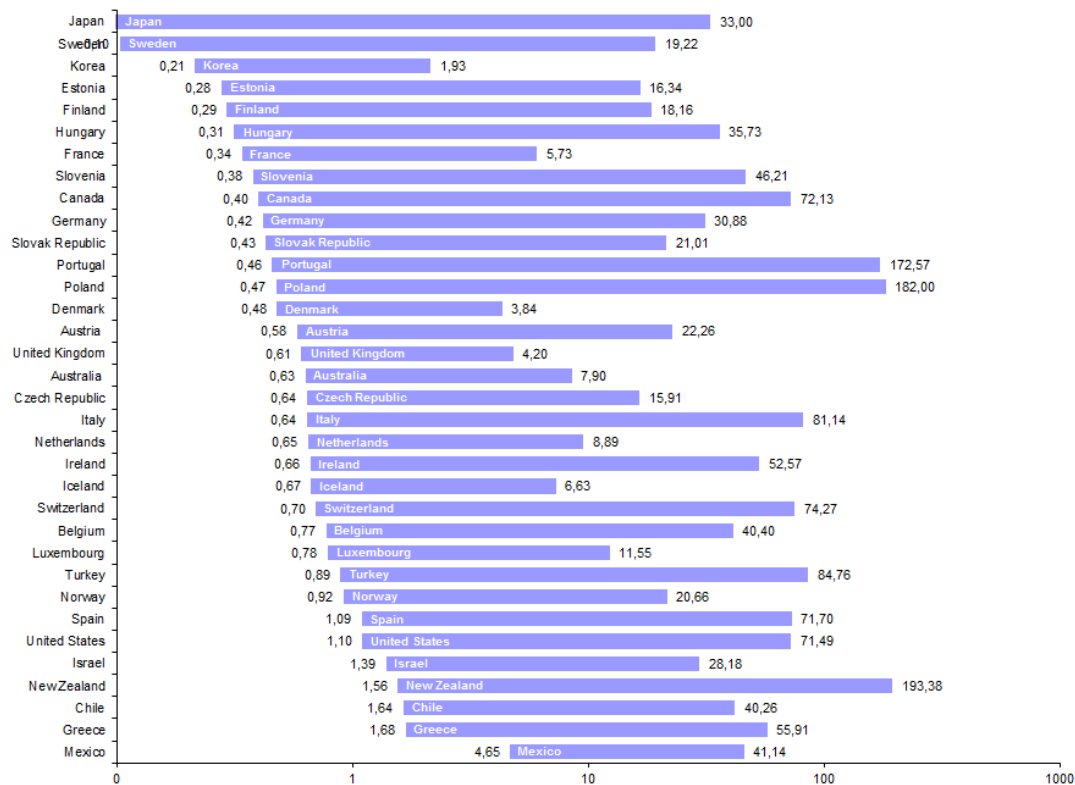
$$|\eta_{ff}| > \eta_{fm} > 0,$$

with $\eta_{ff} = \frac{\partial q_f}{\partial p_f} \frac{p_f}{q_f}$ and $\eta_{fm} = \frac{\partial q_f}{\partial p_m} \frac{p_m}{q_f}$, where f denotes fixed-line broadband and m mobile broadband. Since it is rather complex to find an accurate standardized

measure for country-level mobile broadband prices because mobile tariffs consist of bundles of voice minutes, texts (SMS), data and so on, mobile tariffs are standardized with the tariff's uncapped data volume in Gigabit per second (Gbps), i.e., a mobile broadband tariff's price is measured in US\$ PPP/Gbps. To facilitate comparisons, the average of the three cheapest tariffs is calculated per country.

Tariff diversity

The recent success of (simple) flat-rate tariffs suggests that simple tariffs may trigger more demand, as they are easily understandable in comparison to more diverse offerings while more complex tariffs may deter consumers from buying. In contrast, classical industrial economics theory suggests that price discrimination in final consumer markets should lead to an expansion of output. The purpose and novelty of this paper is to provide an empirical assessment for how tariff diversity influences broadband demand. As a proxy for a country's tariff diversity the standard deviation of prices in US\$ PPP/Mbps is calculated. Figure 2 shows the price/Mbps ranges in all 34 OECD countries which are related to the newly introduced variable tariff diversity. Thus, we test the classical industrial economic theory that would



Source: OECD, 2012

Figure 2: Fixed broadband prices (US\$ PPP) per Mbps, September 2011

suggest a positive relationship between tariff diversity and fixed broadband demand against the more recently developed behavioral economics view that may suggest a negative relationship.

3.1.2 Explanatory variables

In addition to the three price related variables explained above further explanatory variables are included: First, disposable income which is a key determinant of a person’s decision to purchase goods and services, and, therefore, it is expected to affect broadband demand positively. income is measured as the gross national income (GNI) per capita in \$US PPP.⁷ However, we cannot use current income in our regression as one has to cope with possible endogeneity issues, precisely reverse causality. The endogeneity problem arises because increased income probably leads to higher investments in infrastructure and increased consumption for technologies, and this in turn can lead to higher income (cf. Koutroumpis 2009, Gruber & Koutroumpis 2013). Following Gruber & Koutroumpis (2013) we use one year lags of income as a simple way to tackle the effect of reverse causality. The underlying insight is that broadband adoption influences future income after having been adopted, not before. So by using lagged values for GNI we only measure the effect of income on fixed broadband adoption for which we expect a positive impact.

Second, platform competition is expected to foster broadband coverage, since rivalry between technologies is seen as one important determinant promoting broadband adoption. The competitive situation is indicated by a binary dummy variable which equals one if there is competition between DSL technologies and cable in a country, and zero otherwise. Indeed, the data indicates that in countries with competing platforms broadband coverage is on average 12% higher than in countries without platform competition. As a result, inter-modal competition is expected to promote broadband, i.e., to have a positive impact.

In a nutshell, the fixed broadband demand model which we estimate is given by

$$\begin{aligned} \log(BP_{it}^{fix}) = & \beta_0 + \beta_1 p_{it}^{fix} + \beta_2 p_{it}^{mob} + \beta_3 diversity_{it} + \beta_4 income_{it-1} \\ & + \beta_5 comp_{it} + \beta_6 oecd_{it} + \epsilon_{it}^d, \end{aligned}$$

where $i = 1, \dots, 91$ indicates each market (or country). BP_{it}^{fix} indicates broadband penetration, measured as the number of fixed-line broadband subscriptions per 100 inhabitants in country i in year $t = 2012$. p_{it}^{fix} is the average monthly subscription

⁷Precisely, in high-income countries, i.e., a country with a larger or equal GNI per capita of 30,000 US\$ per annum, the penetration rate is nearly 30%, whereas in lower income countries with an annual GNI per capita of around 7,500 US\$ the diffusion is only about 10%.

price in US\$ PPP per Mbps for a fixed broadband tariff, p_{it}^{mob} is the average mobile broadband monthly subscription price in US\$ PPP standardized by the tariff's data cap. $diversity_{it}$ indicates tariff diversity measured by the price variety in country i , $income_{it-1}$ is approximated by GNI per capita in US\$ PPP and corresponds to 2011, $comp_{it}$ is a binary dummy variable that equals one if there is inter-modal competition between xDSL and cable in a country, $oecd_{it}$ indicates whether a country is an OECD member state or not, and ϵ_{it}^d is the error term.⁸

3.2 Results

3.2.1 Descriptive statistics

Table 1 shows summary statistics for variables used in the analysis. Statistics are given for all countries with fixed-broadband connections faster than 256 Kbps and -as a robustness check of our results- for a subgroup of countries with connections faster than 2 Mbps.

Table 1: Summary statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.	Source
≥ 256 Kbps						
BP^{fix}	91	10.73	12.53	0.00	39.96	ITU
p^{fix}	91	154.45	349.02	0.95	2527.15	Google
p^{mob}	85	11.89	21.76	0.51	155.65	Google
$diversity$	91	142.23	483.57	0.42	4085.30	Google
$income$	91	13692	14161	376	59993	World Bank
$comp$	91	0.32	0.47	0.00	1.00	Google
$oecd$	91	0.29	0.45	0.00	1.00	OECD
≥ 2 Mbps						
BP^{fix}	81	11.23	12.16	0.00	38.61	
p^{fix}	81	179.56	271952	22.22	1738.14	
p^{mob}	75	36.36	50.95	1.99	370.06	
$diversity$	81	133.38	329.78	0.00	2561.28	
$income$	81	15183	14317	376	59993	
$comp$	81	0.34	0.48	0.00	1.00	
$oecd$	81	0.32	0.47	0.00	1.00	

In total 91 countries are included, 26 OECD members and 65 non-member states.

⁸The selection of independent variables respond to theoretical considerations and data availability, as well as to the need to keep the number of parameters to be estimated low, given the limited number of observations.

The monthly price per Mbps differs substantially between countries: in countries with less wired broadband infrastructure a price/Mbps above 2,500 US\$ PPP [150 US\$ PPP/Gbps for mobile broadband] is possible, whereas in some high income countries only about 1 US\$ PPP [0.5 US\$ PPP/Gbps] is paid. The indicator for tariff diversity varies strongly. In some countries prices are very similar, while in other countries there are larger differences in price/Mbps. Moreover, we can infer that in 32% of the countries platform competition between telephone networks and cable is present. In the subsample 81 countries are included. Fixed-line penetration and price are adjusted by subscribers with less than 2 Mbps download speed.

Table 2 shows the correlation between the variables. As expected, in both samples prices are (strongly) negatively correlated with penetration and positively correlated with income, presence of inter-platform competition and OECD membership. All variables are significantly at the 1%-level. Mobile broadband price and tariff diversity are negatively correlated with demand, however not significantly different from zero at all or only at 10%-level, respectively.

Table 2: Pairwise correlation

Variables	$\log(BP^{fix})$	p^{fix}	p^{mob}	<i>diversity</i>	<i>income</i>	<i>comp</i>	<i>oecd</i>
≥ 256 Kbps							
$\log(BP^{fix})$	1.000						
p^{fix}	-0.473	1.000					
p^{mob}	-0.299	0.351	1.000				
<i>diversity</i>	-0.198	0.666	0.134	1.000			
<i>income</i>	0.776	-0.342	-0.237	-0.193	1.000		
<i>comp</i>	0.310	-0.087	-0.179	0.000	0.324	1.000	
<i>oecd</i>	0.622	-0.275	-0.212	-0.182	0.716	0.335	1.000
≥ 2 Mbps							
$\log(BP^{fix})$	1.000						
p^{fix}	-0.391	1.000					
p^{mob}	-0.013	0.047	1.000				
<i>diversity</i>	-0.284	0.877	0.074	1.000			
<i>income</i>	0.797	-0.379	0.158	-0.261	1.000		
<i>comp</i>	0.443	-0.222	0.136	-0.128	0.401	1.000	
<i>oecd</i>	0.786	-0.340	-0.182	-0.222	0.629	0.390	1.000

3.2.2 Empirical results

Table 3 reports the regression results.⁹ Column (1) presents a simple bivariate regression model in which the price level is the only explanatory variable. Column (2) includes all proposed variables. The first two columns state the OLS results. The fixed-line price coefficient has the expected negative sign and is significantly different from zero at the 1% significance level. Increased income and tariff diversity as well as OECD membership positively and significantly enhance demand. Neither the mobile broadband price nor the level of competition are significantly different from zero.

However, in the OLS estimation the price variable is endogenous, since price and penetration are determined simultaneously in equilibrium. Hence, we have to apply instrumental variable techniques to get unbiased estimators. We need to find at least one good instrument which affects supply without affecting demand, thus, we are searching for exogenous supply shifters. Optimal supply shifters are cost factors, however, data on cost is not available. Instead we use a time variable which indicates the interval since the broadband penetration rate in country i exceeds 3% as well as the lagged penetration measured in logarithm. Both variables are expected to influence price but be unrelated to the demand side and thus, assumed to be unrelated to the error term. The time variable is included as a means to reflect differing cost conditions across nations resulting from the network infrastructure roll-out process. To serve at least 3% of the population via fixed broadband an incipient network is needed whose building costs crucially depend on the distance between households which are to be connected. With a low penetration rate a low network coverage is approximated, hence, the initial cost of installing are higher. The previous penetration rate is an adequate instrument under the assumption that in the presence of economies of scale operators set lower prices when they serve more subscribers. However, this effect might diminish if a certain level of penetration is reached and the roll-out in sparsely populated areas is promoted (cf. Calzada & Martínez-Santos 2014).

Table 5 shows the first stage regression results. We test the validity of our instruments using the Hausman test and the Sargan test of overidentifying restrictions. Both test confirm the power of our instruments. For all IV regressions we reject the Hausman test's null hypothesis that OLS and 2SLS yield the same estimates, and further, do not reject the Sargan tests's null hypothesis that the instruments are uncorrelated with the error term.

In Table 3 columns three and four the second stage results of the 2SLS procedure

⁹All regressions were run using Stata/IC 11.2 for Windows.

Table 3: Estimation results

Dependent variable: $\log(BP^{fix})$					
Variable	OLS		2SLS		
	≥ 256 Kbps		≥ 2 Mbps		
	(1)	(2)	(1)	(2)	
p^{fix}	-0.003*** (0.001)	-0.002*** (0.007){2.18}	-0.015*** (0.003)	-0.015*** (0.003)	-0.022*** (0.008)
p^{mob}		-0.003 (0.004){1.20}		0.01 (0.009)	-0.001 (0.003)
$diversity$		0.001* (0.000){1.85}		0.007** (0.003)	0.014** (0.006)
$income$		0.084*** (0.017){1.24}		0.001 (0.000)	0.001*** (0.000)
$comp$		0.618 (0.397){1.11}		-0.331 (0.288)	0.283 (0.335)
$oecd$		0.989* (0.524){2.28}		1.368** (0.552)	0.205 (0.522)
Intercept	1.331*** (0.249)	-0.449 (0.291)	3.121*** (0.262)	1.298*** (0.424)	2.29*** (0.85)
N	91	85	91	85	75
R ²	0.227	0.655			
R ² (centered)			-0.714	-1.016	0.245
F	25.63	24.74	35.67	24.58	17.76
Prob>F	0.000	0.000	0.024	0.000	0.000
Hausman χ^2			17.08 [0.000]	9.79 [0.081]	17.76 [0.003]
Sargan χ^2			2.392 [0.122]	0.636 [0.425]	0.357 [0.550]

Significance levels: * : 10% ** : 5% *** : 1%.

Robust standard errors are reported in parentheses.

P-values are reported in squared brackets.

Variance inflation factors are reported in curly brackets.

are stated. Both price level coefficients have the expected signs. The coefficient of p^{fix} is negative and statistically significant at the 1% level. This underlines that countries with lower prices have higher penetration rates. The observed effect of price on broadband demand is considerably larger than the one estimated by OLS. The effect of p^{mob} is, as before, not significant.

The estimated coefficient for tariff *diversity* is positive and significantly different from zero in each specification at the 5% level.¹⁰ Its strong and robust positive impact supports the classical hypothesis that price discrimination leads to an expansion of output, as it allows suppliers to serve low-value customers as well as high-value customers with different prices at the same time. Consequently, we can deduce that firms should have an incentive to offer a range of tariffs with different prices to increase broadband adoption.

The analysis also reveals that higher income countries, i.e. OECD states, have a pronounced fixed-line broadband demand. This result is in line with previous findings. Higher income enables consumers to spend more on internet services, and therefore fosters fixed broadband uptake in a country. This finding is confirmed by various other empirical works. Platform competition between telephone technologies and cable is not found to be statistically different from zero. This finding is in line with recent analyses, e.g., Gruber & Koutroumpis (2013).

For a robustness check of the results we conduct the same analysis for a subsample. In the subsample only connections faster than 2 Mbps are regarded as broadband. The 2SLS regression results are stated in the last column of Table 3. Results do not change much. We still observe a negative effect of price and a positive impact of tariff diversity, significant at 1% and 5% level, respectively. Furthermore, income (strongly) increases demand whereas there is no effect on demand by mobile broadband price or inter-modal competition.

4 Discussion and Conclusion

The present paper has determined factors that influence the adoption of broadband internet access and that help to explain the observable patterns of broadband penetration in different countries. In particular, it has been examined how tariff diversity influences broadband uptake which has not been analyzed before.

For the estimation of fixed-line broadband penetration in 91 countries an entirely new data set was used, which includes nearly 1500 fixed-line and more than 2000

¹⁰Including interactions terms of tariff diversity with either OECD membership or time variables to account for different diffusion of broadband does not change the results.

mobile broadband tariffs. Based on an instrumental variable approach, which remedies the endogeneity problem that is present in a simple OLS regression, the analysis shows: Firstly, the fixed-line broadband price level crucially matters, it is negatively related to demand in all specifications. Secondly, the newly introduced variable tariff diversity, which measures the standard deviation of tariffs, significantly enhances demand. This results are independent of the level of broadband diffusion. The possibility of price discrimination seems, as suggested by traditional economic theory, to enlarge output and demand by serving consumers with a low willingness-to-pay. Thirdly, higher income and OECD membership positively influence adoption. The positive coefficients indicate that fixed broadband penetration tends to be higher in wealthier economies; again this result is robust. Lastly, the estimated coefficients for mobile broadband price level and inter-platform competition had the expected positive signs, but were insignificant.

These findings indicate that primarily price related factors and socio-economic effects determine fixed broadband penetration. The results also suggest that reduced prices and increased tariff diversity are a more important channel of fixed broadband adoption than increased inter-platform competition. As a policy matter, these results suggest that policy makers should be lenient towards price discrimination in broadband markets.

The estimated model works quite well for a cross-sectional regression of heterogeneous countries with the majority of non OECD countries. The results seem to be true for emerging markets as well as for more mature markets. It is worth pointing out that there are some limitations of this empirical analysis which should be kept in mind. Aggregated data at a national level is used which makes it impossible to account for differences within a country. This is an important aspect that has also been pointed out by other authors in the literature (e.g. Kim et al. 2003, Garcia-Murillo 2005). Further, more detailed data on the level of competition would be desirable, but was unfortunately not available, and finally, broadband adoption, like any process of technology diffusion, is seen as a dynamic development. Such a process of adoption evolves through time and this feature can not be taken into account in a cross-sectional estimation model. Consequently, using time-series data in future research should be eligible.

In conclusion, the results obtained by the model provide some useful first insights and point to the importance of factors that are often overlooked in broadband policy, namely tariff diversity. Given the above-mentioned necessary assumptions and data limitations, further evaluation to confirm the importance of tariff diversity with time-series data should be aspired.

References

- Bolle, F. & Heimel, J. (2005), ‘A fallacy of dominant price vectors in network industries’, *Review of Network Economics* **4**(3), 1–8.
- Bouckaert, J., van Dijk, T. & Verboven, F. (2010), ‘Access regulation, competition, and broadband penetration: An international study’, *Telecommunications Policy* **34**(11), 661–671.
- Briglauber, W. (2014), The impact of regulation and competition on the adoption of fiber-based broadband services: Recent evidence from the European Union member states, *Journal of Regulatory Economics*, forthcoming.
- Briglauber, W., Ecker, G. & Gugler, K. (2013), ‘The impact of infrastructure and service-based competition on the deployment of next generation access networks: Recent evidence from the european member states’, *Information Economics and Policy* **25**(3), 142–153.
- Briglauber, W. & Gugler, K. (2013), ‘The deployment and penetration of high-speed fiber networks and services: Why are EU member states lagging behind?’, *Telecommunications Policy* **37**(10), 819–835.
- Brown, J., Hossain, T. & Morgan, J. (2010), ‘Shrouded attributes and information suppression: Evidence from the field’, *The Quarterly Journal of Economics* **125**(2), 859–876.
- Calzada, J. & Martínez-Santos, F. (2014), ‘Broadband prices in the European Union: Competition and commercial strategies’, *Information Economics and Policy* **27**, 24–38.
- Cardona, M., Kretschmer, T. & Strobel, T. (2013), ‘ICT and productivity: Conclusions from the empirical literature’, *Information Economics and Policy* **25**(3), 109–125.
- Cava-Ferreruela, I. & Alabau-Muñoz, A. (2006), ‘Broadband policy assessment: A cross-national empirical analysis’, *Telecommunications Policy* **30**(8-9), 445–463.
- Chavula, H. (2013), ‘Telecommunications development and economic growth in Africa’, *Information Technology for Development* **19**(1), 5–23.
- Crandall, R. W., Hahn, R. & Tardiff, T. (2002), The benefits of broadband and the effects of regulation, in ‘Broadband: Should We Regulate High-Speed Internet Access?’, AEI-Brookings Joint Center for Regulatory Studies, pp. 295–330.

- Czernich, N., Falck, O., Kretschmer, T. & Woessmann, L. (2011), ‘Broadband infrastructure and economic growth’, *The Economic Journal* **121**(552), 505–532.
- Denni, M. & Gruber, H. (2007), ‘The diffusion of broadband telecommunications in the U.S. - the role of different forms of competition’, *Communications & Strategies* **68**, 139–157.
- Distaso, W., Lupi, P. & Manenti, F. M. (2006), ‘Platform competition and broadband uptake: Theory and empirical evidence from the European Union’, *Information Economics and Policy* **18**(1), 87–106.
- Eliasz, K. & Spiegel, R. (2006), ‘Contracting with diversely naive agents’, *The Review of Economic Studies* **73**(3), 689–714.
- Esteves, R.-B. (2014), ‘Behavior-based price discrimination with retention offers’, *Information Economics and Policy* **27**, 39–51.
- European Commission (2010), ‘A digital agenda for Europe’.
URL: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0245:FIN:EN:PDF>
- European Council (2000), ‘Lisbon strategy’.
URL: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/00100-r1.en0.htm
- Galperin, H. & Ruzzier, C. A. (2013), ‘Price elasticity of demand for broadband: Evidence from Latin America and the Caribbean’, *Telecommunications Policy* **37**(6-7), 429–438.
- Garcia-Murillo, M. (2005), ‘International broadband deployment: The impact of unbundling’, *Communications & Strategies* **57**, 83–105.
- Gruber, H. & Koutroumpis, P. (2011), ‘Mobile telecommunications and the impact on economic development’, *Economic Policy* **26**(67), 387–426.
- Gruber, H. & Koutroumpis, P. (2013), ‘Competition enhancing regulation and diffusion of innovation: The case of broadband networks’, *Journal of Regulatory Economics* **43**(2), 168–195.
- Haucap, J. & Heimeshoff, U. (2011), ‘Consumer behavior towards on-net/off-net price differentiation’, *Telecommunications Policy* **35**, 325–332.

- Herweg, F. & Mierendorff, K. (2013), 'Uncertain demand, consumer loss aversion, and flat-rate tariffs', *Journal of the European Economic Association* **11**(2), 399–432.
- Höfler, F. (2007), 'Cost and benefits from infrastructure competition. Estimating welfare effects from broadband access competition', *Telecommunications Policy* **31**(6-7), 401–418.
- ITU (2003), 'Promoting broadband: Background paper'.
URL: <http://www.itu.int/osg/spu/ni/promotebroadband/PB03-PromotingBroadband.pdf>
- ITU (2006), 'ITU Internet Report 2006: digital.life'.
URL: <http://www.itu.int/osg/spu/publications/digitalife/docs/digital-life-web.pdf>
- ITU & UNESCO (2013), 'The state of broadband 2013: Universalizing broadband'.
URL: <http://www.broadbandcommission.org/Documents/bb-annualreport2013.pdf>
- Jung, H.-J., Na, K.-Y. & Yoon, C.-H. (2013), 'The role of ICT in Korea's economic growth: Productivity changes across industries since the 1990s', *Telecommunications Policy* **37**(4-5), 292–310.
- Kim, J., Bauer, J. M. & Wildman, S. S. (2003), Broadband uptake in OECD countries: Policy lessons from comparative statistical analysis, SSRN Scholarly Paper, Rochester, NY.
- Koutroumpis, P. (2009), 'The economic impact of broadband on growth: A simultaneous approach', *Telecommunications Policy* **33**(9), 471–485.
- Lam, P.-L. & Shiu, A. (2010), 'Economic growth, telecommunications development and productivity growth of the telecommunications sector: Evidence around the world', *Telecommunications Policy* **34**(4), 185–199.
- Lambrecht, A. & Skiera, B. (2006), 'Paying too much and being happy about it: Existence, causes and consequences of tariff-choice biases', *Journal of Marketing Research* **18**(2), 212–223.
- Lee, S. & Brown, J. S. (2008), 'Examining broadband adoption factors: An empirical analysis between countries', *info* **10**(1), 25–39.

- Lee, S. H., Levendis, J. & Gutierrez, L. (2012), ‘Telecommunications and economic growth: An empirical analysis of sub-saharan africa’, *Applied Economics* **44**(4), 461–469.
- Lee, S., Marcu, M. & Lee, S. (2011), ‘An empirical analysis of fixed and mobile broadband diffusion’, *Information Economics and Policy* **23**(3-4), 227–233.
- Lin, M.-S. & Wu, F.-S. (2013), ‘Identifying the determinants of broadband adoption by diffusion stage in OECD countries’, *Telecommunications Policy* **37**(4-5), 241–251.
- Nardotto, M., Valletti, T. & Verboven, F. (2013), Unbundling the incumbent: Evidence from UK broadband, CEPR Discussion Papers 9194.
- OECD (2001), ‘The development of broadband access in OECD countries’.
URL: <http://www.oecd.org/sti/2475737.pdf>
- OECD (2003), Developments in local loop unbundling, Technical report.
URL: <http://www.oecd-ilibrary.org>
- OECD (2008), ‘Broadband growth and policies in OECD countries’.
URL: <http://www.oecd.org/sti/broadband/40629067.pdf>
- Piccione, M. & Spiegler, R. (2012), ‘Price competition under limited comparability’, *The Quarterly Journal of Economics* **127**(1), 97–135.
- Pradhan, R., Bele, S. & Pandey, S. (2013), ‘The link between telecommunication infrastructure and economic growth in 34 OECD countries’, *International Journal of Technology, Policy and Management* **13**(3), 278–293.
- Qiang, C. Z.-W., Rossotto, C. M. & Kimura, K. (2009), Economic impacts of broadband, *in* ‘Information and Communications for Development 2009: Extending Reach and Increasing Impact’, World Bank, chapter 3, pp. 35–50.
- Röller, L.-H. & Waverman, L. (2001), ‘Telecommunications infrastructure and economic development: A simultaneous approach’, *The American Economic Review* **91**(4), 909–923.
- Sassi, S. & Goaid, M. (2013), ‘Financial development, ICT diffusion and economic growth: Lessons from MENA region’, *Telecommunications Policy* **37**(4-5), 252–261.

- Shiu, A. & Lam, P.-L. (2008), 'Causal relationship between telecommunications and economic growth in China and its regions', *Regional Studies* **42**(5), 705–718.
- Spiegler, R. (2006), 'Competition over agents with boundedly rational expectations', *Theoretical Economics* **1**(2), 207–231.
- Thompson, H. G. J. & Garbacz, C. (2011), 'Economic impacts of mobile versus fixed broadband', *Telecommunications Policy* **35**(11), 999–1009.
- Trkman, P., Blazic, J. B. & Turk, T. (2008), 'Factors of broadband development and the design of a strategic policy framework', *Telecommunications Policy* **32**(2), 101–115.
- Wallsten, S. & Hausladen, S. (2009), 'Net neutrality, unbundling, and their effects on international investment in next-generation networks', *Review of Network Economics* **8**(1), 1–23.
- Wu, I. (2004), 'Canada, South Korea, Netherlands and Sweden: Regulatory implications of the convergence of telecommunications, broadcasting and Internet services', *Telecommunications Policy* **28**(1), 79–96.

Appendix

Table 4: Broadband penetration and prices by country

Country	fixed broadband user (in %)	internet users (in %)	Price/Mbps (in US\$ PPP/Mbps)
Afghanistan	-	5.00	687.88
Algeria	2.78	14.00	45.63
Angola	0.13	15.00	114.65
Argentina	10.54	47.70	34.48
Australia	24.32	79.00	4.97
Austria	25.42	79.80	2.16
Azerbaijan	10.73	50.00	144.22
Bangladesh	0.31	5.00	1370.15
Belarus	21.94	39.60	20.46
Belgium	32.95	78.00	1.17
Benin	0.43	3.50	335.81
Bolivia	0.65	30.00	512.26
Brazil	8.59	45.00	8.60
Bulgaria	16.45	51.00	1.49
Burkina Faso	0.08	3.00	268.12
Cambodia	0.15	3.10	101.73
Cameroon	0.01	5.00	654.18
Canada	31.83	83.00	2.77
Chile	11.60	53.90	7.74
China	11.61	38.30	6.59
Colombia	6.94	40.40	17.47
Cote d'Ivoire	0.25	2.20	286.55
Czech Republic	15.84	72.90	4.89
Denmark	37.60	90.00	1.99
Dominican Rep.	4.02	35.50	29.32
Ecuador	4.22	31.40	12.02
Egypt	2.21	38.70	35.67
El Salvador	3.31	17.70	22.94
Finland	29.50	89.40	4.27
France	36.04	79.60	2.12
Germany	33.09	83.00	2.67
Ghana	0.25	14.10	440.44

Greece	21.62	53.00	3.66
Guatemala	-	11.70	60.16
Honduras	0.43	15.90	31.19
Hong Kong, China	31.58	74.50	1.21
Hungary	22.16	59.00	3.32
India	1.08	10.10	32.30
Indonesia	1.13	18.00	180.04
Iran (Islamic Rep.)	2.37	21.00	206.30
Israel	24.85	70.00	2.27
Italy	22.08	56.80	2.16
Japan	27.60	79.50	2.58
Jordan	3.16	34.90	61.62
Kenya	0.10	28.00	185.45
Korea (South)	36.91	83.80	0.95
Kyrgyzstan	0.69	20.00	154.26
Lao P.D.R.	0.66	9.00	91.63
Libya	1.09	17.00	36.53
Madagascar	0.03	1.90	186.16
Malaysia	7.44	61.00	48.62
Mali	0.01	2.00	258.13
Mexico	10.21	36.20	12.10
Morocco	1.83	51.00	4.28
Nepal	0.31	9.00	106.07
Netherlands	38.74	92.30	1.39
Nicaragua	1.45	10.60	19.35
Niger	0.01	1.30	386.57
Pakistan	0.42	9.00	38.42
Papua New Guinea	0.11	2.00	2527.15
Paraguay	0.92	23.90	98.55
Peru	4.05	36.50	1161.01
Philippines	1.89	29.00	39.95
Poland	14.68	64.90	6.45
Portugal	20.95	55.30	1.77
Saudi Arabia	5.62	47.50	19.97
Senegal	0.73	17.50	72.39
Serbia	11.29	42.20	20.12
Singapore	25.63	71.00	2.27

Slovak Republic	13.65	74.40	2.22
Slovenia	24.34	72.00	6.23
South Africa	1.80	21.00	86.93
Spain	23.78	67.60	1.86
Sri Lanka	1.71	15.00	36.01
Sudan	0.04	19.00	165.23
Sweden	31.77	91.00	2.23
Switzerland	39.96	85.20	3.28
Syria	0.58	22.50	66.84
Taiwan, China	23.71	72.00	8.33
Tajikistan	0.07	13.00	97.60
Tanzania	0.01	12.00	489.97
Uganda	0.10	13.10	985.96
Ukraine	7.01	30.60	9.02
United Arab Emi- rates	10.99	70.00	61.21
United Kingdom	32.74	82.00	0.97
United States	27.35	77.90	3.32
Uzbekistan	0.53	30.20	222.39
Venezuela	6.17	40.20	46.90
Yemen	0.44	14.90	184.99
Zambia	0.06	11.50	218.16
Zimbabwe	0.27	15.70	103.75

Table 5: First stage estimation results 2SLS

Dependent variable: p^{fix}			
	≥ 256 Kbps		≥ 2 Mbps
Variable	(1)	(2)	
$\log(BP_{t-1}^{fix})$	-57.86*** (14.491)	-52.977 (10.89)	-54.429** (21.898)
3% coverage	-0.012 (5.296)	-1.179 (7.149)	7.577 (7.596)
p^{mob}		0.789 (0.726)	-0.038 (0.130)
diversity		0.439*** (0.159)	0.617*** (0.056)
income		0.000 (0.001)	0.001 (0.001)
comp		-28.466 (21.125)	15.738 (18.331)
oecd		90.286 (8.006)	-9.65 (14.463)
Intercept	195.238** (49.432)	86.249*** (27.976)	103.856*** (20.483)
N	91	85	75
R ²	0.196	0.573	0.895
F	10.37	9.96	44.85
Prob>F	0.000	0.000	0.000
F (excluded)	10.37	12.04	8.19
Prob>F	0.000	0.000	0.000

Significance levels: * : 10% ** : 5% *** : 1%.

Robust standard errors are reported in parentheses.

PREVIOUS DISCUSSION PAPERS

- 156 Haucap, Justus, Heimeshoff, Ulrich and Lange, Mirjam R. J., The Impact of Tariff Diversity on Broadband Diffusion – An Empirical Analysis, August 2014.
- 155 Baumann, Florian and Friehe, Tim, On Discovery, Restricting Lawyers, and the Settlement Rate, August 2014.
- 154 Hottenrott, Hanna and Lopes-Bento, Cindy, R&D Partnerships and Innovation Performance: Can There be too Much of a Good Thing?, July 2014.
- 153 Hottenrott, Hanna and Lawson, Cornelia, Flying the Nest: How the Home Department Shapes Researchers' Career Paths, July 2014.
- 152 Hottenrott, Hanna, Lopes-Bento, Cindy and Veugelers, Reinhilde, Direct and Cross-Scheme Effects in a Research and Development Subsidy Program, July 2014.
- 151 Dewenter, Ralf and Heimeshoff, Ulrich, Do Expert Reviews Really Drive Demand? Evidence from a German Car Magazine, July 2014.
- 150 Bataille, Marc, Steinmetz, Alexander and Thorwarth, Susanne, Screening Instruments for Monitoring Market Power in Wholesale Electricity Markets – Lessons from Applications in Germany, July 2014.
- 149 Kholodilin, Konstantin A., Thomas, Tobias and Ulbricht, Dirk, Do Media Data Help to Predict German Industrial Production?, July 2014.
- 148 Hogrefe, Jan and Wrona, Jens, Trade, Tasks, and Trading: The Effect of Offshoring on Individual Skill Upgrading, June 2014.
- 147 Gaudin, Germain and White, Alexander, On the Antitrust Economics of the Electronic Books Industry, May 2014.
- 146 Alipranti, Maria, Milliou, Chrysovalantou and Petrakis, Emmanuel, Price vs. Quantity Competition in a Vertically Related Market, May 2014.
Published in: *Economics Letters*, 124 (1) (2014), pp.122-126.
- 145 Blanco, Mariana, Engelmann, Dirk, Koch, Alexander K., and Normann, Hans-Theo, Preferences and Beliefs in a Sequential Social Dilemma: A Within-Subjects Analysis, May 2014.
Published in: *Games and Economic Behavior*, 87 (2014), pp.122-135.
- 144 Jeitschko, Thomas D., Jung, Yeonjei and Kim, Jaesoo, Bundling and Joint Marketing by Rival Firms, May 2014.
- 143 Benndorf, Volker and Normann, Hans-Theo, The Willingness to Sell Private Data, May 2014.
- 142 Dauth, Wolfgang and Suedekum, Jens, Globalization and Local Profiles of Economic Growth and Industrial Change, April 2014.
- 141 Nowak, Verena, Schwarz, Christian and Suedekum, Jens, Asymmetric Spiders: Supplier Heterogeneity and the Organization of Firms, April 2014.
- 140 Hasnas, Irina, A Note on Consumer Flexibility, Data Quality and Collusion, April 2014.
- 139 Baye, Irina and Hasnas, Irina, Consumer Flexibility, Data Quality and Location Choice, April 2014.

- 138 Aghadadashli, Hamid and Wey, Christian, Multi-Union Bargaining: Tariff Plurality and Tariff Competition, April 2014.
- 137 Duso, Tomaso, Herr, Annika and Suppliet, Moritz, The Welfare Impact of Parallel Imports: A Structural Approach Applied to the German Market for Oral Anti-diabetics, April 2014.
Forthcoming in: Health Economics.
- 136 Haucap, Justus and Müller, Andrea, Why are Economists so Different? Nature, Nurture and Gender Effects in a Simple Trust Game, March 2014.
- 135 Normann, Hans-Theo and Rau, Holger A., Simultaneous and Sequential Contributions to Step-Level Public Goods: One vs. Two Provision Levels, March 2014.
Forthcoming in: Journal of Conflict Resolution.
- 134 Bucher, Monika, Hauck, Achim and Neyer, Ulrike, Frictions in the Interbank Market and Uncertain Liquidity Needs: Implications for Monetary Policy Implementation, July 2014 (First Version March 2014).
- 133 Czarnitzki, Dirk, Hall, Bronwyn, H. and Hottenrott, Hanna, Patents as Quality Signals? The Implications for Financing Constraints on R&D?, February 2014.
- 132 Dewenter, Ralf and Heimeshoff, Ulrich, Media Bias and Advertising: Evidence from a German Car Magazine, February 2014.
Forthcoming in: Review of Economics.
- 131 Baye, Irina and Sapi, Geza, Targeted Pricing, Consumer Myopia and Investment in Customer-Tracking Technology, February 2014.
- 130 Clemens, Georg and Rau, Holger A., Do Leniency Policies Facilitate Collusion? Experimental Evidence, January 2014.
- 129 Hottenrott, Hanna and Lawson, Cornelia, Fishing for Complementarities: Competitive Research Funding and Research Productivity, December 2013.
- 128 Hottenrott, Hanna and Rexhäuser, Sascha, Policy-Induced Environmental Technology and Incentive Efforts: Is There a Crowding Out?, December 2013.
- 127 Dauth, Wolfgang, Findeisen, Sebastian and Suedekum, Jens, The Rise of the East and the Far East: German Labor Markets and Trade Integration, December 2013.
Forthcoming in: Journal of European Economic Association.
- 126 Wenzel, Tobias, Consumer Myopia, Competition and the Incentives to Unshroud Add-on Information, December 2013.
Published in: Journal of Economic Behavior and Organization, 98 (2014), pp. 89-96.
- 125 Schwarz, Christian and Suedekum, Jens, Global Sourcing of Complex Production Processes, December 2013.
Published in: Journal of International Economics, 93 (2014), pp. 123-139.
- 124 Defever, Fabrice and Suedekum, Jens, Financial Liberalization and the Relationship-Specificity of Exports, December 2013.
Published in: Economics Letters, 122 (2014), pp. 375-379.
- 123 Bauernschuster, Stefan, Falck, Oliver, Heblich, Stephan and Suedekum, Jens, Why Are Educated and Risk-Loving Persons More Mobile Across Regions?, December 2013.
Published in: Journal of Economic Behavior and Organization, 98 (2014), pp. 56-69.

- 122 Hottenrott, Hanna and Lopes-Bento, Cindy, Quantity or Quality? Knowledge Alliances and their Effects on Patenting, December 2013.
- 121 Hottenrott, Hanna and Lopes-Bento, Cindy, (International) R&D Collaboration and SMEs: The Effectiveness of Targeted Public R&D Support Schemes, December 2013.
Forthcoming in: Research Policy.
- 120 Giesen, Kristian and Suedekum, Jens, City Age and City Size, November 2013.
Forthcoming in: European Economic Review.
- 119 Trax, Michaela, Brunow, Stephan and Suedekum, Jens, Cultural Diversity and Plant-Level Productivity, November 2013.
- 118 Manasakis, Constantine and Vlassis, Minas, Downstream Mode of Competition With Upstream Market Power, November 2013.
Published in: Research in Economics, 68 (2014), pp. 84-93.
- 117 Sapi, Geza and Suleymanova, Irina, Consumer Flexibility, Data Quality and Targeted Pricing, November 2013.
- 116 Hinloopen, Jeroen, Müller, Wieland and Normann, Hans-Theo, Output Commitment Through Product Bundling: Experimental Evidence, November 2013.
Published in: European Economic Review 65 (2014), pp. 164-180.
- 115 Baumann, Florian, Denter, Philipp and Friehe Tim, Hide or Show? Endogenous Observability of Private Precautions Against Crime When Property Value is Private Information, November 2013.
- 114 Fan, Ying, Kühn, Kai-Uwe and Lafontaine, Francine, Financial Constraints and Moral Hazard: The Case of Franchising, November 2013.
- 113 Aguzzoni, Luca, Argentesi, Elena, Buccirossi, Paolo, Ciari, Lorenzo, Duso, Tomaso, Tognoni, Massimo and Vitale, Cristiana, They Played the Merger Game: A Retrospective Analysis in the UK Videogames Market, October 2013.
Forthcoming in: Journal of Competition and Economics under the title: "A Retrospective Merger Analysis in the UK Videogames Market".
- 112 Myrseth, Kristian Ove R., Riener, Gerhard and Wollbrant, Conny, Tangible Temptation in the Social Dilemma: Cash, Cooperation, and Self-Control, October 2013.
- 111 Hasnas, Irina, Lambertini, Luca and Palestini, Arsen, Open Innovation in a Dynamic Cournot Duopoly, October 2013.
Published in: Economic Modelling, 36 (2014), pp. 79-87.
- 110 Baumann, Florian and Friehe, Tim, Competitive Pressure and Corporate Crime, September 2013.
- 109 Böckers, Veit, Haucap, Justus and Heimeshoff, Ulrich, Benefits of an Integrated European Electricity Market, September 2013.
- 108 Normann, Hans-Theo and Tan, Elaine S., Effects of Different Cartel Policies: Evidence from the German Power-Cable Industry, September 2013.
Forthcoming in: Industrial and Corporate Change.
- 107 Haucap, Justus, Heimeshoff, Ulrich, Klein, Gordon J., Rickert, Dennis and Wey, Christian, Bargaining Power in Manufacturer-Retailer Relationships, September 2013.

- 106 Baumann, Florian and Friehe, Tim, Design Standards and Technology Adoption: Welfare Effects of Increasing Environmental Fines when the Number of Firms is Endogenous, September 2013.
- 105 Jeitschko, Thomas D., NYSE Changing Hands: Antitrust and Attempted Acquisitions of an Erstwhile Monopoly, August 2013.
Published in: Journal of Stock and Forex Trading, 2 (2) (2013), pp. 1-6.
- 104 Böckers, Veit, Giessing, Leonie and Rösch, Jürgen, The Green Game Changer: An Empirical Assessment of the Effects of Wind and Solar Power on the Merit Order, August 2013.
- 103 Haucap, Justus and Muck, Johannes, What Drives the Relevance and Reputation of Economics Journals? An Update from a Survey among Economists, August 2013.
- 102 Jovanovic, Dragan and Wey, Christian, Passive Partial Ownership, Sneaky Takeovers, and Merger Control, August 2013.
Revised version forthcoming in: Economics Letters.
- 101 Haucap, Justus, Heimeshoff, Ulrich, Klein, Gordon J., Rickert, Dennis and Wey, Christian, Inter-Format Competition Among Retailers – The Role of Private Label Products in Market Delineation, August 2013.
- 100 Normann, Hans-Theo, Requate, Till and Waichman, Israel, Do Short-Term Laboratory Experiments Provide Valid Descriptions of Long-Term Economic Interactions? A Study of Cournot Markets, July 2013.
Forthcoming in: Experimental Economics.
- 99 Dertwinkel-Kalt, Markus, Haucap, Justus and Wey, Christian, Input Price Discrimination (Bans), Entry and Welfare, June 2013.
- 98 Aguzzoni, Luca, Argentesi, Elena, Ciari, Lorenzo, Duso, Tomaso and Tognoni, Massimo, Ex-post Merger Evaluation in the UK Retail Market for Books, June 2013.
- 97 Caprice, Stéphane and von Schlippenbach, Vanessa, One-Stop Shopping as a Cause of Slotting Fees: A Rent-Shifting Mechanism, May 2012.
Published in: Journal of Economics and Management Strategy, 22 (2013), pp. 468-487.
- 96 Wenzel, Tobias, Independent Service Operators in ATM Markets, June 2013.
Published in: Scottish Journal of Political Economy, 61 (2014), pp. 26-47.
- 95 Coublucq, Daniel, Econometric Analysis of Productivity with Measurement Error: Empirical Application to the US Railroad Industry, June 2013.
- 94 Coublucq, Daniel, Demand Estimation with Selection Bias: A Dynamic Game Approach with an Application to the US Railroad Industry, June 2013.
- 93 Baumann, Florian and Friehe, Tim, Status Concerns as a Motive for Crime?, April 2013.
- 92 Jeitschko, Thomas D. and Zhang, Nanyun, Adverse Effects of Patent Pooling on Product Development and Commercialization, April 2013.
Published in: The B. E. Journal of Theoretical Economics, 14 (1) (2014), Art. No. 2013-0038.
- 91 Baumann, Florian and Friehe, Tim, Private Protection Against Crime when Property Value is Private Information, April 2013.
Published in: International Review of Law and Economics, 35 (2013), pp. 73-79.

- 90 Baumann, Florian and Friehe, Tim, Cheap Talk About the Detection Probability, April 2013.
Published in: International Game Theory Review, 15 (2013), Art. No. 1350003.
- 89 Pagel, Beatrice and Wey, Christian, How to Counter Union Power? Equilibrium Mergers in International Oligopoly, April 2013.
- 88 Jovanovic, Dragan, Mergers, Managerial Incentives, and Efficiencies, April 2014 (First Version April 2013).
- 87 Heimeshoff, Ulrich and Klein Gordon J., Bargaining Power and Local Heroes, March 2013.
- 86 Bertschek, Irene, Cerquera, Daniel and Klein, Gordon J., More Bits – More Bucks? Measuring the Impact of Broadband Internet on Firm Performance, February 2013.
Published in: Information Economics and Policy, 25 (2013), pp. 190-203.
- 85 Rasch, Alexander and Wenzel, Tobias, Piracy in a Two-Sided Software Market, February 2013.
Published in: Journal of Economic Behavior & Organization, 88 (2013), pp. 78-89.
- 84 Bataille, Marc and Steinmetz, Alexander, Intermodal Competition on Some Routes in Transportation Networks: The Case of Inter Urban Buses and Railways, January 2013.
- 83 Haucap, Justus and Heimeshoff, Ulrich, Google, Facebook, Amazon, eBay: Is the Internet Driving Competition or Market Monopolization?, January 2013.
Published in: International Economics and Economic Policy, 11 (2014), pp. 49-61.
- 82 Regner, Tobias and Riener, Gerhard, Voluntary Payments, Privacy and Social Pressure on the Internet: A Natural Field Experiment, December 2012.
- 81 Dertwinkel-Kalt, Markus and Wey, Christian, The Effects of Remedies on Merger Activity in Oligopoly, December 2012.
- 80 Baumann, Florian and Friehe, Tim, Optimal Damages Multipliers in Oligopolistic Markets, December 2012.
- 79 Duso, Tomaso, Röller, Lars-Hendrik and Seldeslachts, Jo, Collusion through Joint R&D: An Empirical Assessment, December 2012.
Forthcoming in: The Review of Economics and Statistics.
- 78 Baumann, Florian and Heine, Klaus, Innovation, Tort Law, and Competition, December 2012.
Published in: Journal of Institutional and Theoretical Economics, 169 (2013), pp. 703-719.
- 77 Coenen, Michael and Jovanovic, Dragan, Investment Behavior in a Constrained Dictator Game, November 2012.
- 76 Gu, Yiquan and Wenzel, Tobias, Strategic Obfuscation and Consumer Protection Policy in Financial Markets: Theory and Experimental Evidence, November 2012.
Forthcoming in: Journal of Industrial Economics under the title "Strategic Obfuscation and Consumer Protection Policy".
- 75 Haucap, Justus, Heimeshoff, Ulrich and Jovanovic, Dragan, Competition in Germany's Minute Reserve Power Market: An Econometric Analysis, November 2012.
Published in: The Energy Journal, 35 (2014), pp. 139-158.

- 74 Normann, Hans-Theo, Rösch, Jürgen and Schultz, Luis Manuel, Do Buyer Groups Facilitate Collusion?, November 2012.
- 73 Riener, Gerhard and Wiederhold, Simon, Heterogeneous Treatment Effects in Groups, November 2012.
Published in: Economics Letters, 120 (2013), pp 408-412.
- 72 Berlemann, Michael and Haucap, Justus, Which Factors Drive the Decision to Boycott and Opt Out of Research Rankings? A Note, November 2012.
- 71 Muck, Johannes and Heimeshoff, Ulrich, First Mover Advantages in Mobile Telecommunications: Evidence from OECD Countries, October 2012.
- 70 Karaçuka, Mehmet, Çatik, A. Nazif and Haucap, Justus, Consumer Choice and Local Network Effects in Mobile Telecommunications in Turkey, October 2012.
Published in: Telecommunications Policy, 37 (2013), pp. 334-344.
- 69 Clemens, Georg and Rau, Holger A., Rebels without a Clue? Experimental Evidence on Partial Cartels, April 2013 (First Version October 2012).
- 68 Regner, Tobias and Riener, Gerhard, Motivational Cherry Picking, September 2012.
- 67 Fonseca, Miguel A. and Normann, Hans-Theo, Excess Capacity and Pricing in Bertrand-Edgeworth Markets: Experimental Evidence, September 2012.
Published in: Journal of Institutional and Theoretical Economics, 169 (2013), pp. 199-228.
- 66 Riener, Gerhard and Wiederhold, Simon, Team Building and Hidden Costs of Control, September 2012.
- 65 Fonseca, Miguel A. and Normann, Hans-Theo, Explicit vs. Tacit Collusion – The Impact of Communication in Oligopoly Experiments, August 2012.
Published in: European Economic Review, 56 (2012), pp. 1759-1772.
- 64 Jovanovic, Dragan and Wey, Christian, An Equilibrium Analysis of Efficiency Gains from Mergers, July 2012.
- 63 Dewenter, Ralf, Jaschinski, Thomas and Kuchinke, Björn A., Hospital Market Concentration and Discrimination of Patients, July 2012 .
Published in: Schmollers Jahrbuch, 133 (2013), pp. 345-374.
- 62 Von Schlippenbach, Vanessa and Teichmann, Isabel, The Strategic Use of Private Quality Standards in Food Supply Chains, May 2012.
Published in: American Journal of Agricultural Economics, 94 (2012), pp. 1189-1201.
- 61 Sapi, Geza, Bargaining, Vertical Mergers and Entry, July 2012.
- 60 Jentzsch, Nicola, Sapi, Geza and Suleymanova, Irina, Targeted Pricing and Customer Data Sharing Among Rivals, July 2012.
Published in: International Journal of Industrial Organization, 31 (2013), pp. 131-144.
- 59 Lambarraa, Fatima and Riener, Gerhard, On the Norms of Charitable Giving in Islam: A Field Experiment, June 2012.
- 58 Duso, Tomaso, Gugler, Klaus and Szücs, Florian, An Empirical Assessment of the 2004 EU Merger Policy Reform, June 2012.
Published in: Economic Journal, 123 (2013), F596-F619.
- 57 Dewenter, Ralf and Heimeshoff, Ulrich, More Ads, More Revs? Is there a Media Bias in the Likelihood to be Reviewed?, June 2012.

- 56 Böckers, Veit, Heimeshoff, Ulrich and Müller Andrea, Pull-Forward Effects in the German Car Scrappage Scheme: A Time Series Approach, June 2012.
- 55 Kellner, Christian and Riener, Gerhard, The Effect of Ambiguity Aversion on Reward Scheme Choice, June 2012.
- 54 De Silva, Dakshina G., Kosmopoulou, Georgia, Pagel, Beatrice and Peeters, Ronald, The Impact of Timing on Bidding Behavior in Procurement Auctions of Contracts with Private Costs, June 2012.
Published in: Review of Industrial Organization, 41 (2013), pp.321-343.
- 53 Benndorf, Volker and Rau, Holger A., Competition in the Workplace: An Experimental Investigation, May 2012.
- 52 Haucap, Justus and Klein, Gordon J., How Regulation Affects Network and Service Quality in Related Markets, May 2012.
Published in: Economics Letters, 117 (2012), pp. 521-524.
- 51 Dewenter, Ralf and Heimeshoff, Ulrich, Less Pain at the Pump? The Effects of Regulatory Interventions in Retail Gasoline Markets, May 2012.
- 50 Böckers, Veit and Heimeshoff, Ulrich, The Extent of European Power Markets, April 2012.
- 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.
Forthcoming in: Telecommunications Policy.
- 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.
Published in: Telecommunications Policy, 36 (2012), pp. 595-607.
- 45 Graf, Julia, The Effects of Rebate Contracts on the Health Care System, March 2012,
Published in: The European Journal of Health Economics, 15 (2014), pp.477-487.
- 44 Pagel, Beatrice and Wey, Christian, Unionization Structures in International Oligopoly, February 2012.
Published in: Labour: Review of Labour Economics and Industrial Relations, 27 (2013), pp. 1-17.
- 43 Gu, Yiquan and Wenzel, Tobias, Price-Dependent Demand in Spatial Models, January 2012.
Published in: B. E. Journal of Economic Analysis & Policy, 12 (2012), Article 6.
- 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.
Forthcoming in: Telecommunications Policy.
- 41 Stühmeier, Torben and Wenzel, Tobias, Regulating Advertising in the Presence of Public Service Broadcasting, January 2012.
Published in: Review of Network Economics, 11/2 (2012), Article 1.

Older discussion papers can be found online at:
<http://ideas.repec.org/s/zbw/dicedp.html>

Heinrich-Heine-University of Düsseldorf

**Düsseldorf Institute for
Competition Economics (DICE)**

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