Düsseldorf Institute
for Competition Economics

DISCUSSION PAPER

No 163

The Impact of Local Loop and Retail Unbundling Revisited

Gordon J. Klein,
Julia Wendel

October 2014

HEINRICH HEINE
UNIVERSITÄT DÜSSELDORF

d|u|p düsseldorf university press

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

ISSN 2190-9938 (online) – ISBN 978-3-86304-162-5

The Impact of Local Loop and Retail Unbundling Revisited

Gordon J. Klein* and Julia Wendel#

October 2014

Abstract

For more than a decade the unbundling of telecommunications networks has been used as a regulatory means to stifle competition. However, despite its assumed positive effects on market entry and competition intensity, the negative effects on network investment incentives are widely shown in the theoretical literature. Therefore broadband penetration might also be affected negatively. In our paper we concentrate on the impact of local loop unbundling and Bitstream access on broadband penetration. Using a panel of European countries for a time period of 17 years, we find that the effect of unbundling on penetration is positive when an intermediate level of broadband penetration has been achieved in a country. However, this impact turns negative if the initial level of broadband penetration is rather low or high. We argue that this confirms possible negative effects on investment incentives, but may successfully lower prices to foster demand. These are two findings which should be carefully considered by policy makers when deciding on unbundling policies.

Keywords: Broadband Internet Penetration, Local Loop Unbundling, Bitstream Access, Policy Evaluation, Panel Data Analysis

---

* DICE,Heinrich-Heine-University, Düsseldorf; klein@dice.hhu.de
# Philipps-University Marburg; julia.wendel@wiwi.uni-marburg.de
We gratefully acknowledge data provided by Cullen International. Gordon J. Klein acknowledges financial support from the ANR-DFG research grant of the project "Competition and Bargaining in Vertical Chains."We thank participants of the 25th ITS European Regional Conference for comments and suggestions. Moreover, we would like to thank Germain Gaudin, Ulrich Heimeshoff and Wolfgang Kerber for valuable comments. All remaining errors are ours.

1. Introduction

Access to broadband networks[1] is widely considered to be an important driver for both economic and social development.[2] It is no surprise that given the large economic difficulties among many —particularly European— countries, specific political strategies to stimulate digital development have been designed (e.g., the EU initiative "Digital Agenda for Europe")[3] to pursue a wide broadband uptake in the population. However, there is a considerable diversity in the adoption path of broadband across industrialized countries over time and presently.[4] Hereby, countries not only face the problem of getting non-adopters on board, but they also need to roll out even faster broadband technologies such as Fiber-to-the-Curb (FTTC) or Fiber-to-the-Home (FTTH). Therefore, experience with policies fostering broadband penetration on old networks is needed to make appropriate decisions about future policies.

There are two main dimensions determining the penetration of broadband Internet, which can be summarized as availability and usage. Availability enables usage, but pure availability is not sufficient since the usage given availability is determined by demand, i.e., the combination of service quality and price. In addition, broadband is not available everywhere, even in countries with a generally good infrastructure.[5] Moreover, the factors are interrelated since a high usage of available infrastructure increases demand for future infrastructure.

Given the highly concentrated telecommunication markets, after the deregulation of the telecom sector in Europe, for many years the main issue was to increase competition to ensure efficiency and affordable prices. One method utilized to achieve the goal of a high level of broadband penetration was the regulatory means of "unbundling." This means has now been widely adopted across European countries for the regulation of traditional

[1] Broadband Internet access has been defined by the European Commission as "an access ensuring an always-on service with speeds in excess of 144 kbps. This speed is measured in download terms." (EC, 2013).
[2] See for example OECD (2009), Katz and Avila (2010). There are also several studies highlighting the positive effects of broadband investments for GDP, e.g., Czernich et al. (2011), Koutroumpis (2009).
[3] The initiative is part of the EU 2020 strategy, http://ec.europa.eu/digital-agenda/en/high-speed-broadband.
[4] See OECD (2014).
[5] An example is Germany, which started a government program to enhance coverage. http://www.bmvbw.bund.de/DE/Digitales/DigitaleInfrastrukturen/Breitbandstrategie/breitbandstrategie_node.html.

copper-based networks.[6] Unbundling allows competitors in concentrated markets to use parts of the incumbent's network infrastructure. This should help to increase complementary investment and to enhance competition in final customer markets, typically leading to lower prices.[7] On the other hand, those obligations to share infrastructure for a regulator-defined compensation may potentially lower the investment incentives of incumbents, due to a direct impact on the value of the investments.[8] Given the fact that new Fiber-based networks may also face the same concentration process, it becomes evident that those regulatory means may also be relevant for the regulation of future networks.

In particular, taking into account these two discussed effects, it is a priori not obvious whether the effect of unbundling on the penetration with broadband Internet is either positive or negative. This has motivated several empirical studies to investigate this impact. However, the results are not clear-cut. While some analyses find positive correlations of the impact of unbundling on broadband penetration,[9] others suggest that the impact is neither positive throughout nor statistically significant.[10] However, a number of studies find the opposite and claim this to be a long-run impact due to a lack of investments.[11] Recent research also distinguishes between different levels of interference, i.e., retail unbundling and local loop unbundling. One main issue seems to be that the impact appears to be heterogeneous across countries, depending on the particular environment. The literature has tried to disentangle different circumstances (employment, GDP)[12] as well as timing effects (years since unbundling),[13] but has not provided a satisfying reasoning as to when unbundling may have a positive or negative effect.[14]

The lack of understanding of the particular impact of those unbundling policies is not only relevant from a historic perspective, but has importance for any future regulation of new

---

[6] See Table (2).
[7] See Cave (2006).
[8] See Hausman and Sidak (2005).
[9] See Grosso (2006), Garcia-Murillo (2005) for middle-income countries.
[10] See Wallsten (2006).
[11] See Crandall et al (2013). Pindyck (2007) finds a tradeoff between the interests of entrants for low wholesale prices and the incumbents' interest in long-term incentives for infrastructure investments; a discussion on the potential negative economic effects for innovation and new investment by setting cost-based prices for an unbundled infrastructure is presented by Hausman and Sidak (2005).
[12] See Crandall et al (2013).
[13] See de Ridder (2007), Boyle, Howell and Zhang (2008), Gruber and Koutroumpis (2013).
[14] This is discussed in more detail in the literature review.

Fiber (e.g., Fiber to the home [FTTH]) networks as well. Given the discussed trade-offs the particular impact and the particular threats have to be considered for future policies. This is what our paper analyzes. We use a panel of European countries' broadband data and investigate how the impact of (retail) local loop unbundling on penetration depends on the achieved level of broadband penetration. We find that the the impact of unbundling on penetration is positive when an intermediate level of broadband penetration has been achieved. However, the effect turns negative if the initial level of broadband penetration is rather low or high. In the tail end of the distribution investments are important, for rolling out the general network and to close any gaps.[15] This is consistent with the earlier literature which pronounced a negative impact of long-term investments. These findings help regulatory agencies use the means of unbundling more specificly in situations where the benefits over-compensate the potentially negative investment effects. These findings are important for the regulation of future networks such as FTTH. In particular, unbundling policies may be harmful at an early stage of deployment, while they can be beneficial after a solid roll-out that leads to a certain high level of technology penetration.

The rest of the paper is organized as follows. In section 2, we describe the related literature, in section 3 we discuss the empirical strategy including the data available. Section 4 provides the results and section 5 concludes.

2. Literature Review

In network industries, the rationale for access regulation is to intensify competition and therewith ensure efficiency and social welfare. Considering a **static** environment, with open access to competitors, competition is increased, which decreases margins and prices ultimately leading to a higher consumer surplus. In **dynamic** settings, however, as in the case of telecommunication markets, the relationship between access regulation and welfare is more complex. As outlined by Laffont and Tirole (2000, 7, 208), lower access prices might increase competition in the short term, but might also undermine incumbents' incentives to invest in the network. Higher access prices promote greater incentives to invest[16] but

[15] As a side result, we find also some more positive long-run effects of Local Loop Unbundling, also in lower parts of the broadband distribution while we find negative of Bitstream Access on higher parts of the distribution.

[16] See e.g., Pindyck (2007), Weisman (2005) for growing investment in service quality with a growing level of price cap.

hamper the entrants' use of the incumbents' infrastructure[17] (and thus reduces competition). As access regulation lowers market entry barriers, entrants' might see lower incentives to invest in own network elements since the infrastructure can be leased from incumbents at prescribed prices. The general regulatory challenge is therefore to promote short- and long-term investment by meanwhile encouraging competition.[18]

The political (and most of the academic) discussion in this context focuses on the stimulation of a high adoption of broadband as a vital goal of access regulation. This seems to be plausible, as penetration can be assumed to be a relatively good proxy for output and consumer welfare by capturing both the static and dynamic effects of unbundling (see Crandall et al 2013, 266). Therefore, the following section reviews the key arguments made in the literature concerning the effects of unbundling on the level of broadband penetration.

From a short-term perspective, a regulator has to consider the demand-side effects of unbundled access. Since unbundling the local loop allows competitors to use parts of the incumbents' network infrastructure, an increase of competition at the retail level is expected. There are therefore positive effects on the side of the customers as lower prices (compared to an unregulated monopolistic situation) and, accordingly, higher demand is assumed.

The positive effects of unbundling on broadband adoption have been shown under specific settings. Garcia-Murillo (2005), for example, suggests that such an impact exists for countries with a middle income. However, covering 18 countries and cross-sectional data with a time horizon limited to the year 2001, the number of observations is rather low. Grosso (2006) also uses cross-sectional panel data on 30 OECD countries for the time period 2000 to 2005. In order to capture technology adoption effects, the assumption that potential broadband consumers base part of their decision to consume broadband upon previous penetration levels is applied. One result of the study is that unbundling (and therefore an

[17]Bourreau and Dogan (2005, 2006); Avenali et al (2010) show that a rising access charge over time is critical to foster competitive investment by alternative operators; an excellent literature review on broadband investment and regulation can be found in Cambini and Jiang (2009).

[18] The problem is even more complicated if one considers possible investments in complementary services. Haucap and Klein (2012) show that in those circumstances tighter regulation may lead to benefits for the complementary services which may even compensate for losses in the regulated market, but may also lead to losses of investment incentives in both markets.

increase in competition) encourages broadband penetration. This explicit inclusion of former time periods has also been adopted by de Ridder (2007), who assumes that the effect of an unbundling policy in a particular country and year might be a function of the number of years unbundling has been in place. Using a panel covering 30 OECD countries for 2005 and quite low observation numbers, the author concludes that unbundling has a statistically significant positive effect on household penetration rates. Still, the literature has shown that the results uncovered are presumably not robust in adding further information.[19]

In contrast to earlier studies, which are often limited in data availability, a more recent study on the issue, Gruber and Koutroumpis (2013) base their analysis on a broader data basis (covering 167 countries in the time period 2000 until 2010). The authors find that broadband adoption is encouraged in several ways by regulatory unbundling. What is vital is the consideration of diverging (technological and regulatory) diffusion patterns across countries over time. If local loop unbundling is in place, the effects of its introduction and subsequent year-effects on broadband penetration are found to be always positive and significant. However, the effects reach a peak in the third year after the introduction of unbundling and then they diminish (Gruber and Koutroumpis, 2013, 182, 192). Their study highlights important dynamic aspects without, however, describing the underlying mechanism in place to determine the effects observed. Contrary to those studies, the literature finds several examples where the effects of unbundling on broadband penetration are either negative or insignificant.

The effects of mandatory access on static efficiency and in particular investment incentives depend to a large extent on how access prices are regulated. If entrants have to pay low fees in order to get access, an increase in penetration, caused by higher incentive for entrants to provide services is expected. As confirmed by Distaso et al (2006), who find for the time period 2000 to2004, covering 14 countries, that a lower price of LLU stimulates broadband adoption.

[19]However, as also outlined in more detail by Crandall et al (2013, 267), Boyle, Howell and Zhang (2008) correct the approach of de Ridder and reverse his results.

However, many studies claim that by setting low access prices investment incentives for incumbents may determine broadband adoption in the middle and long-run.[20] A study by Wallsten (2006) uses a panel of 30 OECD countries and shows that any positive effect of local loop unbundling as well of bitstream access vanishes if someone controls for country and year fixed effects. However one drawback is that the timeframe considered is rather short. This neutral effect also corresponds to findings by Distaso et al (2006), showing that competition in the retail market does not play a significant role for broadband adoption.[21]

In a recent study, Crandall et al. (2013) use a panel from OECD countries for the period between 2001 and 2010 —and therefore extend the time period of Wallsten (2006)—to study the long-term impact on broadband penetration rates. They use an OLS approach controlling for several economic drivers as well as the time since the DSL introduction and can identify even a negative correlation.

One reason for this possible negative effect is related to the possible negative dynamic effect, caused by a reduction of investment incentives.[22] In European telecommunications, which is relevant for the sample we use, national regulators widely adopt a regulatory approach, which includes the idea of a "ladder of investment," as proposed by Cave (2006). The concept of a ladder should reflect the idea that entrants acquire, as a first "rung," access to the incumbents' infrastructure at a level which typically requires little investment to provide a service (e.g., resale) and are supposed to climb this ladder henceforth, motivated by increasing prices for the climbed rungs.[23] Even if the real validity of the ladder of investment is challenging, empirical approaches did not verify its clear existence (e.g.,Hausman and Sidak 2005) and practical problems in its implementation exist,[24] the ultimate goal to invest in new lines is clearly stated. This possibility of platform competition is assumed to bring greater benefits in various terms, e.g., in long-term pricing and the

[20] For an overview of the most current studies, see Crandall et al. (2013, p. 268).

[21] Denni and Gruber (2005), find contrary findings using semi-annual data from the US, including the years 1999 until 2004. The authors are able to show the positive effects of intra-platform competition (incumbents vs. entrants) on broadband penetration. However, over time, this positive influence is found to disappear.

[22] See also Grajek and Röller (2012) on the negative impact of regulation on investments.

[23] The underlying idea is that service-based entry and facility-based entry are seen as complements, with the ladder of investment as a means to solve the trade-off, that service-based entry promotes short-run competition and facility-based entry fosters long-run (and therefore sustainable) competition (Bourreau et al 2010).

[24] As an example, Poel (2006) reports on the practical problems of increasing access prices in the Netherlands.

consideration of innovations and investment. Bouckaert et al (2010), covering data of 19 OECD countries in the time period 2003 to2008 and a sufficient number of observations, identify platform competition as a main driver for broadband diffusion. As the final customer is still served by the same subscriber line, local loop unbundling does not lead to inter-platform competition. This is confirmed by Bacache et al (2014), who do not find that local loop unbundling leads to new infrastructure deployment.

3. Empirical strategy

3.1 Data

The dataset used in this study is based on different sources. The first data we use is the World Telecommunication/ICT Indicators database, provided by the International Telecommunication Union (ITU). This dataset contains statistics on ICT access for countries worldwide on an annual basis and provides us with the broadband penetration, which is labeled as "Fixed (wired)-broadband subscriptions per 100 inhabitants." We clearly do not consider mobile broadband and rely only on fixed subscriptions. Given the used sample, this is a reasonable assumption. Since we want to identify the effect for a segment of comparably developed countries we take into account a panel of 16 EU and non-EU countries[25] throughout the years 1997 to 2013. The broadband penetration develops in an S-curvature, as can be seen in table (1).[26] This diffusion process is characteristic of the adoption of a new technology over time in a market.[27] Since investment requirements differ significantly, depending on where on the diffusion curve technology is,[28] the impact of mandated infrastructure is assumed to depend on the given spread of a technology.

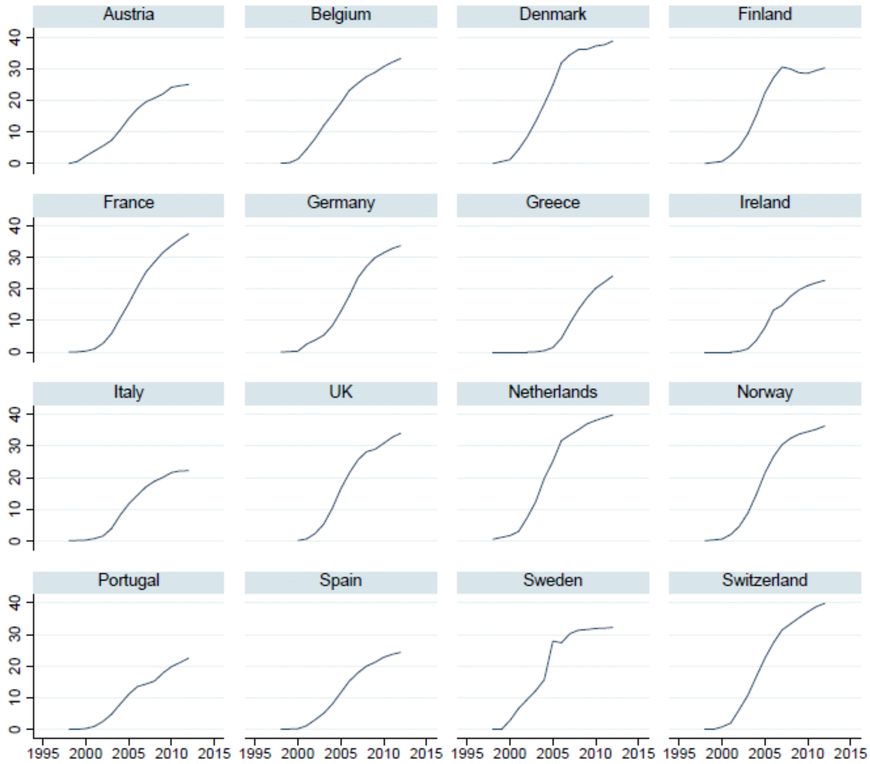
[25] The countries are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the UK. For other countries, such as Luxembourg, our data availability was not sufficient.

[26] Our study diverges to several previous studies that use further information as GDP, population density to describe differences across countries. However, we use country fixed effects that take account of this particular information more precisely as those can be summarized as time-invariant country-specific heterogeneity, which is exactly what we consider due to fixed effects estimation.

[27] The first illustration of the cumulative adoption of an innovation over time as a horizontal S-shaped curve was done by Rogers (1995).

[28] Applied to the fixed telecommunications sector, this means high initial investments in local loop broadband access were required (e.g. Bouwman et al. (2006), Gruber and Koutroumpis (2013). But also to connect remote households with broadband access after broadband technology has been widely spread, is assumed to require a particular high level of investment. This is often encouraged by governmental activities; see, for example, the United Kingdom: https://www.gov.uk/government/policies/transforming-uk-broadband.

Table 1: Fixed broadband subscriptions per 100 inhabitants over time



Source: ITU data

We are primarily interested in identifying the introduction effect from distinct levels of mandated infrastructure division. Therefore, we collected information on the formal introduction of Local Loop Unbundling (LLU) and Bitstream Access (BSA). A key difference between the two levels of access is the amount the entrant has to invest to get access to the incumbents' network.

Local loop unbundling occurs when entrants have to build a core network down to the local exchanges of the incumbent, and to install their own broadband equipment.[29]On the other hand, with Bitstream access the entrant leases access to the incumbents' high bandwidth architecture. The latter chooses the technology and decides on its investment plan.[30] Therefore, we understand Bitstream Access to be a type of retail unbundling. Since for Local Loop Unbundling a higher level of investment is needed (compared to Bitstream Access), we assume Bitstream Access increases retail competition more quickly.

[29] This is the installation of a Digital Subscriber Line Access Multiplexers (in short: DSLAMs) in the incumbent's local exchanges.

[30] Bourreau and Dogan (2004); However, entrants need to invest in a data network of their own, see Bacache et al (2014).

To collect information on the formal introduction of the two means in the countries under observation we use various sources. The particular introduction date is taken from OECD (2005), Cullen International[31] and DIW (2006). Moreover, as the identification of the exact date of the formal introduction of an access obligation was not always easy, e.g., in cases where an unbundling offer was potentially given on the market before the authority requested it, we conducted a small survey ourselves. Therewith, we addressed the respective National Regulatory Authorities and asked them for the date of their first formal obligation on the incumbent to share access in terms of LLU and BSA.[32] The following table (2) provides a detailed overview of the data sources:

Table 2: Introduction Dates Local Loop and Bitstream Access

	Full Unbundling		Bitstream Access	
Country	Year	Source	Year	Source
Austria	1999	OECD 2005, RTR	2000	RTR
Belgium	2000	OECD 2005: in place since 2001_3; BIPT Annual Report 2001: 2000_12	2001	BIPT
Denmark	1998	OECD 2005	2000	OECD 2005
Finland	1996	OECD 2005	2004	FICORA 2004
France	2000	OECD 2005: 2001_1; ARCEP	2001	ARCEP
Germany	1998	OECD 2005, Cullen	2006	BNetzA
Greece	2001	OECD 2005, EETT	2006	EETT
Ireland	2001	OECD 2005	2000	Cullen International
Italy	2000	OECD 2005, AGCOM	2000	Gallo E./Pontarollo, E, in: DIW (2006), p. 10
Netherlands	1999	OECD 2005: (since 1997_12 available); OPTA Guidelines 1999_3; Implementation EC Directive 2001_1	2003	Gallo E./Pontarollo, E, in: DIW (2006), p. 10
Norway	2001	OECD 2005; NPT	2001	NPT
Portugal	2001	OECD 2005; ANACOM	2000	ANACOM
Spain	2001	OECD 2005	1999	Cullen International
Sweden	2000	PTS	2004	PTS
Switzerland*	2007	COMCOM	2007	COMCOM
UK	1999	OFCOM	2004	OFCOM

* Special case Switzerland: Here LLU and BSA are regulated not ex-ante, but ex-post

[31] Cullen International is a regulatory consultancy in Brussels which undertook encompassing data collection on European telecommunication markets.

[32] Up to our knowledge LLU and BSA remained in place until end of 2013 after their introduction. One exception is the Netherlands, where the regulators decision to introduce bitstream in May 2003 has been overruled by Court in December 2003 (Baacke 2006, 3). Therefore, we treat only 2003 as being regulated with BSA.

3.2 Econometric Model

In order to analyse the impact of the regulatory introduction of local loop and retail unbundling we investigate controlled correlates of broadband penetration with the two unbundling policies (local loop unbundling and retail unbundling). The main issue we are concerned with is the unobserved heterogeneity across our units of investigation as well as omitted variable bias. We tackle this by controlling for country-fixed effects as well as a linear time trend. Moreover, we control for past broadband penetration, which allows the observed variety to be captured. This allows us to consider unbundling as a heterogeneous policy (LLU as well as BSA). We estimate the following relationship:

$$BBP_{i,t} = f(Unbundling_{i,t-1} + BBP_{i,t-1} + Unbundling_{i,t-1}xBBP_{i,t-1} + TimeTrend_{i,t} + CountryFE_i)$$

Where $BBP_{i,t}$ is the broadband penetration rate, Unbundling is a vector of different unbundling strategies (LLU,BSA, interactions of both or none), to capture the heterogeneity of the different policies,$BBP_{i,t-1}$, controls for past broadband penetration since we assume that the past usage also has an impact on current penetration. The interaction between Unbundling and BBP ($Unbundling_{i,t-1}xBBP_{i,t-1}$) is used to investigate for which parts of the penetration distribution we can find heterogeneous effects of unbundling. This allows us to go further than the existing literature when there is a potentially positive or negative impact of unbundling on the penetration rate. To analyse the past penetration rate we use, besides the linear form, also a non-linear one and use the quartile of each countries penetration distribution (between 1997 and 2013) to interact this with the Unbundling variable. We use country individual effects as in all countries the S-shaped distribution is nearly close to the satisfaction rate, however, with different end values. The variable $TimeTrend_{i,t}$ captures a linear time trend to capture an international trend to more general usage, for instance, given by an increasing supply of applications.[33] $CountryFE_i$ takes care of unobserved countrywide heterogeneity that is time-invariant.

[33] Given the small size of the data a non-linear time trend using annual dummies cannot be used since this would lead to too many degrees of freedom for the estimation.

The estimation remains a controlled correlation and can neither infer causality since good instruments are missing, nor can it add many more controls given the limited sample size, which may lead to a course of dimensionality. Still, it adds more details than the existing studies and can in particular explain the heterogeneous effects of unbundling found in the literature.

4. Results

Table (3) provides the basic estimates for the relationship between unbundling and broadband penetration. Column (1) provides a simple OLS regression correlating LLU and BSA with broadband penetration and positive correlations showing that in the years with higher broadband penetration, the values are more prevalent. Since unbundling has been introduced and is not observed to have been abolished, the estimation clearly overestimates the impact, not controlling for the time trend. Column (2) considers this time trend such that the coefficient for LLU turns out to switch to a negative value, as BSA also does, but in addition, BSA becomes insignificant. This corresponds to the results found, for instance, by Crandall et al. (2013) for a similar framework, identifying a negative effect of LLU. Column (3) now uses a fixed effects regression with the country being the level of the fixed effects. While the effect for BSA turns positive again, the impact of LLU remains negative. However, both effects become insignificant. A major issue in many studies is that they do not take into account the broadband penetration in earlier periods. This is considered in column (4) by introducing the lagged penetration rate. Controlling for past broadband penetration leads to a change in the estimations results for LLU as the sign of the coefficient switches again. Similar, the effect for BSA becomes significant. The now positive sign in LLU is similar to the result found by Gruber et al. (2013). However, their results are for a very different sample of more worldwide countries which have very heterogeneous conditions. These initial conditions captured by the earlier penetration rate may now be a reason for the different conditions.

Table 3:

dependent Var: Broadband Penetration	*(1)* *OLS*	*(2)* *OLS*	*(3)* *Fixed Effect*	*(4)* *Fixed Effect*
LLU (1 lag)	11.3044***	-2.0268**	-2.6036	1.6151**
	(1.7939)	(0.9595)	(1.612)	0.6416)
BSA (1 lag)	10.0369***	-0.4795	1.9061	2.1596***
	(1.8801)	(1.1428)	(1.5056)	(0.4393)
Broadband Penetration (1 lag)				0.8764***
				(0.0235)
Year		2.8293***	2.6869***	0.0858
		(0.1327)	(0.153)	(0.0748)
Constant	0.0716	-5655.3942***	-5371.0957***	-170.9672
	(0.8356)	(265.2136)	(306.5286)	(149.3979)
R^2	0.37	0.7894	0.8997	0.9805
Observations	231	231	231	208

Heteroskedasticity-robust standard errors in parentheses. Fixed Effects on country level.
***, **, * statistically significant at1, 5, 10% level.

Table (4) investigates the interaction with the past broadband penetration rate. Column (1) introduces the interaction terms of LLU and BSA with the past broadband penetration rate. The main coefficient remains positive for both LLU and BSA, but the interaction with the past penetration rate becomes negative for LLU. However, the impact of BSA becomes insignificant and must be interpreted as zero. The coefficient for LLU indicates that, given a particular size of the overall penetration rate (approximately 12-13%), the positive coefficient switches from positive to negative. This indicates that the impact of unbundling, but is dependent on the particular size of the already achieved penetration. Clearly, the interaction remains linear in column (1) so that column (2) investigates non-linearity in the relationship between unbundling and past penetration. Column (2) therefore uses an interaction between LLU and an indicator variable capturing in which quartile of the lowest and highest observed value for penetration within the time series of a particular country the observation lies. It becomes evident that the interaction is very different for each quartile. In particular, in the two mid-quartiles there is hardly any effect of the interactions while in the first and last quartile there is a strong negative effect that outweighs slightly the positive basic effect. This result indicates that in the mid-range of penetration, positive effects can be gained with LLU, but negative effects are to be expected in the first and last stages of diffusion. This finding corresponds to the observed findings that investments are particular relevant if a network is initially set up and connected to the last regions, which are probably the most rural and unprofitable regions. The effect can also be explained by the not working ladder-of-investment shown by Bacache et al. (2014), since the ladder of investment expects that after entrants gained enough market shares they may be more prevalent to invest into networks to get the last users on board. The same analysis is provided for BSA in column (3). Here we can observe that in the outer tails of the distribution the interaction effect of unbundling is also negative for penetration while it is zero for the mid-parts. The overall effect seems to be close to zero in the tails with the effect for the first quartile being slightly negative. This non-linearity disentangles the impact of unbundling on the broadband penetration such that the differences between the findings in the literature can be explained.

Table 4:

dependent Var: Broadband Penetration	*(1)* *Fixed Effect*	*(2)* *Fixed Effect*	*(3)* *Fixed Effect*
Broadband Penetration (1 lag)	0.9554***	0.9298***	0.9211***
	(0.1354)	(0.0329)	(0.0299)
LLU (1 lag)	2.1693***	2.0748***	1.8001***
	(0.5373)	(0.5474)	(0.5024)
LLU x Broadband Penetration (1 lag)	-0.1719***		
	(0.0207)		
BSA (1 lag)	1.0596	1.6357***	2.2019***
	(0.622)	(0.3663)	(0.3928)
BSA x Broadband Penetration (1 lag)	0.1449		
	(0.1085)		
LLU x BBP_quart1 (1Lag)		-2.2083***	
		(0.398)	
LLU x BBP_quart2 (1Lag)		0.2078	
		(0.4868)	
LLU x BBP_quart3 (1Lag)		0.0205	
		(0.4939)	
LLU x BBP_quart4 (1Lag)		-2.4454***	
		(0.5144)	
BSA x BBP_quart1 (1 lag)			-2.3904***
			(0.4254)
BSA x BBP_quart2 (1 lag)			0.1746
			(0.4842)
BSA x BBP_quart3 (1 lag)			0.2044
			(0.5148)
BSA x BBP_quart4 (1 lag)			-2.0960***
			(0.5778)
Year	0.0023	0.0138	-0.0028
	(0.0867)	(0.0806)	(0.0801)
Constant	-3.9229	-26.789	6.3248
	(173.1751)	(161.2228)	(160.2349)
R^2	0.9843	0.9844	0.9837
Observations	208	208	208

Heteroskedasticity-robust standard errors in parentheses. Fixed Effects on country level.
***, **, * statistically significant on 1, 5, 10% level.

The differences in the two unbundling strategies may be explained in the speed of diffusion of the two policies. While BSA will increase retail competition more rapidly, LLU may require time since investments have to been made. Therefore, table (5) analyzes the difference in the timing using lags for the two different policies. Column (1) uses the first three lags of each unbundling variable. Interestingly, the first two are insignificant for the LLU while the third is significantly positive. This corresponds to the findings of Gruber and Koutroumpis (2013) showing that the effect of unbundling is strongest after three years. The opposite can be observed for the BSA variable. Here, the first is significantly positive, while the second and third are insignificant. Column (2) now investigates whether the interactions between the penetration quartiles used in table (2) are also relevant in this context. It can be shown that the overall impact of LLU is positive and is even more relevant in the first quartile, while it is negative for interaction of the third and fourth (with the overall effect being positive for the third and close to zero for the fourth). This indicates that the impact considering a lag can be positive. Column (3) provides the same analysis as column (2) but now for BSA. The level effect, however, remains insignificant, which corresponds to the insignificant effect of column (1) for the third lag. The interactions for the third and fourth quartile become significantly negative such that a negative long run effects are to be expected. This is consistent with a lower investment requirement for BSA and may be explained by crowding out of other entrants or incumbents investments. Column (4) now estimates the quartiles of the first and third period of LLU and penetration showing that the finding of table (2) and column (2) table (3) hold, indicating that shortly after the introduction of LLU there is a negative impact of LLU unbundling on the tails of the lagged penetration, but a positive for the mid-distribution. However, there is a lagged positive impact of the LLU after a couple of periods for the whole distribution, pronounced in the first quartile as well as a slightly negative, but close to zero in the last quartile. The reasoning of these results may be explained by the longer timeframe until positive demand side effects can be generated, while the negative incentive on investment directly arises. Given the small data, it is hardly possible to describe which effects dominates, but it clearly shows that a regulatory agency has to take into account various trade-offs when deciding on a policy.[34]

[34] We cannot provide the same estimation of BSA as in column (4) provided with LLU, because the particular distribution of BSA leads to the usage of too many degrees of freedom for the observation and failing F-Test.

Table 5:

dependent Var: Broadband Penetration	*(1)* *Fixed Effect*	*(2)* *Fixed Effect*	*(3)* *Fixed Effect*	*(4)* *Fixed Effect*
Broadband Penetration (1 lag)	0.8648***	0.8878***	0.8754***	0.9181***
	(0.0278)	(0.0305)	(0.0313)	(0.0339)
LLU (1 lag)	0.4848	0.3977	0.4373	1.0056**
	(0.4085)	(0.432)	(0.4134)	(0.456)
LLU (2 lag)	0.0937	0.0689	-0.0069	0.2681
	(0.303)	(0.314)	(0.3306)	(0.2934)
LLU (3 lag)	2.0031***	1.6237***	1.7994***	1.5541***
	(0.4574)	(0.4021)	(0.436)	(0.3926)
BSA (1 Lag)	1.7553***	1.6293***	1.6356***	1.6582***
	(0.5123)	(0.4916)	(0.5026)	(0.3173)
BSA (2 Lag)	0.178	0.0476	0.1246	
	(0.438)	(0.4195)	(0.4295)	
BSA (3 Lag)	0.9559	0.7778	0.8036	
	(0.5923)	(0.5619)	(0.6832)	
LLU x BBP_quart1 (3Lag)		0.9402		1.2005***
		(0.5584)		(0.3744)
LLU x BBP_quart1 (1Lag)				-2.2997***
				(0.4278)
LLU x BBP_quart2 (3Lag)		1.0550**		0.5464
		(0.4489)		(0.5019)
LLU x BBP_quart2 (1Lag)				-0.6683
				(0.4615)
LLU x BBP_quart3 (3Lag)		-0.7438*		-0.5847
		(0.4237)		(0.4251)
LLU x BBP_quart3 (1Lag)				-0.0564
				(0.5302)
LLU x BBP_quart4 (3Lag)		-1.5872***		-0.8492*
		(0.5178)		(0.4408)
LLU x BBP_quart4 (1Lag)				-1.6630***
				(0.5344)
BSA x BBP_quart1 (3 lag)			0.4385	
			(0.5729)	
BSA x BBP_quart2 (3 lag)			0.7384	
			(0.5555)	
BSA x BBP_quart3 (3 lag)			-0.9031*	
			(0.4894)	
BSA x BBP_quart4 (3 lag)			-1.8600***	
			(0.5714)	
Year	-0.066	-0.0041	0.013	-0.0358
	(0.0765)	(0.1027)	(0.104)	(0.0964)
Constant	132.7543	9.0471	-25.0805	72.4109
	-152.9251	-205.3995	-207.8822	-192.7306
R^2	0.9831	0.9852	0.9849	0.9863
Observations	200	200	200	200

Heteroskedasticity-robust standard errors in parentheses. Fixed Effects on country level. ***, **, * statistically significant on 1, 5, 10% level.

5. Conclusion

Our paper adds new insights to the discussion about the effects of unbundling on broadband penetration. In particular, we are able to show that previous results showing an either positive or negative impact of unbundling can be confirmed and explained by the given level of broadband penetration. Depending on the initial level of broadband penetration the effects of broadband can be either positive or negative. This ambiguous effect can be explained by the different necessity of investments. We conclude that unbundling policies should be used when there is a need to stifle demand side effects when a proper network has already been rolled out. These findings can help policy makers to design policies intended to foster broadband usage more carefully. To be more precise, they can also indicate when implementing a tight regulation may backfire. Therefore the non-implementation of such a policy may be the better option.

This is particularly relevant when deciding on new networks such as FTTH. Hereby, in the case of young, not fully developed, networks, mandated infrastructure access may not promote the penetration of technology usage. Thus accordingly, the installation of unbundling may be an option at a later stage of the penetration development, if there is no infrastructure competition.

As a side result, we are able to show that the long-run effects of LLU are different to those of BSA. While we can observe more positive long-run effects of LLU, BSA seems to have negative long-run effects on developed networks.

References

Avenali, A., Matteucci, G. & Reverberi, P. (2010). Dynamic access pricing and investment in alternative infrastructures. *International Journal of Industrial Organization*, 28 (2), 167–175.

Baacke, P.(2006). Introduction, in P. Baake/B. Preissl (Eds), Local loop unbundling and bitstream access: Regulatory practice in Europe and the US. Politikberatung kompakt 20, DIW Berlin.

Bacache, M., Bourreau, M. & Gaudin, G. (2014). Dynamic Entry and Investment in New Infrastructures: Empirical Evidence from the Fixed Broadband Industry. *Review of Industrial Organization*, 44, 179–206.

Bouckaert, J., van Dijk, T. & Verboven, F. (2010). Access regulation, competition, and broadband penetration: An international study. *Telecommunication Policy*, 34, 661–671.

Bourreau, M. &Dogan, P. (2005).Unbundling of the Local Loop. *European Economic Review*, 49(1), 173–199.

Bourreau, M. & Dogan, P. (2006). "Built-or-buy" strategies in the local loop.*American Economic Review*, 96(2), 72–76.

Bouwman, H., Fijnvandraat, M. & van de Wijngaert, L. (2006). White spots and black holes: developing a conceptual model for broadband rollout. *Info*, 8(1), 72–90. Available at: http://www.emeraldinsight.com/doi/pdfplus/10.1108/14636690610643294.

Boyle, G., Howell, B. & Zhang, W. (2008). Catching up in Broadband Regressions: Does Local Loop Unbundling Really Lead to Material Increases in OECD Broadband Uptake? Available at http://ssrn.com/abstract=1184339

Cambini, C. & Jiang, Y. (2009). Broadband investment and regulation: A literature review. *Telecommunication Policy*, 33, 559–574.

Cave, M.(2006): Encouraging Infrastructure Competition through the Ladder of Investment. *Telecommunication Policy*, 30, 223–237.

Crandall, R., Ingraham, A. & Singer, H. (2004). Do Unbundling Policies Discourage CLEC Facility-Based Investment? *Topics in Economic Analysis & Policy*, 4 (1), 1–23.

Crandall, R., Eisenach, J. A. & Ingraham, A.T. (2013). The long-run effects of copper-loop unbundling and the implications for fiber. *Telecommuncation Policy*, 37, 262–281.

Cullen International (1998 - 2012). Western Europe Telecom Cross-Country Analysis. (unpublished manuscripts).

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. (2005). The diffusion of broadband telecommunications: the role of competition. Available at SSRN:
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=829504.

Deutsches Institut für Wirtschaftsforschung (DIW, 2006). Local Loop Unbundling and Bitstream Access: Regulatory Practice in Europe and the U.S., Politikberatung kompakt, 20.

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), 677–699.

European Commission (2013). Broadband Internet Access Cost (BIAC). Final Report, Information Society and Media Directorate-General.Van Dijk – Management Consulting.
Available at: https://ec.europa.eu/digital-agenda/en/news/study-retail-broadband-access-prices-2013-smart-20100038.

Gallo E. & Pontarollo, E.(2006). From facility-based competition to equality of access: The Italian way, In P. Baake/B. Preissl (Eds), Local loop unbundling and bitstream access: Regulatory practice in Europe and the US. Politikberatung kompakt 20, DIW Berlin.

Garcia-Murillo, M. (2005). International Broadband Deployment: The Impact of Unbundling. Communication & Strategies, 57, 83–107.

Grajek, M. & Röller, L-H. (2012). Regulation and Investment in Network Industries: Evidence from European Telecoms. *Journal of Law and Economics*, 55 (1), 189–216.

Grosso, M. (2006). Determinants of broadband penetration in OECD nations, Working Paper, Regulatory Development Branch, Australian Competition and Consumer Commission.

Gruber, H. & Koutroumpis, P.(2013). Competition enhancing regulation and diffusion of innovation: the case of broadband networks. *Journal of Regulatory Economics*, 43, 168–195.

Haucap, J. & Klein, G**.** (2012). How Regulation Affects Network and Service Quality in Related Markets, *Economics Letters*, 117, 521–524.

Hausman, J. A. & Sidak, J. G. (2005). Did Mandatory Unbundling Achieve Its Purpose? Empirical Evidence from Five Countries. *Journal of Competition Law & Economics*, 1, 173–245.

Katz, R. L. & Avila, J. G. (2010). The impact of broadband policy on the economy. Presented at the 4th ACORN-REDECOM Conference, May 14–15, Brasilia. Available at: from http://www.acorn-redecom.org/papers/acornredecom2010katz.pdf.

Koutroumpis, P. (2009). The Economic Impact of Broadband on Growth: A Simultaneous Approach. *Telecommunications Policy*, 33(9), 471–485.

Laffont, J. &Tirole, J. (2000). Competition in Telecommunications, Cambridge, MA: MIT Press.

OECD (2005). OECD Communications Outlook. Available at: http://www.oecd.org/internet/ieconomy/oecdcommunicationsoutlook2005.htm.

OECD (2009). Network Developments in Support of Innovation and User Needs. Available at: http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&cote=dsti/iccp/cisp%282009%292/final.

OECD (2014). OECD Broadband Portal. Available at http://www.oecd.org/sti/broadband/oecdbroadbandportal.htm.

Pindyck, R. (2007). Mandatory unbundling and irreversible investment in telecom networks. *Review of Network Economics*, 6 (3), 274–298.

Poel, M.(2006).Regulation of the local loop in the Netherlands. In P. Baake/B. Preissl (Eds), *Local loop unbundling and bitstream access: Regulatory practice in Europe and the US*. Politikberatung kompakt 20, DIW Berlin.

deRidder, J. (2007). Catching-up in broadband- what will it take? Available at SSRN: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2118202.

Rogers, E. M. (1995). The diffusion of innovations, 4th edition, New York: Free Press.

Wallsten, S. (2006). Broadband and unbundling regulations in OECD countries. AIE-Brookings Joint Center Working Paper No. 06-16. Available at SSRN: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=906865.

Weisman, D. L. (2005). Price regulation and quality. *Information Economics and Policy*, 17 (2), 165-174.

PREVIOUS DISCUSSION PAPERS

163 Klein, Gordon J. and Wendel, Julia, The Impact of Local Loop and Retail Unbundling Revisited, October 2014.

162 Dertwinkel-Kalt, Markus, Haucap, Justus and Wey, Christian, Raising Rivals' Costs Through Buyer Power, October 2014.

161 Dertwinkel-Kalt, Markus and Köhler, Katrin, Exchange Asymmetries for Bads? Experimental Evidence, October 2014.

160 Behrens, Kristian, Mion, Giordano, Murata, Yasusada and Suedekum, Jens, Spatial Frictions, September 2014.

159 Fonseca, Miguel A. and Normann, Hans-Theo, Endogenous Cartel Formation: Experimental Evidence, August 2014.
Forthcoming in: Economics Letters.

158 Stiebale, Joel, Cross-Border M&As and Innovative Activity of Acquiring and Target Firms, August 2014.

157 Haucap, Justus and Heimeshoff, Ulrich, The Happiness of Economists: Estimating the Causal Effect of Studying Economics on Subjective Well-Being, August 2014.
Forthcoming in: International Review of Economics Education.

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.
Published in: Economics Letters, 125 (2014), pp.223-225.

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 (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 Personal Data, April 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.
Published in: Health Economics, 23 (2014), pp. 1036-1057.

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.
Published in: Review of Economics, 65 (2014), pp. 77-94.

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 Inventive 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.
Forthcoming in: Industrial and Corporate Change.

121 Hottenrott, Hanna and Lopes-Bento, Cindy, (International) R&D Collaboration and SMEs: The Effectiveness of Targeted Public R&D Support Schemes, December 2013.
Published in: Research Policy, 43 (2014), pp.1055-1066.

120 Giesen, Kristian and Suedekum, Jens, City Age and City Size, November 2013.
Published in: European Economic Review, 71 (2014), pp. 193-208.

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 Law and Economics under the title: "A Retrospective Merger Analysis in the UK Videogame 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.
Published in: Industrial and Corporate Change, 23 (2014), pp.1037-1057.

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.
Published in: Economics Letters, 125 (2014), pp. 32-35.

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.
Published in: Experimental Economics, 17 (2014), pp. 371-390.

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.
Forthcoming in: Journal of Industrial Economics.

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.
Published in: The Review of Economics and Statistics, 96 (2014), pp.349-370.

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.
Erscheint in: Economic Modelling.

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.
Published in: Economics Letters, 125 (2014), pp. 134-137.

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

ISSN 2190-9938 (online)
ISBN 978-3-86304-162-5