

Aghadadashli, Hamid; Dertwinkel-Kalt, Markus; Wey, Christian

Working Paper

The Nash bargaining solution in vertical relations with linear input prices

DICE Discussion Paper, No. 224

Provided in Cooperation with:

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

Suggested Citation: Aghadadashli, Hamid; Dertwinkel-Kalt, Markus; Wey, Christian (2016) : The Nash bargaining solution in vertical relations with linear input prices, DICE Discussion Paper, No. 224, ISBN 978-3-86304-223-3, Heinrich Heine University Düsseldorf, Düsseldorf Institute for Competition Economics (DICE), Düsseldorf

This Version is available at:

<https://hdl.handle.net/10419/142251>

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 224

The Nash Bargaining Solution in Vertical Relations With Linear Input Prices

Hamid Aghadadashli,
Markus Dertwinkel-Kalt,
Christian Wey

June 2016

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, 2016

ISSN 2190-9938 (online) – ISBN 978-3-86304-223-3

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 Nash Bargaining Solution in Vertical Relations With Linear Input Prices*

Hamid Aghadadashli[†] Markus Dertwinkel-Kalt[‡] Christian Wey[§]

June 2016

Abstract

We re-examine the Nash bargaining solution when an upstream and a downstream firm bargain over a linear input price. We show that the profit sharing rule is given by a simple and instructive formula which depends on the parties' disagreement payoffs, the profit weights in the Nash-product and the elasticity of derived demand. A downstream firm's profit share increases in the equilibrium derived demand elasticity which in turn depends on the final goods' demand elasticity. Our simple formula generalizes to bargaining with N downstream firms when bilateral contracts are unobservable.

JEL-Classification: L13

Keywords: Nash Bargaining, Demand Elasticity.

*We thank Germain Gaudin and Roman Inderst for thier valuable comments. We also benefited from presentations at the 2016 IIOC conference (Philadelphia), the 2016 BECCLE conference (Bergen), and the DICE Brown Bag Seminar (University Düsseldorf, 2015). Christian Wey gratefully acknowledges financial support by the Deutsche Forschungsgemeinschaft (DFG) for the research project "Competition and Bargaining in Vertical Chains" (WE 4228/2-2).

[†]Heinrich-Heine University Düsseldorf, Düsseldorf Institute for Competition Economics (DICE); e-mail: aghadadashli@dice.hhu.de.

[‡]University of Cologne; e-mail: markus.dertwinkel-kalt@uni-koeln.de.

[§]Heinrich-Heine University Düsseldorf, Düsseldorf Institute for Competition Economics (DICE); e-mail: wey@dice.hhu.de.

1 Introduction

We investigate the properties of the Nash bargaining solution when an upstream supplier bargains with a downstream firm over a linear wholesale price.¹ The Nash bargaining solution is given by equating the slopes of the bargaining frontier and the Nash product. The slope of the Nash product depends directly on the parties' disagreement payoffs and the profit weights. It is well understood that a better disagreement payoff and a higher profit weight in the Nash product improves a party's bargaining position, and hence, the profit share it gets. Our focus, in contrast, is on the slope of the bargaining frontier which gives the upstream firm's maximal profit for a given profit level of the downstream firm. Under efficient contracts the slope of the bargaining frontier is -1 , while it is strictly larger (*i.e.*, between -1 and 0) when bargaining is over a linear input price. This is a direct result of assuming that profits can only be transferred with a linear input price which leads to the well-known double mark-up problem. An increase of the wholesale price (so as to shift profits to the upstream firm) necessarily reduces the overall surplus available. Intuitively, the "steeper" the slope of the bargaining frontier, the harder it is to shift profits to the upstream firm so that the profit share of the downstream firm increases.

Our analysis of the bargaining frontier confirms this basic intuition and we derive a simple and instructive formula which combines all three determinants of parties' bargaining powers according to the Nash bargaining solution; namely, the disagreement payoffs, the weights in the Nash product, and the slope of the bargaining frontier. The critical step in our analysis is to show that the slope of the bargaining frontier is equal to the total value of 1 plus the *derived demand elasticity* of the downstream firm for the input. The *derived demand elasticity* is the elasticity of the optimal input quantity with respect to the price of the input good. Its absolute value must be between zero and one to ensure the existence of a Nash bargaining solution in case of a linear transfer price. It then follows that a more elastic equilibrium derived demand goes hand in hand

¹The concept of Nash bargaining over linear input prices is widely used to solve the bilateral bargaining problem between up- and downstream firms, both theoretically (Horn and Wolinsky, 1988; Dobson and Waterson, 1997; von Ungern-Sternberg 1997; Naylor, 2002; Symeonidis, 2010; Iozzi and Valletti, 2015; Gaudin, 2015, 2016) and empirically (Gowrisankaran et al., 2015; Draganska et al., 2008; Grennan, 2013, 2014). Nash bargaining over linear input prices has been also widely assumed in labor economics where input prices are workers' wages. For instance, Dowrick (1990) and Conlin and Furusawa (2000) compare inefficient bargaining over wages with efficient bargaining over input prices *and* employment. They derive conditions such that the employer is better off under inefficient bargaining.

with an increasing share of the total profit the downstream firm gets. This is driven by the fact that the more elastic the derived demand is the less transferable are utilities between the up- and the downstream firms and the larger are the dead-weight losses due to double marginalization. As derived and final demand elasticities are closely related, we can also express our findings in terms of the final demand elasticity.

The paper proceeds as follows. In Section 2 we present the analysis of the bilateral bargaining problem and we derive the central profit sharing formula. In Section 3 we extend our model toward N downstream firms and provide the analysis both for unobservable and for observable contracts. Section 4 concludes.

2 Model and Analysis

2.1 The Model Setup

We refer to a successive monopoly problem with an upstream firm U and a downstream firm D . The input is produced at marginal cost $c = 0$ and transformed one to one by the downstream firm into the final good. Consumer demand for the final good is given by $x(p)$, where p is the final good price, and $p(x)$ gives the inverse demand. The game proceeds in two stages. In the first stage both firms bargain over a linear wholesale price w . In the second stage, the downstream firm sets the final good price (or, equivalently, the quantity of the final good).

We impose the standard assumption

$$p''x + p' < 0, \tag{1}$$

which guarantees the existence of a unique equilibrium. We abstract from all downstream costs other than the procurement costs $w \cdot x$, such that the downstream firm's profit is given by

$$\pi := p(x)x - w \cdot x.$$

while the upstream firm maximizes $L := w \cdot x$. In equilibrium the downstream firm chooses quantity x^* such that the first-order condition

$$p'(x^*)x^* + p(x^*) = w \tag{2}$$

holds. For any given w , Equation (2) determines a well-defined function, the *derived demand* $x^*(w)$ of the downstream firm when bargaining with the upstream firm. Taking the total derivative of (2) gives the slope of the derived demand function:

$$\frac{dx^*}{dw} = \frac{1}{p''x + 2p'} \quad (3)$$

such that $dx^*/dw < 0$. Due to (1), the downstream firm's second-order condition

$$\frac{d^2\pi}{dx^2} = p''x + 2p' < 0.$$

holds, which ensures that the derived demand function is strictly downward sloping. We can write the downstream firm's profit as a function of its derived demand, that is,

$$\pi(w) = p(x^*(w))x^*(w) - wx^*(w) \quad (4)$$

and the upstream firm's profit function as

$$L(w) = wx^*(w). \quad (5)$$

2.2 The Bargaining Frontier

As $d\pi/dw < 0$ and $dx^*/dw < 0$ hold, there is a one-to-one relation between wage levels and profit levels. Thus, the supplier's profit can be written as a well-defined function of the downstream firm's profit, $L = L(\pi(w))$, which assigns each profit level of the downstream firm the according profit level of the upstream firm. We denote $L = L(\pi(w))$ the *bargaining frontier*. The chain rule yields

$$\frac{dL(\pi(w))}{dw} = \frac{dL(\pi(w))}{d\pi(w)} \cdot \frac{d\pi(w)}{dw}.$$

Rearranging gives the slope of the bargaining frontier

$$\frac{dL(\pi(w))}{d\pi(w)} = \frac{dL(\pi(w))}{dw} \left(\frac{d\pi(w)}{dw} \right)^{-1}. \quad (6)$$

Denote the *derived demand elasticity* as

$$\epsilon := \frac{dx^*(w)}{dw} \frac{w}{x^*(w)}.$$

Using $dL/dw = x + w \cdot dx/dw$ (which follows from Equation (5)) and $d\pi/dw = \partial\pi/\partial w = -x$ (which follows from Equation (4) and the Envelope Theorem), the slope of the bargaining

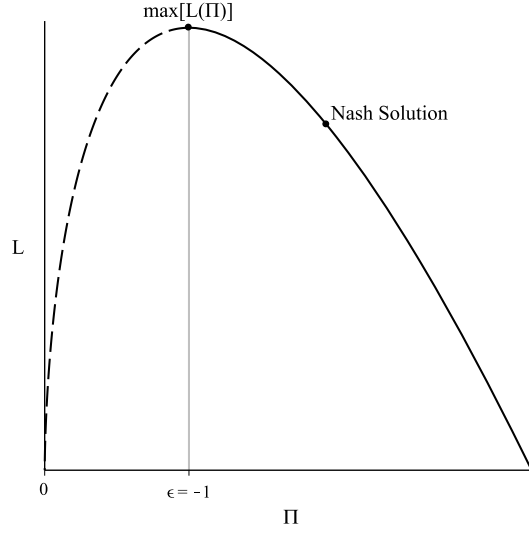


Figure 1: *Bargaining frontier*

frontier can be written as a function of the derived demand elasticity,

$$\frac{dL(\pi(w))}{d\pi(w)} = -(1 + \epsilon). \quad (7)$$

This formula reflects that the transferability of utility between the retailer and the supplier depends crucially on the derived demand elasticity. The more inelastic derived demand is in equilibrium the larger is the loss the retailer has to bear in order to shift one unit of utility to the supplier. We will speak of a bargaining frontier effect when a change in the economic environment changes the derived demand elasticity ϵ and thus the slope of the bargaining frontier.

Next, we describe the curvature of the bargaining frontier $L(\pi(w))$. A necessary condition for a local maximum of $L(\pi)$ is $dL/d\pi = 0$. With formula (7) it is straightforward to check that there is a unique optimum at $\epsilon = -1$. If derived demand is elastic, $\epsilon < -1$, then $dL/dw = x^*(w) + w dx^*(w)/dw < 0$. As $d\pi/dw < 0$, it follows that $dL/d\pi > 0$, that is, the bargaining frontier is positively sloped. If derived demand is inelastic, $\epsilon > -1$, then $dL/dw = x^*(w) + w dx^*(w)/dw > 0$. As $d\pi/dw < 0$, it follows that $dL/d\pi < 0$, that is, the bargaining frontier is negatively sloped.

Figure 1 depicts the bargaining frontier. If the derived demand is elastic, that is, $\epsilon < -1$, then $dL/dw < 0$ and $d\pi/dw < 0$ hold such that both the supplier and the retailer can obtain a higher payoff with a lower input price w . Therefore, due to Pareto-optimality, the Nash bargaining

solution has to lie in the domain where the derived demand is inelastic, that is, $\epsilon \geq -1$.

2.3 Nash Bargaining

We investigate under which conditions a Nash bargaining solution exists.

Lemma 1. *A bargaining problem $(X, (\pi_0, L_0))$ is defined by the set of feasible payoff combinations $X = \{(\pi, L) \in \mathbb{R}^2 | L \leq L(\pi)\}$ and the profits (π_0, L_0) obtained if negotiation breaks down. Suppose that (I) $L(\pi)$ is a concave function and (II) there exist $(\pi, L) \in X$ with $\pi > \pi_0$ and $L > L_0$. Then there exists a unique solution $(\pi(w^*), L(w^*))$ to the Nash bargaining problem which is given by*

$$\arg \max_{(\pi, L)} \{(\pi - \pi_0)^\alpha (L - L_0)^{1-\alpha} | L \leq L(\pi)\},$$

where parameter $\alpha \in [0, 1]$ gives the downstream firm's profit weight.²

Proof: See for instance Eichberger (1993), Theorem 9.2 □

In order to apply Lemma 1, we investigate under which conditions the bargaining frontier is concave.

Lemma 2. *A necessary condition for the bargaining frontier to be concave is that the upstream firm's second-order condition*

$$\frac{d^2 L}{dw^2} < 0 \tag{8}$$

holds. A sufficient condition for the bargaining frontier to be concave is that the derived demand is concave, that is,

$$\frac{d^2 x^*}{dw^2} < 0. \tag{9}$$

Proof: We investigate under which conditions $d^2 L / d\pi^2 < 0$ holds. The chain rule gives

$$\frac{d \left[\frac{dL(\pi(w))}{d\pi(w)} \right]}{dw} = \frac{d \left[\frac{dL(\pi(w))}{d\pi(w)} \right]}{d\pi(w)} \cdot \frac{d\pi(w)}{dw}$$

²Strictly speaking, α denotes the weight on the downstream firm's gain from trade.

such that

$$\begin{aligned}
\frac{d^2 L(\pi(w))}{d\pi^2} &= \frac{d \left[\frac{dL(\pi(w))}{d\pi(w)} \right]}{d\pi(w)} = \frac{d \left[\frac{dL(\pi(w))}{dw} \right]}{dw} \left(\frac{d\pi(w)}{dw} \right)^{-1} \\
&= \frac{d \left[\frac{dL}{dw} \left(\frac{d\pi}{dw} \right)^{-1} \right]}{dw} \left(\frac{d\pi}{dw} \right)^{-1} \\
&= \left[\frac{d^2 L}{dw^2} \cdot \left(\frac{d\pi}{dw} \right)^{-1} + \frac{dL}{dw} (-1) \left(\frac{d\pi}{dw} \right)^{-2} \frac{d^2 \pi}{dw^2} \right] \left(\frac{d\pi}{dw} \right)^{-1} \\
&= \left[\underbrace{\frac{d^2 L}{dw^2}}_{>0} - \underbrace{\frac{dL}{dw} \left(\frac{d\pi}{dw} \right)^{-1}}_{<0} \underbrace{\frac{d^2 \pi}{dw^2}}_{>0} \right] \underbrace{\left(\frac{d\pi}{dw} \right)^{-2}}_{>0}, \tag{10}
\end{aligned}$$

where

$$\frac{d^2 \pi}{dw^2} = \frac{d(d\pi/dw)}{dw} = \frac{d(-x)}{dw} = \frac{-dx}{dw} > 0.$$

Thus, $d^2 L/dw^2 < 0$ is a necessary condition for the bargaining frontier to be concave. To derive condition (9) note that $d^2 L/d\pi^2 < 0$ is equivalent to

$$2 \frac{dx}{dw} + w \frac{d^2 x}{dw^2} < \left(x + w \frac{dx}{dw} \right) \frac{1}{x} \frac{dx}{dw} = (1 + \epsilon) \left(\frac{dx}{dw} \right),$$

or

$$\frac{d^2 x}{dw^2} < \frac{dx}{dw} \frac{\epsilon - 1}{w}$$

This holds if the derived demand is not too convex, and, in particular, if $d^2 x/dw^2 < 0$. \square

Assumption. The derived demand is concave, that is, $d^2 x^*/dw^2 < 0$ holds.

Given the preceding Assumption holds (and given that the outside options for both firms are sufficiently small) the Nash bargaining solution is given by the maximum of the Nash product $N = (\pi - \pi_0)^\alpha \cdot (L - L_0)^{1-\alpha}$ subject to $L \leq L(\pi)$.

The slope of the iso-Nash-product lines is given by the total differential of the Nash product

$$dN = \alpha(\pi - \pi_0)^{\alpha-1} \cdot (L - L_0)^{1-\alpha} d\pi + (\pi - \pi_0)^\alpha \cdot (1 - \alpha)(L - L_0)^{-\alpha} dL = 0.$$

Rearranging gives the slope of the objective function as

$$\frac{dL}{d\pi} = - \frac{\alpha}{(1 - \alpha)} \frac{(L - L_0)}{(\pi - \pi_0)} \tag{11}$$

Pareto-optimality implies $L = L(\pi)$ and thus $dL/d\pi = dL(\pi)/d\pi$. Using (11) and (7), we can equate the slopes of the objective function and of the bargaining frontier and obtain

$$L - L_0 = \frac{1 - \alpha}{\alpha} \cdot (1 + \epsilon) \cdot (\pi - \pi_0). \tag{12}$$

Theorem. *Suppose a retailer and a supplier bargain over a linear input price via Nash bargaining while the retailer sets quantities in the final goods market. Then, in equilibrium the relation between profit shares, profit weights and the derived demand elasticity is given by (12).*

Note that this formula gives non-negative profits for the upstream and the downstream firm as $\epsilon \geq -1$. It gives an equilibrium condition and states that the higher the derived demand elasticity in equilibrium is, the larger is the profit share of the downstream firm. In principle, it can be used to estimate empirically the profit weights of the different parties: if the firms' profits can be observed and if the derived demand elasticity was known, then the parties' bargaining power could be estimated. The derived demand elasticity, however, is typically unknown. Therefore, we show in the following that it is closely related to the final good demand elasticity which is often determined in empirical studies.³

2.4 Demand Elasticity and Derived Demand Elasticity

In order to derive a relationship between the demand elasticity and the derived demand elasticity, we distinguish between the *demand function* $x(p)$ and the *derived demand function* $x(w)$. Demand elasticity is defined by

$$\eta = \left(\frac{dp}{dx} \right)^{-1} \frac{p}{x}.$$

We say that (derived) demand elasticity increases if η (ϵ , resp.) increases in absolute value. Equations (2) and (3) yield the following relationship between the demand and the derived demand elasticity:

$$\epsilon = \frac{1 + \eta}{\frac{p''}{p'}x + 2}. \quad (13)$$

For instance, for linear final demand, the relation between the elasticities is linear, such that with known profits and known equilibrium final demand elasticity, (12) and (13) allow to estimate the parties' bargaining power.

Symmetric Nash Bargaining. Under symmetric Nash bargaining where both parties have no outside option we can derive a more explicit relation between ϵ and η . Under symmetric Nash

³Other papers such as Grennan (2013, 2014) have derived similar interpretations of the Nash bargaining solution (see also Gaudin, 2016). None of these papers, however, stresses the relation to the derived demand elasticity which we focus on.

bargaining, the Nash product

$$[(p(x(w)) - w)x(w)] \cdot [w \cdot x(w)]. \quad (14)$$

is maximized. Considering the first-order conditions and applying equations (2) and (3) gives $3p'p + xp''p + x(p')^2 = -2xp' \cdot (p''x + 2p')$. Using this as well as the equations (2) and (3), we can re-write the sum of the two elasticities as

$$\begin{aligned} \epsilon + \eta &= \frac{3p'p + xp''p + x(p')^2}{xp'(p''x + 2p')} \\ &= -2. \end{aligned} \quad (15)$$

Thus, under symmetric bargaining the two elasticities add up in equilibrium to -2 . As the derived demand elasticity lies between -1 and 0 , final demand is always elastic in equilibrium, that is, $\eta \in (-2, -1)$.

Example: Linear Demand Suppose that the downstream firm faces a linear inverse demand function $p(x) = a - bx$. The outside options are zero for both firms, $\pi_0 = L_0 = 0$. The downstream firm's profit is equal to $\pi = (a - bx - w)x$, while the supplier gets $L = wx$. In equilibrium, the downstream firm's first-order condition $a - 2bx - w = 0$ holds, which gives rise to the derived demand

$$x^*(w) = \frac{a - w}{2b}. \quad (16)$$

As Condition (9) holds, the bargaining frontier is concave and a unique Nash bargaining solution exists. Substituting (16) into the downstream firm's and the supplier's profit functions gives $\pi(w) = (a - w)^2 / (4b)$, and $L(w) = w(a - w) / (2b)$, respectively. Moreover, from (16) we obtain the derived demand elasticity

$$\epsilon = -\frac{w}{a - w}.$$

Using (12), we obtain the bargaining solution $w^* = a(1 - \alpha)/2$ and $x^* = a(1 + \alpha)/(4b)$. In particular, both the derived demand and the demand elasticity depend only on firms' bargaining power and equal

$$\begin{aligned} \epsilon &= -\frac{1 - \alpha}{1 + \alpha}, \\ \eta &= -\frac{3 - \alpha}{1 + \alpha}. \end{aligned}$$

In equilibrium, the downstream firm's share is also independent of the demand function's parameters a and b as

$$\frac{\pi}{\pi + L} = \frac{1 + \alpha}{2(1 - \alpha)}$$

holds. Thus, the sharing rule between the up- and the downstream firm is independent from the exact specification of the linear demand function. Note that, under symmetric bargaining, in particular Equation (15) is satisfied, that is, the demand elasticities sum up to -2 in equilibrium.

3 Extensions

We show that our equilibrium condition holds also in more general setups, for instance, if there are $N > 1$ downstream firms. We provide the analysis both for the case with unobservable and with observable contracts.

3.1 N Downstream Firms and Unobservable Contracts

We extend our model toward N downstream firms facing a single upstream firm U . As in the previous section, we normalize U 's marginal production cost to zero and assume that all firms have the same production technology which transforms one unit of input to one unit of output. Firm $i \in \{1, \dots, N\}$ produces quantity x_i of a homogeneous product. Demand is given by the inverse demand function $p(x_1, \dots, x_N)$ for which the N -firm analogon of condition (1) is assumed to hold.

In the first stage of the game, U bargains simultaneously with the N downstream firms. We follow the literature on simultaneous Nash bargaining (see, for instance, Inderst and Wey, 2003) and assume that U bargains with the downstream firms through sales agents, that is, for each downstream firm there is one sales agent representing firm U in the negotiation. In the second stage, downstream firms compete *à la* Cournot.

As contracts are unobservable, the sales agents and the downstream firms cannot observe outcomes in the other negotiations and therefore have to form beliefs on them. Most common in the economic literature on multilateral contracting are "passive beliefs" according to which it is assumed that all unobservable bargaining outcomes are equilibrium outcomes, even if it receives an out-of-equilibrium offer (see Hart and Tirole, 1990; O'Brien and Shaffer, 1992; Inderst

and Ottaviani, 2012).⁴ In order to guarantee that the Nash product is well-defined, we assume that a sales agent and the downstream firm he bargains with have the same beliefs on the outcomes of all simultaneous negotiations. Denote \hat{w}_j firm i 's and the respective sales agent's belief about firm j 's negotiated input price.

We solve the game via backward induction. If downstream firm i has negotiated input price w_i , it expects to get a profit of

$$\pi_i(w_i) = [p(x_1^*(\hat{w}_1), \dots, x_{i-1}^*(\hat{w}_{i-1}), x_i^*(w_i), x_{i+1}^*(\hat{w}_{i+1}), \dots, x_N^*(\hat{w}_N)) - w_i]x_i^*(w_i), \quad (17)$$

while the upstream firm U expects to get

$$L(w_i) = w_i x_i^*(w_i) + \sum_{i \neq j} \hat{w}_j x_j^*(\hat{w}_j). \quad (18)$$

The best-response function of firm i solves the first-order condition

$$p - w_i = -\frac{\partial p}{\partial x_i} x_i. \quad (19)$$

Firm i 's equilibrium quantity choice can be written as

$$x_i^*(w_i) = x_i(\hat{w}_1, \dots, \hat{w}_{i-1}, w_i, \hat{w}_{i+1}, \dots, \hat{w}_N).$$

Note that, in particular, firm i 's equilibrium quantity x_i^* depends only on its own and not on its rivals' input prices.

When bargaining with firm i , U 's outside option is $L_{i,0} = L(\hat{w}_1, \dots, \hat{w}_{i-1}, 0, \hat{w}_{i+1}, \dots, \hat{w}_N)$ while we set the disagreement point of the downstream firms to zero. Thus, we can write the Nash bargaining problem between the supplier and firm i as

$$N_i(w_i) = (\pi_i(w_i))^\alpha \cdot (L(w_i) - L_{i,0})^{1-\alpha}.$$

If the Nash product is maximized, the first-order condition

$$\frac{dL(w_i)/dw_i}{d\pi_i(w_i)/dw_i} = -\frac{\alpha}{(1-\alpha)} \frac{(L(w_i) - L_{i,0})}{\pi_i(w_i)} \quad (20)$$

⁴Besides passive beliefs, also symmetric and wary beliefs are analyzed in the literature (Rey and Vergé, 2004). If firm i has symmetric beliefs, negotiated prices are assumed to be identical for all firms, that is, $w_j(w_i) = w_i$. With wary beliefs, if firm i negotiates an input price $w_i \neq w^*$ with the upstream firm, then firm i believes that $w_j(w_i)$ maximizes the Nash product of U bargaining with firm j , conditional on U knowing w_i .

holds. From (18) we obtain

$$\frac{dL(w_i)}{dw_i} = x_i^*(w_i) + \frac{dx_i^*(w_i)}{dw_i} w_i. \quad (21)$$

Using firm i 's derived demand elasticity $\epsilon_i = \frac{dx_i^*(w_i)}{dw_i} \frac{w_i}{x_i^*(w_i)}$, we can rewrite (21) as

$$\frac{dL(w_i)}{dw_i} = x_i^*(w_i) (1 + \epsilon_i). \quad (22)$$

Similarly, (17) yields

$$\frac{d\pi_i(w_i)}{dw_i} = \frac{\partial p}{\partial x_i} \frac{dx_i^*(w_i)}{dw_i} x_i^*(w_i) - x_i^*(w_i) + \frac{dx_i^*(w_i)}{dw_i} (p - w_i).$$

Using (19) we then obtain

$$\frac{d\pi_i(w_i)}{dw_i} = -x_i^*(w_i). \quad (23)$$

Inserting (22) and (23) into (20) yields the equilibrium profit of the downstream firm i as

$$\pi_i^* = (L^* - L_{i,0}) \frac{\alpha}{(1 - \alpha)} \frac{1}{(1 + \epsilon_i)}. \quad (24)$$

where, with passive beliefs, $L_{i,0} = \sum_{j \neq i} w_j^* x_j^*$ and $L^* - L_{i,0} = w_i^* x_i^*$. Thus, the equilibrium condition (12) derived for the bilateral monopoly case generalizes to N downstream firms if contracts are not observable. Note, however, that ϵ in (12) stands for the overall demand's elasticity with respect to input prices while ϵ_i denotes the elasticity of firm i 's derived demand with respect to its input price.

3.2 N Downstream Firms and Observable Contracts

We repeat the preceding analysis for the case in which contracts are observable. Profits are given by $\pi_i := p(x_1, \dots, x_N) x_i - w_i x_i$ and $L := \sum_{i=1}^N w_i x_i$, and the first-order condition (19) holds. As quantities are observable, firm i 's equilibrium quantity choice can be written as $x_i^*(w_1, \dots, w_N)$. We assume that the second order condition holds.

We can write the downstream firm i 's profit as

$$\pi_i(w_1, \dots, w_N) = [p(x_1^*(w_1, \dots, w_N), \dots, x_N^*(w_1, \dots, w_N)) - w_i] x_i^*(w_1, \dots, w_N), \quad (25)$$

while the upstream firm's profit equals

$$L(w_1, \dots, w_N) = \sum_{i=1}^N w_i x_i^*(w_1, \dots, w_N). \quad (26)$$

The general Nash bargaining problem between the supplier and firm i is given by

$$N_i(w_i) = (\pi_i(w_1, \dots, w_N) - \pi_{i,0})^\alpha \cdot (L(w_1, \dots, w_N) - L_{i,0}(w_1, \dots, w_{i-1}, w_{i+1}, \dots, w_N))^{1-\alpha}, \quad (27)$$

where $\pi_{i,0}$ is firm i 's the outside option and $L_{i,0}(w_j)$ is the outside option of the upstream firm when it bargains with firm i . As before, $\pi_{i,0} = 0$.

If the Nash product is maximized, the first-order condition

$$\frac{dL(w_1, \dots, w_N)/dw_i}{d\pi_i(w_1, \dots, w_N)/dw_i} = -\frac{\alpha}{(1-\alpha)} \frac{(L - L_{i,0})}{\pi_i}. \quad (28)$$

holds. Formula (26) gives

$$\frac{dL(w_1, \dots, w_N)}{dw_i} = x_i + \frac{dx_i(w_1, \dots, w_N)}{dw_i} w_i + \sum_{j \neq i} \frac{dx_j(w_1, \dots, w_N)}{dw_i} w_j. \quad (29)$$

Using firm i 's elasticity of derived demand, $\epsilon_i = \frac{dx_i}{dw_i} \frac{w_i}{x_i}$, and the cross-price elasticity of derived demand, $\epsilon_{ji} = \frac{dx_j}{dw_i} \frac{w_i}{x_j}$, we can rewrite (29) as

$$\frac{dL(w_1, \dots, w_N)}{dw_i} = x_i \left(1 + \epsilon_i + \sum_{j \neq i} \epsilon_{ji} \frac{x_j w_j}{x_i w_i} \right). \quad (30)$$

Similarly, (25) yields

$$\frac{d\pi_i(w_1, \dots, w_N)}{dw_i} = \frac{\partial p(x_1, \dots, x_N)}{\partial x_i} \frac{dx_i}{dw_i} x_i + \sum_{j \neq i} \frac{\partial p(x_1, \dots, x_N)}{\partial x_j} \frac{dx_j}{dw_i} x_i - x_i + \frac{dx_i}{dw_i} (p - w_i). \quad (31)$$

Inserting (19) into the preceding equation gives

$$\frac{d\pi_i(w_1, \dots, w_N)}{dw_i} = \sum_{j \neq i} \frac{\partial p(x_1, \dots, x_N)}{\partial x_j} \frac{dx_j}{dw_i} x_i - x_i, \quad (32)$$

or,

$$\frac{\partial \pi_i(w_1, \dots, w_N)}{\partial w_i} = -x_i \left(1 - \sum_{j \neq i} \frac{p}{w_i} \eta_j \epsilon_{ji} \right), \quad (33)$$

where $\eta_j = \frac{\partial p(x_1, \dots, x_N)}{\partial x_j} \frac{x_j}{p}$ gives firm j 's elasticity of demand. Inserting (30) and (33) into (28) yields

$$\frac{\alpha}{(1-\alpha)} \frac{(L - L_{i,0})}{\pi_i} = \frac{\left(1 + \epsilon_i + \sum_{j \neq i} \epsilon_{ji} \frac{x_j w_j}{x_i w_i} \right)}{\left(1 - \sum_{j \neq i} \frac{p}{w_i} \eta_j \epsilon_{ji} \right)}. \quad (34)$$

As the downstream firms are symmetric, we assume a symmetric Nash solution in which $w_i^* = w_j^*$ and $x_i^* = x_j^*$, for any $i, j \in 1, \dots, N$. We can write equilibrium profit of the downstream firm i as

$$\pi_i^* = (L - L_{i,0}) \frac{\alpha}{(1 - \alpha)} \frac{\left(1 - (N - 1) \frac{p}{w_i} \eta_j \epsilon_{ji}\right)}{(1 + \epsilon_i + (N - 1) \epsilon_{ji})}. \quad (35)$$

As a consequence, with observable contracts, the profit sharing rule does not only depend on the elasticity of derived demand, but also on the cross-price elasticities of the derived demand.

4 Conclusion

We have established a novel link between the profit shares and the demand elasticity in vertical relations if up- and downstream firms bargain over linear input prices. Besides the disagreement payoffs and the weights of firms' profits in the Nash product, our formula singles out the slope of the bargaining frontier as an additional determinant of bargaining power. The slope of the bargaining frontier is equal to the total value of one plus the downstream firm's derived demand elasticity. We have provided various examples in which a more elastic equilibrium demand benefits the downstream firm through a change of the slope of the bargaining frontier. Our model should be instructive also for empirical studies which seek to determine the bargaining power of the different parties based on observables such as absolute profit levels and equilibrium demand elasticity.

References

- Aghadadashli, Hamid, Markus Dertwinkel-Kalt and Christian Wey (2015). Multi-plant Firms, Production Shifting, and Countervailing Power. Mimeo.
- Binmore, Ken, Ariel Rubinstein, and Asher Wolinsky (1986). The Nash Bargaining Solution in Economic Modelling. *The RAND Journal of Economics* 17(2), 176-188.
- Dobson, Paul W. and Michael Waterson (1997). Countervailing Power and Consumer Prices. *The Economic Journal* 107, 418-430.
- Dowrick, Steve (1990). The Relative Profitability of Nash Bargaining on the Labour Demand Curve or the Contract Curve. *Economic Letters* 33(2), 121-125.

- Draganska, Michaela, Daniel Klapper, and Sofia B. Villas-Boas (2010). A Larger Slice or a Larger Pie? An Empirical Investigation of Bargaining Power in the Distribution Channel. *Marketing Science* 29(1), 57-74.
- Eichberger, Jürgen (1993). *Game Theory for Economists*. Academic Press, San Diego.
- Gaudin, Germain (2015). Vertical Bargaining and Retail Competition: What Drives countervailing Power? DICE Discussion Paper No. 195.
- Gaudin, Germain (2016). Pass-Through, Vertical Contracts, and Bargains. *Economics Letters* 139, 1-4.
- Gowrisankaran, Gautam, Aviv Nevo, and Robert Town (2015). Mergers When Prices Are Negotiated: Evidence from the Hospital Industry. *The American Economic Review* 105(1), 172-203.
- Grennan, Matthew (2013). Price Discrimination and Bargaining: Empirical Evidence from Medical Devices. *The American Economic Review* 103(1), 145-177.
- Grennan, Matthew (2014). Bargaining Ability and Competitive Advantage: Empirical Evidence from Medical Devices. *Management Science* 60(12), 3011-3025.
- Hart, Olivier, and Jean Tirole (1990). Vertical Integration and Market Foreclosure. *The Brookings Papers on Economic Activity: Microeconomics*, 205-286.
- Horn, Henrick, and Asher Wolinsky (1988). Bilateral Monopolies and Incentives for Merger. *The RAND Journal of Economics* 19(3), 408-419.
- Inderst, Roman, and Marco Ottaviani (2012). Competition through Commissions and Kickbacks. *The American Economic Review* 102(2), 780-809.
- Inderst, Roman, and Christian Wey (2003). Bargaining, Mergers, and Technology Choice in Bilaterally Oligopolistic Industries. *The RAND Journal of Economics* 34(1), 1-19.
- Iozzi, Alberto, and Tommaso Valletti (2014). Vertical Contracting and Countervailing Power. *The American Economic Journal: Microeconomics* 6(3), 106-135.

- Naylor, Robin (2002). Industry Profits and Competition under Bilateral Oligopoly. *Economics Letters* 77(2), 169-175.
- O'Brien, Daniel P., and Greg Shaffer (1992). Vertical Control with Bilateral Contracts. *The RAND Journal of Economics* 23(3), 299-308.
- Rey, Patrick, and Thibaud Vergé (2004). Bilateral Control with Vertical Contracts. *The RAND Journal of Economics* 35(4), 728-746.
- Symeonidis, George (2010). Downstream Merger and Welfare in a Bilateral Oligopoly. *International Journal of Industrial Organization* 28, 230-243.
- von Ungern-Sternberg, Thomas (1996). Countervailing Power Revisited. *International Journal of Industrial Organization* 14(4), 507-519.

PREVIOUS DISCUSSION PAPERS

- 224 Aghadadashli, Hamid, Dertwinkel-Kalt, Markus and Wey, Christian, The Nash Bargaining Solution in Vertical Relations With Linear Input Prices, June 2016.
- 223 Fan, Ying, Kühn, Kai-Uwe and Lafontaine, Francine, Financial Constraints and Moral Hazard: The Case of Franchising, June 2016.
Forthcoming in: Journal of Political Economy.
- 222 Benndorf, Volker, Martinez-Martinez, Ismael and Normann, Hans-Theo, Equilibrium Selection with Coupled Populations in Hawk-Dove Games: Theory and Experiment in Continuous Time, June 2016.
Forthcoming in: Journal of Economic Theory.
- 221 Lange, Mirjam R. J. and Saric, Amela, Substitution between Fixed, Mobile, and Voice over IP Telephony – Evidence from the European Union, May 2016.
Forthcoming in: Telecommunications Policy.
- 220 Dewenter, Ralf, Heimeshoff, Ulrich and Lüth, Hendrik, The Impact of the Market Transparency Unit for Fuels on Gasoline Prices in Germany, May 2016.
Forthcoming in: Applied Economics Letters.
- 219 Schain, Jan Philip and Stiebale, Joel, Innovation, Institutional Ownership, and Financial Constraints, April 2016.
- 218 Haucap, Justus and Stiebale, Joel, How Mergers Affect Innovation: Theory and Evidence from the Pharmaceutical Industry, April 2016.
- 217 Dertwinkel-Kalt, Markus and Wey, Christian, Evidence Production in Merger Control: The Role of Remedies, March 2016.
- 216 Dertwinkel-Kalt, Markus, Köhler, Katrin, Lange, Mirjam R. J. and Wenzel, Tobias, Demand Shifts Due to Salience Effects: Experimental Evidence, March 2016.
Forthcoming in: Journal of the European Economic Association.
- 215 Dewenter, Ralf, Heimeshoff, Ulrich and Thomas, Tobias, Media Coverage and Car Manufacturers' Sales, March 2016.
Forthcoming in: Economics Bulletin.
- 214 Dertwinkel-Kalt, Markus and Riener, Gerhard, A First Test of Focusing Theory, February 2016.
- 213 Heinz, Matthias, Normann, Hans-Theo and Rau, Holger A., How Competitiveness May Cause a Gender Wage Gap: Experimental Evidence, February 2016.
Forthcoming in: European Economic Review.
- 212 Fudickar, Roman, Hottenrott, Hanna and Lawson, Cornelia, What's the Price of Consulting? Effects of Public and Private Sector Consulting on Academic Research, February 2016.
- 211 Stühmeier, Torben, Competition and Corporate Control in Partial Ownership Acquisitions, February 2016.
Forthcoming in: Journal of Industry, Competition and Trade.
- 210 Muck, Johannes, Tariff-Mediated Network Effects with Incompletely Informed Consumers, January 2016.

- 209 Dertwinkel-Kalt, Markus and Wey, Christian, Structural Remedies as a Signalling Device, January 2016.
Published in: Information Economics and Policy, 35 (2016), pp. 1-6.
- 208 Herr, Annika and Hottenrott, Hanna, Higher Prices, Higher Quality? Evidence From German Nursing Homes, January 2016.
Published in: Health Policy, 120 (2016), pp. 179-189.
- 207 Gaudin, Germain and Mantzari, Despoina, Margin Squeeze: An Above-Cost Predatory Pricing Approach, January 2016.
Published in: Journal of Competition Law & Economics, 12 (2016), pp. 151-179.
- 206 Hottenrott, Hanna, Rexhäuser, Sascha and Veugelers, Reinhilde, Organisational Change and the Productivity Effects of Green Technology Adoption, January 2016.
Published in: Energy and Resource Economics, 43 (2016), pp. 172–194.
- 205 Dauth, Wolfgang, Findeisen, Sebastian and Suedekum, Jens, Adjusting to Globalization – Evidence from Worker-Establishment Matches in Germany, January 2016.
- 204 Banerjee, Debosree, Ibañez, Marcela, Riener, Gerhard and Wollni, Meike, Volunteering to Take on Power: Experimental Evidence from Matrilineal and Patriarchal Societies in India, November 2015.
- 203 Wagner, Valentin and Riener, Gerhard, Peers or Parents? On Non-Monetary Incentives in Schools, November 2015.
- 202 Gaudin, Germain, Pass-Through, Vertical Contracts, and Bargains, November 2015.
Published in: Economics Letters, 139 (2016), pp. 1-4.
- 201 Demeulemeester, Sarah and Hottenrott, Hanna, R&D Subsidies and Firms' Cost of Debt, November 2015.
- 200 Kreickemeier, Udo and Wrona, Jens, Two-Way Migration Between Similar Countries, October 2015.
Forthcoming in: World Economy.
- 199 Haucap, Justus and Stühmeier, Torben, Competition and Antitrust in Internet Markets, October 2015.
Published in: Bauer, J. and M. Latzer (Eds.), Handbook on the Economics of the Internet, Edward Elgar: Cheltenham 2016, pp. 183-210.
- 198 Alipranti, Maria, Milliou, Chrysovalantou and Petrakis, Emmanuel, On Vertical Relations and the Timing of Technology, October 2015.
Published in: Journal of Economic Behavior and Organization, 120 (2015), pp. 117-129.
- 197 Kellner, Christian, Reinstein, David and Riener, Gerhard, Stochastic Income and Conditional Generosity, October 2015.
- 196 Chlaß, Nadine and Riener, Gerhard, Lying, Spying, Sabotaging: Procedures and Consequences, September 2015.
- 195 Gaudin, Germain, Vertical Bargaining and Retail Competition: What Drives Countervailing Power? September 2015.
- 194 Baumann, Florian and Friehe, Tim, Learning-by-Doing in Torts: Liability and Information About Accident Technology, September 2015.
- 193 Defever, Fabrice, Fischer, Christian and Suedekum, Jens, Relational Contracts and Supplier Turnover in the Global Economy, August 2015.

- 192 Gu, Yiquan and Wenzel, Tobias, Putting on a Tight Leash and Levelling Playing Field: An Experiment in Strategic Obfuscation and Consumer Protection, July 2015.
Published in: International Journal of Industrial Organization, 42 (2015), pp. 120-128.
- 191 Ciani, Andrea and Bartoli, Francesca, Export Quality Upgrading under Credit Constraints, July 2015.
- 190 Hasnas, Irina and Wey, Christian, Full Versus Partial Collusion among Brands and Private Label Producers, July 2015.
- 189 Dertwinkel-Kalt, Markus and Köster, Mats, Violations of First-Order Stochastic Dominance as Salience Effects, June 2015.
Published in: Journal of Behavioral and Experimental Economics, 59 (2015), pp. 42-46.
- 188 Kholodilin, Konstantin, Kolmer, Christian, Thomas, Tobias and Ulbricht, Dirk, Asymmetric Perceptions of the Economy: Media, Firms, Consumers, and Experts, June 2015.
- 187 Dertwinkel-Kalt, Markus and Wey, Christian, Merger Remedies in Oligopoly under a Consumer Welfare Standard, June 2015
Published in: Journal of Law, Economics, & Organization, 32 (2016), pp. 150-179.
- 186 Dertwinkel-Kalt, Markus, Salience and Health Campaigns, May 2015
Published in: Forum for Health Economics & Policy, 19 (2016), pp. 1-22.
- 185 Wrona, Jens, Border Effects without Borders: What Divides Japan's Internal Trade? May 2015.
- 184 Amess, Kevin, Stiebale, Joel and Wright, Mike, The Impact of Private Equity on Firms' Innovation Activity, April 2015.
Published in: European Economic Review, 86 (2016), pp. 147-160.
- 183 Ibañez, Marcela, Rai, Ashok and Riener, Gerhard, Sorting Through Affirmative Action: Three Field Experiments in Colombia, April 2015.
- 182 Baumann, Florian, Friehe, Tim and Rasch, Alexander, The Influence of Product Liability on Vertical Product Differentiation, April 2015.
- 181 Baumann, Florian and Friehe, Tim, Proof beyond a Reasonable Doubt: Laboratory Evidence, March 2015.
- 180 Rasch, Alexander and Waibel, Christian, What Drives Fraud in a Credence Goods Market? – Evidence from a Field Study, March 2015.
- 179 Jeitschko, Thomas D., Incongruities of Real and Intellectual Property: Economic Concerns in Patent Policy and Practice, February 2015.
Forthcoming in: Michigan State Law Review.
- 178 Buchwald, Achim and Hottenrott, Hanna, Women on the Board and Executive Duration – Evidence for European Listed Firms, February 2015.
- 177 Heblich, Stephan, Lameli, Alfred and Riener, Gerhard, Regional Accents on Individual Economic Behavior: A Lab Experiment on Linguistic Performance, Cognitive Ratings and Economic Decisions, February 2015
Published in: PLoS ONE, 10 (2015), e0113475.
- 176 Herr, Annika, Nguyen, Thu-Van and Schmitz, Hendrik, Does Quality Disclosure Improve Quality? Responses to the Introduction of Nursing Home Report Cards in Germany, February 2015.

- 175 Herr, Annika and Normann, Hans-Theo, Organ Donation in the Lab: Preferences and Votes on the Priority Rule, February 2015.
Forthcoming in: Journal of Economic Behavior and Organization.
- 174 Buchwald, Achim, Competition, Outside Directors and Executive Turnover: Implications for Corporate Governance in the EU, February 2015.
- 173 Buchwald, Achim and Thorwarth, Susanne, Outside Directors on the Board, Competition and Innovation, February 2015.
- 172 Dewenter, Ralf and Giessing, Leonie, The Effects of Elite Sports Participation on Later Job Success, February 2015.
- 171 Haucap, Justus, Heimeshoff, Ulrich and Siekmann, Manuel, Price Dispersion and Station Heterogeneity on German Retail Gasoline Markets, January 2015.
- 170 Schweinberger, Albert G. and Suedekum, Jens, De-Industrialisation and Entrepreneurship under Monopolistic Competition, January 2015
Published in: Oxford Economic Papers, 67 (2015), pp. 1174-1185.
- 169 Nowak, Verena, Organizational Decisions in Multistage Production Processes, December 2014.
- 168 Benndorf, Volker, Kübler, Dorothea and Normann, Hans-Theo, Privacy Concerns, Voluntary Disclosure of Information, and Unraveling: An Experiment, November 2014.
Published in: European Economic Review, 75 (2015), pp. 43-59.
- 167 Rasch, Alexander and Wenzel, Tobias, The Impact of Piracy on Prominent and Non-prominent Software Developers, November 2014.
Published in: Telecommunications Policy, 39 (2015), pp. 735-744.
- 166 Jeitschko, Thomas D. and Tremblay, Mark J., Homogeneous Platform Competition with Endogenous Homing, November 2014.
- 165 Gu, Yiquan, Rasch, Alexander and Wenzel, Tobias, Price-sensitive Demand and Market Entry, November 2014
Forthcoming in: Papers in Regional Science.
- 164 Caprice, Stéphane, von Schlippenbach, Vanessa and Wey, Christian, Supplier Fixed Costs and Retail Market Monopolization, October 2014.
- 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.
Published in: Economics Letters, 126 (2015), pp.181-184.
- 161 Dertwinkel-Kalt, Markus and Köhler, Katrin, Exchange Asymmetries for Bads? Experimental Evidence, October 2014.
Published in: European Economic Review, 82 (2016), pp. 231-241.
- 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.
Published in: Economics Letters, 125 (2014), pp. 223-225.

- 158 Stiebale, Joel, Cross-Border M&As and Innovative Activity of Acquiring and Target Firms, August 2014.
Published in: Journal of International Economics, 99 (2016), pp. 1-15.
- 157 Haucap, Justus and Heimeshoff, Ulrich, The Happiness of Economists: Estimating the Causal Effect of Studying Economics on Subjective Well-Being, August 2014.
Published in: International Review of Economics Education, 17 (2014), pp. 85-97.
- 156 Haucap, Justus, Heimeshoff, Ulrich and Lange, Mirjam R. J., The Impact of Tariff Diversity on Broadband Diffusion – An Empirical Analysis, August 2014.
Forthcoming in: Telecommunications Policy.
- 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.
Forthcoming in: Journal of Product Innovation Management.
- 153 Hottenrott, Hanna and Lawson, Cornelia, Flying the Nest: How the Home Department Shapes Researchers' Career Paths, July 2015 (First Version July 2014).
Forthcoming in: Studies in Higher Education.
- 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.
Published in: Applied Economics Letters, 22 (2015), pp. 1150-1153.
- 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.
Published in: Canadian Journal of Economics, 48 (2015), pp. 1537-1560.
- 147 Gaudin, Germain and White, Alexander, On the Antitrust Economics of the Electronic Books Industry, September 2014 (Previous Version 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.
Published in: Journal of Institutional and Theoretical Economics (JITE), 171 (2015), pp. 666-695.
- 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.
Published in: Journal of Conflict Resolution, 59 (2015), pp.1273-1300.
- 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.
Published in: Economics of Innovation and New Technology, 25 (2016), pp. 197-217.
- 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.

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 978-3-86304-223-3