Düsseldorf Institute
for Competition Economics

DISCUSSION PAPER

No 01

Countervailing Power and Dynamic Efficiency

Roman Inderst, Christian Wey

September 2010

HEINRICH HEINE
UNIVERSITÄT DÜSSELDORF

IMPRINT

DICE DISCUSSION PAPER

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

Editor:

Prof. Dr. Hans-Theo Normann
Düsseldorf Institute for Competition Economics (DICE)
Phone: +49(0) 211-81-15009, e-mail: normann@dice.uni-duesseldorf.de

DICE DISCUSSION PAPER

ISSN 2190-9938 (online) – ISBN 978-3-86304-000-0

Countervailing Power and Dynamic Efficiency*

Roman Inderst† Christian Wey‡

Abstract

This paper studies the impact of buyer power on dynamic efficiency. We consider a bargaining model in which buyer power arises endogenously from size and may impact on a supplier's incentives to invest in lower marginal cost. We challenge the view frequently expressed in policy circles that the exercise of buyer power stifles suppliers' incentives. Instead, we find that the presence of larger buyers keeps a supplier "more on his toes" and induces him to improve the competitiveness of his offering, in terms of both price and quality, relative to buyers' alternative options.

Keywords: Buyer Power; Countervailing Power; Dynamic Efficiency.

*Roman Inderst acknowledges financial support from the ESRC grant on "Buyer Power in Retailing" (RES-000-22-0433). The first draft of this paper circulated under the title "How Stronger Buyers Spur Upstream Innovation"(CEPR DP 5365).

†Goethe University Frankfurt and London School of Economics. E-mail: r.inderst@lse.ac.uk.

‡University of Düsseldorf, Düsseldorf Institute for Competition Economics (DICE). E-mail: wey@dice.uni-duesseldorf.de.

1 Introduction

The effect of market structure on dynamic efficiency has received much attention both in academic writing and antitrust policy, primarily with respect to the incentives to invest and innovate. This paper deals, instead, with the exercise of power in *vertical* relations and how this affects dynamic efficiency. Its main purpose is to inform the policy discussion on the exercise of buyer power, which is of increasing concern to antitrust authorities.

The formation of ever larger multinational retailers and the spread of ever larger store formats has increasingly shifted bargaining power away from manufacturers.[1] At the European level, buyer power played an important role the merger decisions on Rewe/Meinl, Kesko/Tuko, and Carrefour/Promodes.[2] In the UK, buyer power was a core issue in several recent investigations into the grocery retail market.[3] The case of the UK is also of particular interest as, similar to Australia, concerns of buyer power have lead to the introduction of a "Code of Practice", which the country's top grocery retailers have to follow in their dealing with suppliers.[4]

This paper investigates a key concern that is frequently raised in relation to the exercise of buyer power, namely that it stifles suppliers' incentives to invest and innovate.[5] We consider a model of bilateral bargaining that allows to explicitly relate investment incentives to buyer power. The model also derives from first principles how buyer power relates to size and, thereby, to changes in the downstream market structure that suppliers face. Following an increase in buyer concentration, a supplier's total profits decrease, which from a standard hold-up perspective would indeed suggest that suppliers' incentives are stifled.[6]. Our results are markedly different: The formation of larger and, consequently,

[1] See the discussion in several recent policy papers, e.g., European Commission (1999), OECD (1999), or FTC (2001).

[2] Case no IV/M.1221, Case no IV/M.784, and Case no IV/M.1684, respectively.

[3] Cf. Competition Commission (2000, 2003, 2008).

[4] The experience in the UK and Europe is discussed in detail in Dobson (2002, 2005). Across the Atlantic, the Antitrust Law Journal has recently dedicated a special issue to this topic (Volume 2 in 2005).

[5] Explicitly, the FTC's 2001 report expresses the concern that when facing increasingly powerful buyers, "suppliers respond by under-investing in innovation or production" (FTC, 2001, p. 57). Likewise, in Euopean Commission (1999, p. 4) it is suggested that, when facing powerful buyers, suppliers may "reduce investment in new products or product improvements, advertising and brand building". As a final example for a different industry, Pitofsky (1997) expresses similar concerns for the US health industry.

[6] This observation has been formalized recently in Chen (2004) as well as Battigalli, Fumagalli, and Polo (2006). Note also that we restrict attention to investments where incentives can not be adequately provided through contractual means. This may be the case as it is hard to specify the investment ex

more powerful buyers will keep a supplier "on his toes" and increase his incentives to invest.

Our focus is on *marginal* incentives, for which a supplier's total profits are, as we find, not informative enough. We find that if buyer power derives from an increase in a buyer's size, then a more powerful buyer may extract a larger share of joint profits but less of incremental profits that are generated by higher upstream investment. While our main analysis considers incentives to reduce marginal costs, we show that our results extend to investment in quality.[7]

We isolate several effects that all support the view that the exercise of bargaining power by large buyers can *increase* a supplier's incentives. What is crucial for our result is that buyers compete in the downstream (retail) market.[8] The role of downstream competition derives from the fact that the value of a buyer's alternative supply option is lower if the supplier can make rivals a more competitive offer.[9] The negative impact on the value of buyers' outside option increases a supplier's incentives to reduce own marginal cost or to make his product more attractive. Importantly, we find that this effect becomes stronger as there are fewer, but larger buyers.

In addition, if we employ a bargaining solution that satisfies the well-known "outside option principle", then there are additional effects at work that further increase a supplier's incentives as there are fewer, but larger buyers.[10] Intuitively, this holds as under the "outside option principle", the value of a buyer's outside option only affects the outcome of negotiations if it is sufficiently attractive, which in our model will be the case only if a buyer is sufficiently large. Once a buyer's outside option binds, this entails two differences. First, under the "outside option principle" the large buyer's payoff is then entirely determined

ante in sufficient detail. Likewise, with a large number of buyers free-rider problems may also limit the extent to which incentives can be provided through multilateral contracts. One possible countervailing force, though arguably only applicable to highly concentrated industries, is that the presence of dominant buyers can overcome free-rider problems (as in Fumagalli and Motta 2007).

[7]Battigalli, Fumagalli, and Polo (2006) also analyze incentives to increase quality, while Chen (2004) looks into investment in product variety.

[8]This represents a key difference to the approach taken in Inderst and Wey (2003, 2007) and Vieira-Montez (2005), where buyers do not compete while buyer power derives from the presence of convex costs or capacity constraints. More formally, in this case larger buyers obtain a discount as they negotiate less "at the margin," where incremental costs are highest. (This follows Chipty and Snyder 1999 and is further extended in Smith and Thanassoulis 2006 through introducing uncertainty). In the presence of larger buyers, a supplier has less incentives to reduce capacity or, more generally, to make his cost function "more convex" so as to extract a larger share of profits.

[9]Such a strategy to undermine the value of buyers' outside options is also considered in Caprice (2006).

[10]On this principle, see Binmore et al. (1986).

by the value of his outside option, which in turn implies that the supplier can pocket all incremental profits from higher investment.[11] Moreover, once a buyer becomes sufficiently large such that his outside option starts to bind, then also the previously discussed effect kicks in: The supplier's incentives further increase, as his investment reduces the value of the large buyer's outside option.

In line with the growing interest in antitrust, more recently the academic literature on buyer power has made further progress (see, for instance, the survey in Inderst and Mazzarotto, 2006). Our model of buyer power further develops the approach pioneered by Katz (1987), which provides a particularly parsimonious treatment of buyer power from first principles. There, larger buyers have a more attractive outside option as they can distribute over more units any fixed costs that arise from searching and choosing an alternative source of supply.

Our analysis focuses on the long-run implications of the exercise of buyer power and thus abstracts from any short-run implications on retail prices, which would arise, in particular, under linear contracts (cf. Dobson and Waterson 1997 and von Ungern-Sternberg 1996).[12] As these short-run implications are known to depend crucially on the type of considered contract, it could be thought that the consideration of dynamic efficiencies provides more robust predictions. Our results, however, warn against a too naive assessment. In particular, we show that it is premature to conclude from a reduction in suppliers' overall profits that their incentives to invest and innovate are lower.

The rest of the paper is organized as follows. Section 2 presents the model and derives some preliminary results. Section 3 analyzes how the formation of larger and more powerful buyers affects investment incentives. Section 4 provides a discussion of our assumptions and results, while Section 5 extends the analysis to heterogeneous goods and price competition. Section 6 provides concluding remarks.

[11]This insight is also used in DeMeza and Lockwood (1998) and Chiu (1998). There are, however, several important differences between their work and ours. In our model, a supplier negotiates with multiple buyers who compete on a downstream market. Also, we study the role of buyers' size and are interested in what impact it has on welfare and consumer surplus.

[12]More recently, Chen (2003) has extended this setting by using linear contracts only with respect to a market fringe, while allowing for non-linear contracts with the large buyer.

2 The Model and Preliminary Analysis

2.1 The Industry

In the main part of the paper, we analyze a supplier's incentives to reduce marginal costs. The supplier provides an input to an intermediary industry. Firms in the intermediary industry use the input to produce a homogeneous final good. (See, however, Section 5.) All firms in the intermediary industry have an identical production function that transforms one unit of the input into one unit of the output.[13]

There are $N \geq 2$ independent markets. In each market, two competing firms are active. The $2N$ downstream firms are owned by a number $I \geq 2$ of intermediaries, to which we simply refer to as buyers. A given buyer i, where $1 \leq i \leq I$, owns n^i firms in separate markets. This rules out standard monopolization effects. It also allows us to treat all N markets symmetrically, regardless of the number and size of buyers. After presenting our main results, we comment more on these assumptions in the light of a particular application, namely retailing.

In each independent market, downstream firms offer a homogeneous good and compete in quantities. (See, however, Section 5.) All N independent markets are symmetric. If in a given market one of the two active firms chooses the quantity q and the other firm the quantity $\widehat{q}$, the first firm's revenues are given by $R(q, \widehat{q}) := qP(q + \widehat{q})$, where $P(\cdot)$ denotes the inverse demand function. The supplier has constant marginal costs of production $c \geq 0$. It is convenient to assume that P is twice continuously differentiable where positive. We assume that standard stability conditions are satisfied and that best responses are downward sloping. With constant marginal costs, this is ensured by the following assumption.[14]

Assumption 1. *The inverse demand P that characterizes the downstream markets satisfies $P' < \min\{0, -qP''\}$ whenever P is positive.*

We will find that in equilibrium, all buyers are supplied at a constant per-unit price that equals marginal costs c. (We formally introduce supply contracts further below.) Under Assumption 1, the Cournot game where two firms can procure at constant input prices

[13]This description would fit the retailing industry. Given symmetry of production functions, though, this specification is not important for our results.

[14]See, for instance, Vives (1999).

equal to c has a unique equilibrium. In this equilibrium, both firms produce symmetric quantities, which we denote by q_S. From our assumptions on differentiability and by Assumption 1, q_S is continuously differentiable in c (where $q_S > 0$) with $dq_S/dc < 0$.

2.2 Stages of the Model

There are three stages in our model. In the first stage, the supplier can choose a non-contractible action to reduce marginal costs. Subsequently, the supplier negotiates simultaneously with all buyers $i \in I$. We may think of a situation where the supply contracts for all buyers i are up for renewal. Alternatively, our model may capture the introduction of a new product.[15] At the final stage, downstream firms compete in the N local markets.

Turning to a description of the first stage, we suppose that initially the supplier has constant marginal cost $\bar{c} > 0$. By investing $K_S(\Delta_S)$, he can reduce marginal cost to $c = \bar{c} - \Delta_S$, where $0 \leq \Delta_S \leq \bar{c}$. We stipulate that K_S is strictly increasing and satisfies $K_S(0) = 0$. It is also convenient to assume that K_S is twice continuously differentiable and that its derivative satisfies $K_S'(0) = 0$ and $K_S'(\Delta_S) \to \infty$ for $\Delta_S \to \bar{c}$. We want to make sure that production is always profitable in equilibrium. A sufficient condition for this is that there exists some $q > 0$ such that $P(q) > \bar{c}$.

Negotiations take place in the second stage of the model. There, buyers and the supplier negotiate over an only privately observed two-part tariff contract $t^i(q) = \tau^i + qw^i$. The use of two-part tariffs deserves some comments. First, with two-part tariffs we can abstract from well-known issues related to double-marginalization. Second, in the set of non-linear tariffs the further restriction to two-part tariffs is relatively innocuous. As will become clear in what follows, our unique equilibrium with two-part tariffs would also be an equilibrium if we allowed for more general menus $t^i(q)$. In this respect, the two-part tariffs should also not be interpreted too literally. Though in equilibrium the buyer will make a fixed lump-sum transfer τ^i to the supplier, this does not suggest that we should necessarily observe such transfers in practice. We postpone a further description of the bargaining game until the next section. The remainder of this section defines buyers' alternative supply options.

Though our model allows for a broader interpretation, we may follow Katz (1987) and suppose that after disagreement, buyers have the option to integrate backwards. When

[15] This could also justify why there is currently only a single (incumbent) supplier.

integrating backwards, a buyer must incur the fixed costs $F \geq 0$. The attractiveness of the buyer's new supply option depends on the resources that the buyer spends at this stage. A given buyer i that integrates backwards also controls its (new) marginal cost c^i_{Out}. Without any investment, we have that $c^i_{Out} = \bar{c}_{Out}$, while at cost $K_B(\Delta^i_B)$ this can be reduced to $c^i_{Out} = \bar{c}_{Out} - \Delta^i_B$, where $0 \leq \Delta^i_B \leq \bar{c}_{Out}$. We specify that $K_B(0) = 0$, while K_B is twice continuously differentiable with $K'_B(0) = 0$ and $K'_B(\Delta^i_B) \to \infty$ for $\Delta^i_B \to \bar{c}_{Out}$.

While interpreting the alternative supply option as backward integration is convenient, we need only that generating the alternative supply option involves a certain amount of fixed costs, i.e., $F + K_B$ in the chosen setting.[16] These could also be incurred by searching for a new source of supply. Likewise, these costs may arise when reorganizing the purchasing and distribution system.

2.3 Negotiations

For the second stage of the model, where supply contracts are determined, we use the following bargaining model. Bargaining proceeds in pairwise negotiations, where the supplier is represented by I different agents, each negotiating with one buyer. All agents of the supplier form rational expectations about the outcome in all other pairwise negotiations, while their objective is to maximize the supplier's payoff. We employ the axiomatic Nash bargaining solution, though we provide a non-cooperative foundation in Appendix B.[17] In this respect, it is important to note that we employ the multi-agent approach also in the non-cooperative model.

We need not write down the Nash solution in its generality. Several features of our model ensure that the solution has a very simple characterization. Recall first that contracts can specify a fixed fee τ^i. This allows to fully disentangle the issue of maximizing joint profits from that of how to share the surplus. Next, as firms compete in quantities in each of the N markets and as contracts are not observable, the choice of w^i does not affect the supplier's payoff with all other buyers but buyer i. If a mutually beneficial agreement with buyer i is feasible, it is thus uniquely optimal to set $w^i = c$.

[16] Note that while K_B clearly depends on the investment, it is still independent of the subsequently produced quantity. Without changing results we could, however, also introduce an additional variable component.

[17] A different approach, building on the Shapley value, has been used, for instance, in Inderst and Wey (2003) or deFontenay and Gans (2005). Both papers also endogenize the use of the Shapley value. (The approach in Inderst and Wey 2003 is further extended in deFontenay and Gans 2006).

Lemma 1. *The requirement that joint surplus is maximized in each bilateral negotiation implies that* $w^i = c$.

Lemma 1 is a restatement of a well-known result. The supplier faces a problem of opportunism when dealing with multiple competing buyers. This problem has been analyzed, though with a different focus, in a number of papers, including Hart and Tirole (1990), McAfee and Schwartz (1994), or O'Brien and Shaffer (1994).[18] In these papers, the supplier typically makes simultaneous offers to all downstream firms.[19] Consequently, a downstream firm must form beliefs about the (non-observable) offers that the supplier made to all other firms. The outcome where $w^i = c$ is obtained under "passive beliefs."[20]

By Lemma 1, the supplier's total profit is equal to the sum of all agreed fixed transfers τ^i. One implication of this is that an individual agreement does not affect the supplier's profits from all other potential agreements. If all other negotiations are successful, an agreement with buyer i, which controls n^i firms, then generates the joint profits[21]

$$n^i \left[R(q_S, q_S) - q_S c \right], \tag{1}$$

where we substituted the respective equilibrium quantities q_S. Suppose now first that buyer i would cease to operate when negotiations break down. (For instance, the fixed costs F from integrating backwards could be too high.) According to the general Nash bargaining solution, τ^i would then be determined by the requirement that the profits of buyer i are equal to some fraction $0 \le \rho^i \le 1$ of the joint profits (1).

We choose not to model a change in buyer power through an exogenous variation in ρ^i. This follows as we are primarily interested in the role of buyers' size. To our knowledge, there does not exist a formal argument for how size would affect ρ^i (e.g., through affecting a buyer's discount factor in an underlying non-cooperative model of bargaining as in Appendix B). Remaining agnostic about the sharing rules ρ^i, we thus

[18]We follow these papers in assuming that contractual ways to achieve the monopoly outcome (e.g., by granting exclusivity) are not credible or not feasible, e.g., as they would constitute a non-permissible vertical restraint.

[19]A notable exception is O'Brien and Shaffer (1994), who adopt an axiomatic Nash bargaining approach.

[20]Passive beliefs specify that when receiving an unanticipated offer, a firm believes that the supplier did not simultaneously adjust its offer to other firms. Our specification that the supplier negotiates through I agents has the same implications.

[21]The axiomatic approach does not allow for renegotiations following an unanticipated disagreement with other buyers. However, with $w^i = c$ there would clearly be no scope for such mutually beneficial renegotiations.

stipulate that buyers and the supplier have equal bargaining power: $\rho^i = 0.5$.[22]

If one half of the joint profits (1) already exceeds the value of the respective buyer's alternative supply option, the threat to take up this option is not credible. This is the key insight of the "outside option principle" in bargaining theory. According to this principle, the buyer's "outside option" only affects negotiations if its value exceeds the payoff that the buyer would realize when negotiating without having such an option. Once the value of the outside option exceeds one half of (1), however, the value of the buyer's alternative supply option fully determines the buyer's payoff from the negotiation.

In what follows, we first employ the "outside option principle," which will allow for a richer set of effects. In Appendix B we set up and solve a non-cooperative bargaining model in the spirit of Binmore, Rubinstein, and Wolinksy (1989) and provide a foundation for the chosen solution concept. Moreover, in Section 4 we analyze our model, instead, under a solution concept where the "outside option principle" does not apply and show that our results still hold.

The value of the outside option of buyer i, which we denote by V^i_{Out}, is now derived as follows. When choosing the alternative supply option, the buyer can also decide on the amount $K_B(\Delta^i_B)$ that it wants to invest in order to reduce its own marginal cost down to $c^i_{Out} = \overline{c}_{Out} - \Delta^i_B$. If buyer i decides to integrate backwards, the maximum profits from this strategy are equal to[23]

$$v^i_{Out} := \max_{\Delta^i_B} \left\{ n^i \max_q \left[R(q, q_S) - (\overline{c}_{Out} - \Delta^i_B) q \right] - K_B(\Delta^i_B) - F \right\}. \tag{2}$$

As there is always the option not to be active any longer, the outside option of buyer i has thus the value $V^i_{Out} = \max\{0, v^i_{Out}\}$. To ensure that there is indeed scope for a mutually beneficial agreement with all buyers, we make the following joint assumption.

Assumption 2. *For all $n_i \leq N$, it holds that $v^i_{Out} < n^i \left[R(q_S, q_S) - q_S \overline{c} \right]$, while per-firm Cournot profits $R(q_S, q_S) - cq_S$ are strictly decreasing in c.*

[22]While this makes all expressions simpler, none of our qualitative results depends on the particular choice, that is as long as $0 < \rho^i < 1$ for all B^i. However, as we later consider the formation of larger buyers through mergers, it would then fall upon us to specify which value of ρ (or, in the non-cooperative model of Appendix B, which discount factor) to use for the merged buyer. Again, there is no theory that could guide our choice.

[23]We already use that in equilibrium negotiations with all other buyers will be successful. Recall also that buyers' respective own marginal costs are mutually observable.

From the second part of Assumption 2, if there is a mutual beneficial agreement for $c = \overline{c}$, then this holds *a fortiori* for all lower values $c < \overline{c}$.[24] Summing up, we have thus arrived at the following results.

Proposition 1. *Under Assumption 2 and using the symmetric Nash bargaining solution, there is an agreement in all bilateral negotiations. An agreement with buyer i specifies $w^i = c$, while the agreed fixed transfer τ^i is determined as follows. If*

$$\frac{1}{2} n^i [R(q_S, q_S) - q_S c] \geq v^i_{Out}, \tag{3}$$

then τ^i satisfies

$$\tau^i = \frac{1}{2} n^i [R(q_S, q_S) - q_S c]. \tag{4}$$

Otherwise, we have that

$$\tau^i = n^i \left[R(q_S, q_S) - q_S c \right] - v^i_{Out}. \tag{5}$$

Note that the chosen bargaining solution allows the supplier to discriminate between different buyers. In the present setting, discriminatory pricing arises due to the different values of buyers' outside options, which in turn depend on buyers' different size. In what follows, we refer to the case where condition (3) does not hold, i.e., where τ^i is determined by equation (5), as the case where the outside option of buyer *i binds*. As a final remark, it should be noted that an individual disagreement is not observed by other buyers, which is why rival firms leave their output q_S unchanged. We show in Section 4 that this is, however, not critical for our results.

3 Analysis

3.1 Buyer Size and Outside Options

We are interested in how the formation of larger buyers affects the supplier's incentives to reduce production costs in the first stage of the model. As a first step, we ask how

[24] Vives (1999, p. 105) provides sufficient conditions on the demand function for this to hold. The first part of Assumption 2 is thus stronger than needed, as it will have to hold only "sufficiently close" to the equilibrium choice of c. Invoking the stronger assumption allows, however, to rule out case distinctions when deriving our results. Moreover, while Assumption 2 is not on the primitives, it is straightforward to impose conditions on $\overline{c}_{Out}$ (in comparison to $\overline{c}$) and on K_B (in comparison to K_S) that ensure that it holds.

the outcome of negotiations change if there are fewer, but larger buyers with which the supplier has to negotiate.

Suppose first that for some given choice of c, the outside option was not binding for *any* buyer, e.g., as F was sufficiently high. In this case, the average per-unit price of buyer i equals

$$\mu^i := \frac{\tau^i + n^i q_S c}{n^i q_S}, \tag{6}$$

where we make use of $w^i = c$ from Lemma 1. Substituting for τ^i from equation (4), this becomes $\mu^i = [c + P(2q_S)]/2$ and is thus independent of the buyer's size n^i. Intuitively, as the outside option does not affect how profits are shared, each buyer receives one half of the profits that are realized in each of its n^i markets. Consequently, the supplier's overall profits are equal to $N[R(q_S, q_S) - q_S c]$, where we use that there are two competing firms in each of the N independent markets.

The size of individual buyers starts to matter, however, once buyers' outside options become binding. With a binding outside option, the average purchasing price (6) is strictly decreasing in the number of firms n^i that a buyer controls. We next provide an intuition for this result.

When making use of his alternative supply option (e.g., through backward integration), a buyer incurs two types of costs: F and the additional investment costs $K_B(\Delta_B^i)$, which depend on the (optimally) chosen level of cost reduction Δ_B^i. The larger n^i, the larger is the total quantity over which the buyer can distribute these costs. As a consequence, the value of a buyer's outside option increases more than proportionally with n^i, i.e., v_{Out}^i/n^i is strictly increasing in n^i, implying ultimately that the buyer's average purchasing price is lower. More formally, substituting τ^i from (5) in Proposition 1 into the average price μ^i, as given by (6), we can confirm from

$$\mu^i = P(2q_S) - \frac{v_{Out}^i}{n^i q_S} \tag{7}$$

that μ^i is then indeed strictly decreasing in n^i if this holds for the ratio $v_{Out}^i/(n^i q_S)$.

Lemma 2. *Unless the outside option does not bind for any size $n^i \leq N$, there exists a threshold $1 \leq \widehat{n} \leq N$ such that for all buyers with size $n^i < \widehat{n}$ the outside option is not binding, while it is binding for all buyers with size $n^i \geq \widehat{n}$. Moreover, for all $n^i < \widehat{n}$ the average purchasing price μ^i is identical, while μ^i is strictly decreasing in n^i if $n^i \geq \widehat{n}$.*

Proof. See Appendix A.

After a break-down of negotiations, the respective buyer i will invest more in a reduction of c^i_{Out} if he controls more firms n^i, provided that $V^i_{Out} > 0$ and that the buyer is thus still active. As this result will be key for what follows, we state it separately.[25]

Lemma 3. *If $V^i_{Out} > 0$, then c^i_{Out} is strictly decreasing in n^i.*

Proof. See Appendix A.

3.2 Supplier's Incentives

We turn now to the first stage of our model, where the supplier invests in a reduction of own marginal cost. Recall that the supplier sells at a constant marginal price that is equal to marginal cost c. The supplier's profit is thus equal to the sum of all fixed transfers τ^i. Consequently, the supplier optimally chooses its marginal cost $c = \bar{c} - \Delta_S$ to maximize

$$U := \sum_{i \in I} \tau^i - K_S(\Delta_S), \tag{8}$$

where the transfers τ^i are determined by equations (4) or (5), respectively. It is now easily checked (and verified in the following proofs) that U is continuous and almost everywhere differentiable in Δ_S. To analyze the supplier's incentives, define $m := dU/d\Delta_S$ at all points where U is differentiable. Suppose first that for some choice of c the outside option does not bind for any buyer. Then the supplier's incentives to (marginally) decrease c are given by[26]

$$m = -N \frac{d}{dc} \left[R(q_S, q_S) - c q_S \right] - K'_S(\Delta_S). \tag{9}$$

Here, we make use of Proposition 1 and of the fact that there are $2N$ downstream firms. Recall also that $K_S(\Delta_S)$ represents the investment that is needed to reduce marginal cost from $\bar{c}$ to $c = \bar{c} - \Delta_S$. Moreover, if all buyers' outside options do not bind, then the supplier can extract one half all all incremental profits. Finally, note that from Assumption 2 we have that $\frac{d}{dc} \left[R(q_S, q_S) - c q_S \right] < 0$.

How do incentives change if, instead, the outside option of some buyer, say buyer i, binds? We can isolate three effects through which this increases m.[27] First, as the outcome

[25] As we make clear in the proof of Lemma 4, if c^i_{Out} is not uniquely determined, then the assertion holds for the respective set of optimal choices.

[26] The minus sign in front of the first term in (9) follows from $dc/d\Delta_S = -1$.

[27] All effects are derived formally in the proof of Lemma 3.

of negotiations with buyer i is now fully pinned down by the value of the buyer's outside option, following a reduction of c the supplier can pocket the full marginal increase in the respective joint surplus $n^i[R(q_S, q_S) - cq_S]$. In other words, with a binding outside option there is no longer a hold-up problem between the supplier and buyer i, at least not for marginal changes in Δ_S.[28] Second, once the outside option of buyer i binds, there is an additional effect through which the supplier's incentives increase. This holds as a reduction in the supplier's marginal cost reduces the value of a buyer's outside option and, thereby, increases the supplier's profit in case the buyer's outside option binds. To see this, note that in each of the n^i markets in which firms controlled by buyer i are active, the supplier also sells to competing firms. The lower the supplier's marginal cost, the more competitive are these rivals, which reduces a buyer's profits from his alternative supply option.

Importantly, which is our third observation, the previous effect becomes stronger if there are fewer, but larger buyers, even if the outside options of *all* buyers bind. More formally, the size of the (negative) effect that a reduction of c has on v^i_{Out} increases more-than-proportionally with the buyer's size n^i. Consequently, if we merge a subset $\widehat{I} \subset I$ of buyers, then this strictly increases the supplier's incentives. The intuition for this result is somewhat more involved and explored next.

The argument builds again on the insight that a reduction of c makes all other buyers more competitive, inducing them to choose a strictly higher quantity at each of the N markets. Recall from Lemma 3 that a larger buyer chooses a lower value of c^i_{Out} after disagreement, implying that he will produce a larger quantity in each of the n^i markets in which he is active. This implies that following disagreement, a larger buyer will also tend to lose relatively more compared to smaller buyers if rivals increase their quantity and, thereby, push down the price, following a reduction of their marginal purchasing price $w^i = c$.

For the preceding arguments we scaled up the size of one buyer i. To keep the size of the total industry constant, this requires to simultaneously scale down the size of another buyer. In what follows, in order to keep the size of the whole market constant, we focus on mergers between buyers.[29]

[28] Recall our convention by which the outside option is binding if (3) does not hold. Consequently, as $R(q_S, q_S) - cq_S$ and v^i_{Out} both change continuously in c, the outside option stays binding after a small change in Δ_S.

[29] It should be recalled that we only consider market structures where neither of the N independent markets is monopolized.

Lemma 4. *Take some level of the supplier's marginal cost c and consider the marginal incentives for the supplier to further decrease c, which are given by the derivative m. Following a merger of any of the I independent buyers, m increases, which holds strictly whenever the outside option of the newly formed, large buyer binds.*

Proof. See Appendix A.

3.3 Equilibrium Analysis

With Lemma 4 at hands, the following result follows now immediately by applying standard comparative statics results.

Proposition 2. *If there are fewer but larger buyers, then, in equilibrium, the supplier's marginal cost c will never be higher, but it may be strictly lower.*

Note that we do not need for Proposition 2 that there is a unique optimal choice of the cost reduction Δ_S, leading to some $c = \overline{c} - \Delta_S$. If there is a multiplicity of equilibrium choices, then Proposition 2 applies to the respective optimal sets.[30]

If the exercise of buyer power leads to lower marginal costs and thus higher quantities in each of the N markets, consumer surplus is unambiguously higher. We study next the effect on total welfare. Suppose first that the outside option does not bind for any buyer. The resulting hold-up problem with all I buyers reduces the supplier's incentives, inducing a choice of Δ_S that lies below the level that would maximize total industry profits (net of the respective investment costs). This is, however, already strictly below the level at which welfare would be maximized. Hence, by increasing the supplier's incentives, total welfare can be improved.

Consider next the opposite extreme where all outside options bind, making the supplier the residual claimant when (marginally) increasing joint profits. In this case, the equilibrium choice of Δ_S will be strictly above the level that would maximize total industry profits. This follows as a further increase in Δ_S is still beneficial for the supplier, given that it erodes the value of buyers' outside options and thus allows the supplier to extract a

[30]There are two reasons for why the formation of a larger buyer does not always lead to a strictly lower value of c. First, the outside option of the newly formed, larger buyer may not be binding over the relevant range of c. Second, even if this is the case, such that m increases over the relevant range, then the optimal c may still be unchanged as it lies on a kink of the supplier's profits U. (U is differentiable everywhere with the exception of points at which the outside option of one buyer starts to bind.)

higher share of joint profits. We illustrate next that in this case, the supplier's incentives may even become too high from the perspective of maximizing welfare.

For this we suppose that $P(q) = a - bq$ is derived from the utility function of a representative consumer. Given marginal cost c, the symmetric Cournot quantities are $q_S = \frac{a-c}{3b}$. As the wholesale price equals marginal cost, this yields per-firm profits $b\left(\frac{a-c}{3b}\right)^2$. Recall that we want to illustrate that the supplier's incentives after the formation of a large buyer can be even too high.[31] To calculate $-dv^i_{Out}/dc$, we have to substitute the optimal choice of c^i_{Out} after break-down of negotiations. With quadratic investment costs $K_B(\Delta^i_B) = \gamma_B(\Delta^i_B)^2/2$, we have[32]

$$c^i_{Out} = \frac{6b\gamma_B\bar{c}^i_{Out} - n^i(2a+c)}{6b\gamma_B - 3n^i}.$$

Substituting this into

$$v^i_{Out} = n^i\left(\frac{2a+c-3c^i_{Out}}{6b}\right)^2 - \frac{\gamma_B}{2}(\bar{c}_{Out} - c^i_{Out})^2 - F$$

yields

$$\frac{dv^i_{Out}}{dc} = n^i\left(\frac{2a+c-3c^i_{Out}}{18b}\right). \tag{10}$$

In the extreme case where all buyers' outside options bind, the supplier's marginal benefits of reducing c are given by the sum of $-\sum_{i\in I} dv^i_{Out}/dc$ from (10) and the derivative of total industry profits, which becomes $\frac{4N}{9b}(a-c)$.

If we stipulate, in addition, quadratic investment costs K_S for the supplier, then it is straightforward to find examples where the supplier's incentives become *too* high from the perspective of maximizing welfare. For instance, this is the case if only two large buyers remain (such that $I = 2$ and $n^i = N$), whose outside options bind, while we choose $a = b = 1$, $\bar{c} = \bar{c}_{Out} = 0.5$, and $\gamma_B = \gamma_S = 10$ (in addition to a sufficiently low F).

[31] It is, instead, easily checked that incentives are too low if no outside option binds. In this case, while a marginal reduction of c increases social welfare (i.e., the sum of producer surplus and consumer surplus) by $\frac{8N}{9b}(a-c)$, from differentiating total industry profits, we have for the supplier's marginal incentives $\frac{1}{2}\frac{4N}{9b}(a-c)$, which is strictly lower.

[32] Assuming $\gamma_B > \frac{1}{\bar{c}_{Out}}\frac{N}{6b}(2a+c)$ ensures existence of an interior solution $0 < c^i_{Out} < \bar{c}_{Out}$.

4 Discussion

4.1 Discussion of the Bargaining Solution

Multi-Agent Negotiations

Both our axiomatic bargaining solution as well as the non-cooperative foundation in Appendix B assume that the supplier negotiates through I different agents, who act simultaneously and independently. As individual deals are not observable to other buyers, we argued above that the outcome (in terms of $w^i = c$) is the same as with "passive beliefs" in a game of one-sided offers by the supplier, which is standard in the literature. In fact, as is easily checked, the outcome (under passive beliefs) is identical to that of our bargaining setting in case all outside offers bind (such that the sharing rule $\rho = 0.5$ no longer plays a role). Note next that in such a game where the supplier makes take-it-or-leave-it offers to all buyers, given non-observability the characterized outcome represents an equilibrium irrespective of whether we would allow the supplier to deviate by making different offers to any subset of buyers or only to a single buyer (at "a time").[33] In our axiomatic bargaining framework, we could likewise conduct a thought experiment by asking whether a supplier could "profitably deviate" by "orchestrating" different offers (than those characterized in Proposition 1) to several buyers at a time. Given $w^i = c$ and non-observability of offers, there is, however, no set of different offers that would be mutually beneficial to the supplier and the respective buyers.

Bargaining without the "Outside Option Principle"

Our main result made use of the Nash bargaining solution with the "outside option principle". The non-cooperative foundation in Appendix B uses the well-known approach to create costs of continuing negotiations through impatience. If, instead, one follows Binmore, Rubinstein, and Wolinksy (1989) and allows for risk-of-breakdown, then it is well known that this gives rise to the axiomatic Nash bargaining solution *without* the "outside option principle": In each bilateral negotiation, incremental profits are *always* calculated net of the respective disagreement payoffs. If net surplus is still split equally, we have from our previous results that

$$\tau^i = \frac{1}{2}\left[n^i \left[R(q_S, q_S) - q_S c\right] - V^i_{Out}\right].$$

[33]In addition, it is also easily checked that this represents the unique equilibrium in either case.

The supplier's incentives are thus always determined by the derivative

$$\frac{d}{d\Delta_S}\sum_{i\in I}\tau^i = -N\frac{d}{dc}\left[R(q_S,q_S)-q_S c\right]+\frac{1}{2}\sum_{i\in I}\frac{d}{dc}V^i_{Out}. \tag{11}$$

Recall next that we previously decomposed Lemma 4, which states how incentives depend on the concentration of buyers, into several effects. We showed there that the effect that a change of c has on the value of a buyer's outside option increases more-than-proportionally with the buyer's size. Importantly, this implies that our previous results still holds even without the "outside option principle". To make this more formal, it is convenient to restrict consideration to the case where the outside option has strictly positive value $v_i^{Out} > 0$ for all buyers $i \in \widehat{I}$ who merge.[34] Denote the outside option of the merged buyer, who controls all $\widehat{n} := \sum_{i\in\widehat{I}} n^i$ firms, by $\widehat{v}_{Out}$. We want to show that

$$\frac{d\widehat{v}_{Out}}{dc} > \sum_{i\in\widehat{I}}\frac{dv^i_{Out}}{dc}. \tag{12}$$

From the envelope theorem, as well as symmetry of all N markets, we have

$$\frac{dv^i_{Out}}{dc} = \frac{dv^i_{Out}}{dq_S}\frac{dq_S}{dc} \text{ and } \frac{d\widehat{v}_{Out}}{dc} = \frac{d\widehat{v}_{Out}}{dq_S}\frac{dq_S}{dc},$$

respectively, implying from $dq_S/dc < 0$ that (12) holds whenever

$$\frac{d\widehat{v}_{Out}}{dq_S} < \sum_{i\in\widehat{I}}\frac{dv^i_{Out}}{dq_s} \tag{13}$$

Denote by q^i the (off-equilibrium) quantity chosen (pre-merger) by buyer i and the respective quantity of the merged buyer by $\widehat{q}$. Condition (13) then holds if we have for all $i \in \widehat{I}$ that[35]

$$q^i P'(q_S + q^i) > \widehat{q}P'(q_S + \widehat{q}). \tag{14}$$

Observe again that the respective expressions simply capture the (per-market) profit impact from an increase the rival's quantity, q_S. The intuition for why (14) holds is that, as noted before Lemma 4, an increase in q_S affects the merged, larger buyer by more, given

[34] Cf. the final part of the proof of Lemma 4 for a complete formalization.

[35] This represents a restatement of condition (30) in the proof of Lemma 4.

that after disagreement he reduces marginal costs by more and thus produces a larger quantity in any given market.[36]

Proposition 3. *The key results, namely Lemma 4 and Proposition 2, continue to hold under Nash bargaining without the "outside option principle."*

Observability of Disagreement

The derivation of our results was simplified by the assumption that the outcome of each bilateral negotiation was not observable to other buyers. Even if an individual negotiation results in disagreement, this may indeed not be observed in the short run, in particular if downstream firms are manufacturers, while the supplier's product represents one of several inputs. (Note that given $w^i = c$, the supplier has no incentives to inform other buyers.) In contrast, in the case of retailing competitors may pay close attention to the offering of their rivals. We analyze how our previous results extend to the case where rivals observe a break-down of negotiations.

Recall that we identified three effects through which a supplier's incentives increase after the formation of a larger buyer (cf. Lemma 4). Clearly, the two effects that derive from the "outside option principle" continue to hold, irrespective of whether disagreement is observed or not. We thus focus on the analysis of the third effect, which does not rely on the "outside option principle" (cf. Proposition 3). As a first observation, as previously stated in Lemma 3, a larger buyer will still invest mor in a reduction of marginal costs c^i_{Out} after disagreement (cf. the proof of Proposition 4 below).[37]

We need now to consider the Cournot game in a market where firms have potentially different marginal costs. In a slight abuse of notation, suppose that in some market the marginal cost of the two rival firms are c_1 and c_2. If there is a unique Cournot equilibrium where both firms are active with $q_1 > 0$ and $q_2 > 0$, we denote the respective reduced-form profits by $\pi(c_1, c_2) = q_1(P(q_1 + q_2) - c_1)$ and $\pi(c_2, c_1) = q_2(P(q_1 + q_2) - c_1)$.

The following argument is now analogous to that preceding Proposition 3. We again want to show that (12) holds. From the envelope theorem, we have after substituting

[36]More formally, as a larger buyer invests more in a reduction of own marginal cost after disagreement (cf. Lemma 3), we have $q^i < \widehat{q}$. With this observation, (14) follows then as $\frac{d}{dq}[qP(q_S + q)]$ is strictly decreasing in q. (This follows, in turn, from Assumption 1.)

[37]Note that we assume now that also the choice of c^i_{Out} is observable, though also this can be relaxed without affecting results qualitatively.

$c_1 = c^i_{Out}$ and $c_2 = c$ that

$$\frac{d\widehat{v}_{Out}}{dc} = \widehat{n}\frac{d\pi(c^i_{Out}, c)}{dc},$$

which from our previous observations on c^i_{Out} strictly exceeds $\sum_{i\in\widehat{I}} n^i \frac{dv^i_{Out}}{dc}$, which applies prior to the merger, in case

$$\frac{d^2\pi(c_1, c_2)}{dc_1 dc_2} < 0. \tag{15}$$

Condition (15) is regularly applied in the literature (cf. Athey and Schmutzler 2001) and holds, in particular, with linear demand.[38]

Proposition 4. *If (15) is satisfied, then the key results, namely Lemma 4 and Proposition 2, continue to hold also in case the breakdown of bilateral negotiations is observed by rival firms.*

Proof. See Appendix A.

4.2 Discussion of the Industry Set-Up

Single Incumbent Supplier

Suppose that all merging buyers currently purchase from the same supplier, which we denote by $s = 1$, while other buyers may well purchase from different suppliers $s > 1$. To stay in the framework of our model, we further suppose that the input of suppliers $s > 1$ is not compatible to the production function of any of the merging buyers $i \in \widehat{I}$, implying that after disagreement, the buyer must still locate a new source of supply or integrate backwards at cost $F + K_B$.[39] In case none of the rival firms in the $\widehat{n} = \sum_{i\in\widehat{I}} n^i$ markets that the merged buyer controls was also supplied by $s = 1$, then our previous results would only hold if the "outside option principle" applies. This is immediate as in this case a reduction in c does not affect the value of the merging buyers' outside options. On the other hand, for our results to hold also without the "outside option principle" (cf. Proposition 3), it is clearly only necessary that the supplier sells to a *single* rival firm in

[38]For instance, this assumption is frequently made in the literature on R&D investments (cf. Katz 1986).

[39]An analysis of the case where different buyers $i \in \widehat{I}$ initially purchase from different suppliers would raise new issues, e.g., that of strategic single vs. multiple sourcing, which can not be adequately addressed in the presently considered, static procurement model.

these $\widehat{n}$ markets.[40]

Monopolization of Downstream Markets

If the merging buyers operate firms in the same markets, then given that we stipulated that each (local) market is made up of only two firms, the merger would lead to a full monopolization of the respective markets. The effect of such a monopolization is particularly strong given that, as before the merger, the supplier could not dampen intrabrand competition (due to the unobservability problem).

Denote monopoly profits by $R^M(c) := \max_q[q(P(q) - c)]$. These are obtained after the merger to monopoly in a given market as, by optimality, it then still holds that $w^i = c$. If outside options are not binding, e.g., as F is high, then such a merger increases the supplier's incentives if

$$\frac{1}{2}\frac{dR^M(c)}{dc} > \frac{1}{2}\frac{d\left[2\pi(c,c)\right]}{dc}, \tag{16}$$

where we used for Cournot profits the notation from Section 4.1. Whether condition (16) holds can not be generally determined.[41] If buyers' outside options may bind, given that F is not too high, note that as the merger is to a monopoly (and *only* in this case), we have $dv_i^{Out}/dc = 0$, where now

$$v^i_{Out} := \max_{\Delta^i_B} \left\{ n^i R^M(\overline{c}_{Out} - \Delta^i_B) - K_B(\Delta^i_B) - F \right\}.$$

Hence, as the monopolist controls access to the whole local market, the supplier has no longer incentives to decrease c so as to undermine the value of the buyers' outside option. This observation stresses once more the importance of downstream competition for the previously identified channels through which a supplier is incentivated to reduce c. Consequently, in the case where outside options are binding, the supplier's incentives from the joint profits realized in a considered local market are given by $\frac{dR^M(c)}{dc}$ or $2\frac{d\pi(c,c)}{dc}$, respectively, which both exceed the respective incentives in case the outside option does not (yet) bind. Finally, as is immediate to show, the outside option is again more likely to bind for a larger buyer.

[40] A setting with different "competing vertical chains" would rise also new issues. For instance, if two suppliers serve competing buyers and if their choice of marginal cost reductions are strategic substitutes, which ican be shown to be the case for $\pi_{12} > 0$, then as one supplier obtains higher incentives to reduce marginal cost, this stifles the "rival" supplier's investment incentives. We leave such an analysis to future work.

[41] Incidentally, as is easily checked, condition (16) is satisfied for the linear example with $P(q) = a - bq$.

Applications

An application of Proposition 2, which is our main result, could be to retailing, where a larger retailer is formed through the merger of two or more smaller retail chains. The resulting average purchasing price μ^i of a larger chain may then be already fully pinned down by the chain's attractive alternative supply option. From the perspective of the supplier, this leaves no room for haggling over a higher price. In contrast, with small chains there is scope for negotiations. Lemma 4 and Proposition 2 show that the formation of larger retail chains can actually spur upstream investment to reduce marginal costs, even though the supplier's total profits are clearly lower.

Some of the simplifying assumptions that we made in order to focus our analysis on the novel results in this paper seem to be particularly suitable to retailing. There, markets are indeed often locally segmented. Though there may be different competing chains, in a given local market consumers may only choose between few different outlets.[42] If two chains operating in different local markets merge, the merger will thus have no immediate implications for downstream competition. In addition, in case there is some overlap, it is relatively easy for antitrust authorities to impose adequate structural remedies by forcing the divestiture of outlets in the affected markets. Moreover, in retailing backward integration could be seen akin to the introduction of private labels.

In the Introduction we referred to the string of inquiries into the UK grocery market over the last years. In all of these inquiries, buyer power has been a main concern (cf. Competition Commission 2000, 2003, 2008). For its last inquiry, the Competition Commission investigated at length the potential impact of buyer power on suppliers' profitability and their incentives to invest and innovate. Even though the inquiry once again revealed strong evidence of size-related buyer power, the Competition Commission's own research, as well as the submission by parties to the inquiry, did not support the view that the exercise of buyer power comes at a loss of dynamic efficiency. By showing how larger buyers can better "keep suppliers on their toes", our model provides a formal explanation for these findings.[43]

[42] In retailing, in particular in the "one-stop-shopping" segment of super- or hypermarkets, the assumption of a tight local oligopoly (and, in particular, of no further entry) is also often realistic given local planning restrictions. In addition, for many goods or services the local market may also often not support more than a very limited number of competing shops.

[43] For details see, in particular, the extensive material in the Competition Commission's provisional findings (Competition Commission 2007). Of course, there may be other explanations for these findings,

Though the application of our model and insights to retailing is thus apparent, our insights are, however, clearly not restricted to this industry. In fact, if downstream firms are themselves manufacturers, they may have to spend F to adapt production to the use of a different input. Here, the additional costs K_B could arise either from searching for a particularly suitable input or, likewise, from a more efficient adaptation.[44]

4.3 Impact of a Merger on Other Buyers

So far we have only analyzed how the formation of a larger buyer affects the supplier's profits and, thereby, the supplier's incentives. Holding c constant, unless the merged buyer's outside option does not bind, the supplier's profits decrease. This holds still if the supplier optimally adjusts c following the merger. Next, if c remains constant, then the merger will be unambiguously profitable for the larger buyer. Interestingly, this may, however, no longer be the case once we take into account the supplier's optimal adjustment of c. Naturally, buyers would, however, only merge if this was profitable. What remains to be analyzed is how the formation of a larger buyer affects those that remain outside the merger.

In policy discussions, in particular in the area of retailing, it is sometimes argued that other buyers may be *negatively* affected by the formation of a larger and more powerful buyer. In our model, we specified that contracts are sufficiently complex to avoid problems of double-marginalization. An implication of this is that regardless of a buyer's size, each buyer can still procure at the same *marginal* purchasing price c. While a larger buyer can thus procure at better *average* terms, this does not give the buyer an advantage in the downstream market. Consequently, in our model it is only in the long run that other buyers may be affected by a merger, namely through a possible reduction in the supplier's marginal cost. Through this channel, the exercise of buyer power has quite surprising implications for other buyers. Small buyers that do not have a sufficiently valuable outside option benefit from a merger as they can extract in their negotiations a fraction of the additional profits that are created by a reduction in c. In contrast, other large buyers may be hurt as a reduction in c reduces the value of their binding outside option.

---

e.g., that some of the largest retailers have developed close-knit networks with some suppliers, in particular in the area of own-label production. Alternatively, a loss of dynamic efficiency may still be in the waiting.

[44] In this case the necessary adjustment costs could also arise fully or partially at the newly chosen supplier. To stay within the model, we may then suppose that for the alternative supply option more than one (undifferentiated) supplier stands ready.

Proposition 5. *The formation of a larger buyer does not hurt a small buyer whose outside option does not bind, while the small buyer strictly benefits if the merger induces the supplier to invest strictly more in a reduction of marginal cost. On the other hand, a large buyer who remains outside the merger may be negatively affected as the value of his binding outside option decreases in case the supplier invests in lower marginal cost.*

Proof. See Appendix A.

The result that the exercise of buyer power may, in the long run, be beneficial for small buyers, who essentially free ride on the supplier's higher incentives, comes, however, with some important caveats. First, our analysis focuses on incremental investments. As noted above, what matters for the supplier's incentives is consequently not the absolute level of profits but, instead, only how the formation of a larger buyer affects the supplier's incremental profits from a reduction in marginal cost. For other decisions such as, for instance, whether to introduce a new product or whether to stay in the market or to exit, the supplier's total profits should, however, be more relevant. The spill-over that a merger can have on other buyers via this channel may then be quite different from that brought out in Proposition 5.[45]

4.4 Negotiations in the Presence of Inside Options

The bargaining literature makes a distinction between "outside options", which are triggered by permanent disagreement, and "inside options", which are triggered during negotiations. Applied to our setting, a buyer's inside option would thus be to temporarily purchase a substitute for the supplier's input. In what follows, we extend the analysis in this direction.

For this purpose, suppose that any buyer has the inside option to produce at costs $c_{In} > \overline{c}$. We may think of this alternative supply option as a market for inferior or higher-cost substitutes. For instance, c_{In} could be higher as this input is less suitable to buyers' needs and thus requires some additional and costly adjustments.

In an axiomatic approach, the standard way to treat such "inside options" is the following. As negotiations do not have to be cut off irrevocably before one of the parties

[45] In addition, given that all buyers obtain the same marginal purchasing price in equilibrium, irrespective of their size, in the present model there is no scope to analyze how differential buyer power affects a buyer's competitive position vis-a-vis its downstream rivals. See, however, Inderst and Valletti (2007).

makes use of its inside option, there is no issue of credibility. To calculate the additional surplus that is generated by an agreement, the value of each party's inside option is thus subtracted from the respective joint profits. With the symmetric Nash solution, each party's payoff is then equal to the value of its inside option plus one half of this incremental surplus - provided, of course, these payoffs are not lower than the values of the respective outside options.

In Appendix B we incorporate buyers' inside options in a non-cooperative framework and confirm the subsequent results. Before turning to the formal analysis, it should be noted that all buyers have access to the same inside option. In the non-cooperative model, a buyer that delays an agreement with the supplier expects to reach an agreement in the very next period, implying that no buyer would at this stage have incentives to sink resources so as to make this option more attractive. The payoff that buyer i obtains from its inside option is thus given by

$$V_{In}^i := n^i \max_q \left[R(q, q_S) - qc_{In}\right], \tag{17}$$

where we use again that there is agreement in all other negotiations and that the respective firms choose the quantity q_S. The following results are then immediate given our previous arguments.

Proposition 6. *Suppose that buyers have, in addition, the "inside option" to purchase at costs $c_{In} > c$. Then under the symmetric Nash bargaining solution, there is an agreement in all bilateral negotiations, where $w^i = c$ and where τ^i is determined as follows. If*

$$\frac{1}{2}\left[n^i[R(q_S, q_S) - cq_S] + V_{In}^i\right] \geq V_{Out}^i, \tag{18}$$

then τ^i satisfies

$$\tau^i = \frac{1}{2}n^i[R(q_S, q_S) - q_S c] - \frac{1}{2}V_{In}^i. \tag{19}$$

Otherwise, we have that

$$\tau^i = n^i\left[R(q_S, q_S) - q_S c\right] - V_{Out}^i. \tag{20}$$

All our results continue to hold, once we substitute the payoffs from Proposition 6 instead of those from Proposition 1.

5 Price Competition and Heterogeneous Goods

5.1 Robustness

So far we assumed that buyers offer homogeneous goods and compete in quantities. We now relax both assumptions. Introducing first heterogeneous products only, we thus specify that if one firm in a given market chooses quantity q_1 and the other firm quantity q_2, then the price for the first firm's goods is given by $P(q_1, q_2)$, where the partial derivatives satisfy $P_1 < 0$ and $P_2 < 0$, whenever $P > 0$. The following Assumption extends Assumption 1 to the case with heterogeneous goods.[46]

Assumption 1'. *If goods are not perfect substitutes, then whenever $P(q_1, q_2)$ is positive it holds that $P_1(q_1, q_2) < \min\{0, -q_1 P_{11}(q_1, q_2)/2\}$ and that $P_2(q_1, q_2) < \min\{0, -q_1 P_{12}(q_1, q_2)\}$.*

With Assumption 1', we can show that all of our effects are still present. This gives then rise to the following result.

Proposition 7. *If goods are heterogeneous, then the key results, namely Lemma 4 and Proposition 2, continue to hold.*

Proof. See Appendix A.

To consider price competition, we denote the symmetric demand function by $Q(p_1, p_2)$, where p_1 and p_2 are the prices chosen by the respective rival firms. We assume differentiability with $Q_1 < 0$ and $Q_2 > 0$, whenever $Q > 0$. Furthermore, for brevity we assume directly that for any pair of wholesale prices, in a given market there is a unique price equilibrium, while with symmetric wholesale prices equal to c, the resulting symmetric prices, which we denote by p_S, are strictly increasing in c.

With price competition, it is no longer immediate that bilateral negotiations result in $w^i = c$. In fact, if in equilibrium the supplier charged a strictly positive margin $w^j - c > 0$ to a rival firm in one of the markets in which some buyer i operates, then it is immediate that $w^i = c$ does not maximize joint surplus. However, it is still the case that $w^i = c$ represents the unique equilibrium outcome. To see this, recall first our previous observation that pairwise negotiations in our model result in the same opportunism problem as "passive

[46]Precisely, with Assumption 1' each downstream firm still has a well-defined and strictly decreasing best-response function.

beliefs" in a game where the supplier makes unobservable take-it-or-leave-it offers. In the latter case, $w^i = c$ has been shown to hold also under price competition (cf. Rey and Vergé 2004).[47]

It is again immediate that our "first two effects" from an increase in buyer power, which rely on the "outside option principle", hold irrespective of whether there is price or quantity competition: If the outside option starts to bind, then the supplier can extract all incremental surplus from this relationship, while incentives are further increased as a reduction of c reduces the value of the buyer's outside option. In this respect, the assumption of quantity competition (with strategic substitutes, given Assumption 1) is without loss of generality.

It remains to analyze the "third effect", which works also without the "outside option principle". With

$$v^i_{Out} := \max_{\Delta^i_B} \left\{ n^i \max_p \left[Q(p, p_S) \left(p - (\bar{c}_{Out} - \Delta^i_B) \right) \right] - K_B(\Delta^i_B) - F \right\}$$

we have from the envelope theorem, while using p^i for the optimal price after disagreement, that

$$\frac{dv^i_{Out}}{dc} = n^i \frac{dp_S}{dc} \left[\left(p^i - c^i_{Out} \right) Q_2(p^i, p_S) \right]. \tag{21}$$

Even if the outside option of all merging buyers $i \in \widehat{I}$ already binds (or if the "outside option principle" does not apply), the merger still increases incentives if $dv^i_{Out}/dc > 0$ increases more-than-proportionally with size n^i. To analyze whether and when this is the case, note first that we can still show that $c^i_{Out} = \bar{c}_{Out} - \Delta^i_B$ is strictly decreasing in n^i. Suppose now first that Q_2 is constant, as in the case with linear demand. Then the impact dv^i_{Out}/dc increases indeed more-than-proportionally with n^i if the *margin* of the deviating firm, $p^i - c^i_{Out}$, is strictly higher the lower is c^i_{Out}. (As is easily verified, this again holds with linear demand.) Intuitively, if this is the case, then in analogy to the argument under quantity competition, as rival firms become more competitive and lower the price p_S, following a reduction of c, then the negative impact that this has on sales hurts the "deviating" buyer more if, following disagreement and subsequent choice of c^i_{Out}, it sells its goods at a higher margin.

For the preceding argument, we have assumed that Q_2 is constant and that $p^i - c^i_{Out}$ is strictly decreasing in c^i_{Out}, which holds under linear demand. The latter assumption holds

[47] Strictly speaking, this holds with the limitation to single-offer deviations in the latter case. To establish that $w^i = c$ holds under passive beliefs, it is, however, sufficient to consider only such deviations.

as long as the pass-through rate $\partial p^i/\partial c^i_{Out} > 0$ is smaller than one.[48] From inspection of (21), the effect of a reduction of c on buyers' outside options thus increases more-than-proportionally also under price competition and with general demand if[49]

$$-Q_2(p, p_S)\left[1 - \frac{\partial p^i}{\partial c^i_{Out}}\right] + \frac{\partial p^i}{\partial c^i_{Out}}\left(p^i - c^i_{Out}\right) Q_{12}(p, p_S) < 0. \tag{22}$$

Proposition 8. *If goods are heterogeneous and competition is in prices, then the key results, namely Lemma 4 and Proposition 2, continue to hold if (22) is satisfied.*

Summing up from Propositions 7-8, in the particular case of linear demand all our results hold regardless of whether goods are homogeneous or heterogeneous and regardless of whether there is quantity or price competition. With more general demand, to ensure that under price competition also our "third effect" applies, which ensures that buyer power still increases incentives in case the "outside option principle" does not apply, condition (22) must hold.

5.2 Investment in Product Quality

Introducing heterogenous products also allows to analyze the case where the supplier creates a more competitive offering not through lower marginal costs, but through a superior product. We restrict our analysis to the case with linear demand, where we have an explicit and frequently used way of modelling vertical product differentiation. Denoting again the two rival firms in a given market by $n = 1, 2$, if both are supplied by the incumbent supplier and choose quantities q_n, then the indirect demand function is given by $p_n = a - q_n - \gamma q_{n'}$, where $0 \leq \gamma \leq 1$. The supplier can increase a through investing $K_S(a)$. After disagreement, buyer i can, say again through backward integration, sell a product of quality a^i_B, where the choice of a^i_B comes at costs $K_B(a^i_B)$ (next to the switching costs $F \geq 0$). Indirect demand is then given by $p_n = a^i_B - q_n - \gamma q_{n'}$. To simplify expressions,

[48] We use partial derivatives as there is no price reaction of the rival firm, given that presently a disagreement is not observable.

[49] If breakdown of negotiations is observable, then the key difference is that in (21) we have to replace p_S (and, consequently, dp_S/dc) by the respective price that a rival optimally chooses after observing the choice of c^i_{Out}. If, in analogy to the discussion with quantity competition and observable break-down above, we denote the deviating buyer's price by p_1 and that of each rival firm by p_2, we have, after applying the envelope theorem, that $\frac{dv^i_{Out}}{dc} = n^i \frac{\partial p_2}{\partial c}\left[\left(p_1 - c^i_{Out}\right) Q_2(p_1, p_2)\right]$. Note that this time the partial derivative $\partial p_2/\partial c$ is used to denote that for this the observed c^i_{Out} is kept constant. The difference to (21) is that, generally, both p_2 *and* $\partial p_2/\partial c$ now depend also on the prevailing level of prices, p_1 and p_2, and thus, in turn, on c^i_{Out}. (However, with linear demand $\partial p_2/\partial c$ as well as Q_2 are constants.)

albeit without affecting the generality of results, we set marginal costs of production to zero.

We are again brief and restrict attention to showing that our "third effect" is still present: Even when all outside options bind, the formation of a larger buyer increases the supplier's incentives to invest in product quality, as captured by a.[50] Making the dependency of revenues (after disagreement) on a_B^i explicit, we have that

$$v_{Out}^i := \max_{a_B^i} \left\{ n^i \max_q \left[R(a_B^i, q, q_S) \right] - K_B(a_B^i) - F \right\}.$$

From the envelope theorem, this yields

$$\frac{dv_{Out}^i}{da} = n^i \frac{dq_S}{da} \left[q^i P_2(q^i, q_S) \right],$$

which for linear demand becomes

$$\frac{dv_{Out}^i}{da} = -n^i \frac{dq_S}{da} \gamma q^i = -n^i \frac{\gamma}{2+\gamma} q^i, \tag{23}$$

where we used in the final step that $q_S = \frac{a}{2+\gamma}$. The effect working through the outside option, $\frac{dv_{Out}^i}{da}$, thus again increases more-than-proportionally with size (n^i) whenever a larger buyer chooses a higher q^i after disagreement. It is immediate that this holds for any function K_B, provided that the solution satisfies the respective first-order condition. The intuition for why the effect increases more-than-proportionally with size is exactly the same as that for a change in c under quantity competition: As a larger buyer produces more after breakdown of negotiations, he is affected worse if its rivals become more competitive.

With linear demand, it is also immediate that this result extends to the case where a break-down of negotiations is observable. Formally, we can then again rewrite $\frac{dv_{Out}^i}{da} = -n^i \frac{\partial q_2}{\partial a} \gamma q^i$, where q_2 denotes the rivals' quantity.[51] The result follows then as $\frac{\partial q_2}{\partial a}$ is a constant and as q^i is once again strictly higher the higher is a_B^i. Finally, we also extend the result to the case of price competition, where we now assume, in addition, that $\gamma < 1$.

If both firms $n = 1, 2$ in a given market are served by the incumbent supplier, demand equals

$$q_n = a \frac{1}{1+\gamma} - \frac{1}{1-\gamma^2} p_n + \frac{\gamma}{1-\gamma^2} p_{n'}.$$

[50] It is immediate that our "two other effects", which rely on the "outside option principle", are still present, working now towards an increase in the equilibrium quality a.

[51] The partial derivative again captures the fact that it only takes into account a change in a, but not in the subsequently adjusted a_B^i.

Instead, if buyer i continues to be active after disagreement, then in a given market demand equals

$$q^i = \frac{a_B^i - \gamma a}{1-\gamma^2} - \frac{1}{1-\gamma^2} p^i + \frac{\gamma}{1-\gamma^2} p_S,$$

where we have already substituted for $p_{n'} = p_S$, which further becomes $p_S = \frac{a}{2-\gamma}$. Using $q^i = Q(a, p^i, p_S)$, where the direct dependency on a is made explicit, we have

$$\frac{dv_{Out}^i}{da} = n^i \left[\frac{dp_S}{da} \left[p^i Q_2(p^i, p_S, a) \right] + p^i Q_3(p^i, p_S, a) \right],$$

which for linear demand becomes

$$\frac{dv_{Out}^i}{da} = -n^i p^i \frac{\gamma}{1+\gamma} \frac{1}{2-\gamma}. \tag{24}$$

As p^i is strictly increasing in n^i, given that this raises a_B^i, from (24) the effect that a has on the outside option of a buyer increases again more-than-proportionally with the buyer's size.[52]

Proposition 9. *If the supplier's investment is in product quality instead of marginal cost reduction, then for the case with linear demand and differentiated goods all key results, Lemma 4 and Proposition 2, continue to hold. This is the case regardless of whether competition is in quantities or prices and of whether a break-down of negotiations is observable or not.*

5.3 Conclusion

We showed how the presence of larger buyers can make it more profitable for a supplier to reduce marginal cost (or, likewise, to increase quality). This result stands in stark contrast to an often expressed view whereby the exercise of buyer power would stifle suppliers' investment incentives. In a model with bilateral negotiations, a supplier can extract more of the *incremental* profits from an investment if it faces more powerful buyers, though the supplier's total profits decline. Furthermore, the presence of more powerful buyers creates additional incentives to lower marginal cost as this reduces the value of buyers' alternative supply options. The latter effect is due to downstream competition between buyers and, as we show, is also stronger the larger buyers are.

[52] Again, the result holds also if break-down is observable, though we omit a formal discussion.

We endogenized buyer power from buyers' size, which in turn generated more valuable alternative supply options. Depending on the particular industry, there may be, however, other sources of buyer power. For instance, customers' loyalty to particular retail outlets may make it less likely that they will shop elsewhere if these shops drop a single brand. Alternatively, through selling more own-label products, a retailer may be able to capture some of the revenues that would, otherwise, be lost when delisting a supplier's (branded) good. It is an open question how buyer power that originates from these alternatives sources could affect suppliers' incentives.

Appendix A: Proofs

Proof of Lemma 2. Denote the set of optimal choices for Δ_B^i by D_B^i. If following disagreement, it is not optimal for buyer i to remain active, it is uniquely optimal to set $\Delta_B^i = 0$ such that $v_{Out}^i = -F/n^i$.[53] Otherwise, we have from the properties of K_B that all $\Delta_B^i \in D_B^i$ satisfy $\Delta_B^i > 0$ and $0 < \Delta_B^i < \overline{c}_{Out}$. Given the smoothness of the Cournot game and differentiability of K_B, all $\Delta_B^i \in D_B^i$ are determined by the respective first-order conditions. Note next that we can treat n^i as a continuous variable as all expressions in v_{Out}^i are defined for real values n^i. From the envelope theorem, v_{Out}^i is strictly increasing and strictly convex in n^i. The assertion follows then from inspection μ^i together with Proposition 1. **Q.E.D.**

Proof of Lemma 3. We show that the set D_B^i is strictly increasing in n^i, provided that n^i is sufficiently large such that the buyer optimally chooses to be active after disagreement ($n^i \geq \widehat{n}$). To see this, observe first that the cross-derivative of

$$n^i \max_q \left[R(q, q_S) - q(\overline{c}_{Out} - \Delta_B^i) \right] - K_B(\Delta_B^i)$$

with respect to Δ_B^i and n^i is strictly positive. The asserted property of D^i follows then from standard comparative statics results (see, for instance, Vives, 1999). **Q.E.D.**

Proof of Lemma 4. Here and in what follows, we denote the set of the supplier's optimal choices for Δ_S by D_S. By our assumptions on K_S and by Assumption 2, we have that $\Delta_S > 0$ for all $\Delta_S \in D_S$. Denote next the subset of buyers that merge by $\widehat{I}$. Suppose

[53] Note that v_{Out}^i is calculated irrespective of whether vertical integration is more profitable than staying inactive or not.

that before the merger, the outside option was binding for buyers in the set $\widehat{I}' \subseteq \widehat{I}$ and not binding for the buyers in the complementary set $\widehat{I}/\widehat{I}'$. We denote the total number of firms controlled by the merged buyer by $\widehat{n} = \sum_{i \in \widehat{I}} n^i$. Note next that from Lemma 1 and Proposition 1 negotiations with all buyers $i \in I/\widehat{I}$ are not affected by the merger. Hence, to analyze how the supplier's investment incentives are affected by the merger, we only have to compare the derivative of $\sum_{i \in \widehat{I}} \tau^i$ with respect to Δ_S, which sums up the respective fixed transfers of the merging buyers before the merger, with the derivative of the *single* transfer that is subsequently paid by the merged buyer, which we denote by $\widehat{\tau}_S$ (in a slight abuse of notation). Likewise, we denote the merged buyer's outside option by $\widehat{v}_{Out}$.

We now distinguish between two cases. If the outside option is not binding for the merged buyer, then by Lemma 2 it is also not binding for all $i \in \widehat{I}$ before the merger. Consequently, we have from Proposition 1 that[54]

$$\frac{d}{d\Delta_S} \sum_{i \in \widehat{I}} \tau^i = \frac{d}{d\Delta_S} \widehat{\tau}_S = -\frac{1}{2} \widehat{n} \frac{d}{dc} \left[R(q_S, q_S) - c q_S \right]. \tag{25}$$

Suppose next that the merged buyer's outside option is binding. It is now helpful to introduce some additional notation for this case. For this purpose, take some buyer $i \in \widehat{I}$. If this buyer's outside option is binding, then we have $\Delta_B^i > 0$ for all $\Delta_B^i \in D_B^i$. (Recall that D_B^i denotes the set of optimal values Δ_B^i that are chosen by buyer i after disagreement.) From Assumption 1, for given Δ_B^i (and given q_S) there is a unique corresponding optimal quantity $q^i > 0$ that buyer i chooses at all n^i firms. If the set D_B^i is not singular, we denote the set of corresponding optimal choices of q^i by Q^i. We already know from Lemma 2 that D_B^i is strictly increasing in n^i. (That is, provided the buyer remains active after disagreement as n^i is sufficiently large.) As the cross-derivative of the buyer's disagreement payoff with respect to Δ_B^i and q is strictly positive, we have from standard comparative statics results (see also Lemma 2) that Q^i is strictly increasing in n^i. The finding that Q^i is strictly increasing in n^i will be useful later in the proof. Next, v_{Out}^i is continuous and non-increasing in q_S, implying that it is almost everywhere continuously differentiable.[55] By equation (2), the derivative is $dv_{Out}^i/dq_S = n^i q^i P'(q_S + q^i)$.

[54] There is no need to write out the derivative in rectangular brackets, which is $q_S - \frac{d}{dq_S}[R(q_S, q_S) - c q_S] \frac{dq_S}{dc}$. Note that q_S is continuously differentiable from our assumptions on the inverse demand P, while $dq_S/dc < 0$.

[55] Precisely, v_{Out}^i is continuously differentiable whenever Q^i is singular.

Proceeding likewise for the merged buyer, we denote (once more in a slight abuse of notation) the optimal choice of cost reductions after disagreement by $\widehat{\Delta}_B \in \widehat{D}_B$ and the corresponding optimal (per-firm) quantities by $\widehat{q} \in \widehat{Q}$. The resulting payoff for the merged buyer is now $\widehat{v}_{Out}$ with respective derivative $d\widehat{v}_{Out}/dq_S = \widehat{n}\widehat{q}P'(q_S + \widehat{q})$.

Using these results and Proposition 1, we have for the case where the merged buyer's outside option is binding that

$$\frac{d}{d\Delta_S}\widehat{\tau}_S = -\widehat{n}\frac{d}{dc}\left[R(q_S, q_S) - cq_S\right] + \frac{d\widehat{v}_{Out}}{dq_S}\frac{dq_S}{dc}. \tag{26}$$

Summing up the pre-merger fixed fees of the firms participating in the merger and noting that the outside option was already binding for the subset of firms $\widehat{I}'$, we obtain the derivative

$$\begin{aligned} \frac{d}{d\Delta_S}\sum_{i\in\widehat{I}}\tau^i \quad &= \quad \sum_{i\in\widehat{I}'}\left[-n^i\frac{d}{dc}\left[R(q_S, q_S) - cq_S\right] + \frac{dv^i_{Out}}{dq_S}\frac{dq_S}{dc}\right] \\ &\quad -\frac{1}{2}\left(\sum_{i\in\widehat{I}/\widehat{I}'} n^i\right)\frac{d}{dc}\left[R(q_S, q_S) - cq_S\right]. \end{aligned} \tag{27}$$

We want to show that (26) is strictly larger than (27), or formally, that $d\widehat{\tau}_S/d\Delta_S > d\left(\sum_{i\in\widehat{I}}\tau^i\right)/d\Delta_S$, which we can rewrite as

$$\frac{1}{2}\sum_{i\in\widehat{I}/\widehat{I}'} n^i\left(-\frac{d}{dc}\left[R(q_S, q_S) - cq_S\right]\right) + \left(\frac{d\widehat{v}_{Out}}{dq_S} - \sum_{i\in\widehat{I}'}\frac{dv^i_{Out}}{dq_S}\right)\frac{dq_S}{dc} > 0. \tag{28}$$

It is easily checked that the assertion is true. To see this, note first that by Assumption 2 we have that $d\left[R(q_S, q_S) - cq_S\right]/dc < 0$. Hence, the first term of the inequality (28) is strictly positive. Next, observe that $dv^i_{Out}/dq_S < 0$ for all $i \in \widehat{I}$ and that also $d\widehat{v}_{Out}/dq_S < 0$.[56] Thus, the second term of inequality (28) is strictly positive if

$$\sum_{i\in\widehat{I}'}\frac{dv^i_{Out}}{dq_S} > \frac{d\widehat{v}_{Out}}{dq_S} \tag{29}$$

holds for all $i \in \widehat{I}$, which in turn surely holds if we have for all $i \in \widehat{I}'$ that

$$q^i P'(q_S + q^i) > \widehat{q}P'(q_S + \widehat{q}). \tag{30}$$

[56] It should be recalled that according to our definition, the outside option is binding whenever (3) in Proposition 1 does not hold, implying from continuity that it remains binding also after a marginal adjustment of c and thus of q_S.

To see that (30) holds, note first that the expression $qP'(q_S + q) < 0$ is by Assumption 1 strictly decreasing in q.[57]

The assertion (29) thus follows from our previous observation that Q^i is strictly increasing in n^i. This completes the proof of Lemma 3. **Q.E.D.**

Proof of Proposition 4. To extend Lemma 4, which then implies Proposition 2, we only need to prove that the final step in the proof holds also if a disagreement is observable to rivals. Hence, using the notation from the proof of Lemma 4, we need to show that

$$\sum_{i \in \widehat{I}} \frac{dv^i_{Out}}{dc} > \frac{d\widehat{v}_{Out}}{dc}, \tag{31}$$

where we abbreviate the argument by assuming that before the merger the outside option was binding for all $i \in \widehat{I}$. To show that (31) holds, we first need to extend the result from Lemma 3 that D^i_B is strictly increasing in n^i, provided that $v^i_{Out} > 0$. With

$$v^i_{Out} = \max_{\Delta^i_B} \left[n^I \pi(\overline{c}_{Out} - \Delta^i_B, c) - K_B(\Delta^i_B) \right]$$

this follows again as from $\pi_1 < 0$ the term in rectangular brackets has a strictly positive cross-derivative with respect to n^i and Δ^i_B. Given that $dv^i_{Out}/dc = n^i \pi_2(c^i_{Out}, c)$ at points of differentiability, assertion (31) follows then immediately from $\pi_{12} < 0$. **Q.E.D.**

Proof of Proposition 5. We denote the supplier's optimal choice before the merger by $\widetilde{\Delta}_S$ and its choice after the merger by $\widehat{\Delta}_S$, where we have $\widehat{\Delta}_S > \widetilde{\Delta}_S$ if the merger changes the supplier's choice. Suppose first that for the considered buyer i the outside option does not bind at $\widetilde{\Delta}_S$. As the joint surplus $R(q_S, q_S) - cq_S$ is strictly decreasing in c and as v^i_{Out} is non-increasing in c (it is strictly decreasing whenever $v^i_{Out} \geq 0$), it follows from (3) that the outside option is also not binding at $\widehat{\Delta}_S$. Given that the payoff of buyer i is equal to $[R(q_S, q_S) - cq_S]/2$ from (4), buyer i is by Assumption 2 strictly better off after the merger if this lowers marginal costs, while otherwise buyer i is not affected. Suppose next that the outside option of buyer i binds at $\widehat{\Delta}_S$. By the same argument as before, the outside option of buyer i is then also binding at $\widetilde{\Delta}_S$. As v^i_{Out} is now strictly decreasing in Δ_S given that $V^i_{Out} = v^i_{Out} > 0$, buyer i is now strictly worse off after the merger if this lowers marginal costs. **Q.E.D.**

[57] To be precise, note that differentiating $qP'(q_S + q)$ with respect to q gives $qP''(q_S + q) + P'(q_S + q)$. By $P' < 0$ (wherever $P > 0$), this is surely negative if also $P'' \leq 0$. For the case where $P'' > 0$, note that by Assumption 1 we have $QP''(Q) + P'(Q) < 0$, where $Q = q_S + q$, which is a weaker condition.

Proof of Proposition 7. To show that our results with homogeneous goods extend, we need to show only that $v^i_{Out} > 0$ is strictly increasing in c and that the respective derivative increases again more-than-proportionally with n^i. To see this, note that now

$$\frac{dv^i_{Out}}{dc} = n^i q^i P_2(q^i, q_S) \frac{dq_S}{dc},$$

where we denote again by q^i the quantity chosen by buyer i after a breakdown of negotiations. We use now that from Assumption 1' we still have that $dq_S/dc < 0$, while by the arguments in Lemma 4 a higher n^i still leads to a strictly lower c^i_{Out} and thus a strictly higher q^i. It thus remains to show that $q^i P_2(q^i, q_S)$ is strictly decreasing in q^i, which by the same argument as in Lemma 4 holds from Assumption 1'. **Q.E.D.**

Appendix B: A Non-Cooperative Bargaining Model with Outside and Inside Options

We consider an alternating-offer bargaining game with the following features. Time proceeds in equally spaced periods of length $z > 0$, which are denoted by $h = 0, 1$, and so on. Buyers and suppliers are eager to avoid delay as they discount payoffs. We could incorporate different sharing rules by letting the supplier and the various buyers have different interest rates. As discussed in the main text, lacking a theory of how size affects buyers' impatience and thus their respective discount factors, we choose for all players the same interest rate $r > 0$. Bargaining proceeds pairwise, i.e., between I buyers and the I agents of the supplier. As we will focus on the limit where $z \to 0$, it is without consequences that we let the supplier's agents make the first proposal in $h = 0$.

We express supply relations as infinite flows of quantities and transfers. This ensures that if there is delay with one buyer, other firms can already start to purchase and sell. Otherwise, i.e., in a model with a one-shot purchase and sale decision, the delay of one buyer would hold up purchases and sales by all other buyers, which seems artificial. Hence, if the supplier produces the constant flow quantity q, then its flow costs are cq. Likewise, $R(\cdot)$ denotes now the flow of revenues, while a contract specifies the fixed flow of transfers $\tau^i + qw^i$.[58]

[58] We allow firms in the Cournot game to adjust quantities instantaneously and focus on the competitive (Markov) equilibrium. Results would be unaffected if firms could only adjust quantities each period or if they had to fix quantities once and for all after deciding which source of supply to use. Off equilibrium,

The model incorporates both inside and outside options. In a period h where no agreement has been reached between buyer i and the supplier, but where also no side has yet walked away from negotiations, a buyer has the inside option to purchase at the flow costs c_{In}. If, instead, the outside option is taken up after disagreement, buyer i can instantaneously rely on a supply at marginal cost c^i_{Out}, but has to incur the respective (discounted) costs $F + K_B(\Delta^i_B)$.[59] We still define V^i_{In} as in (17), though this is now in flow terms. On the other hand, the outside option of backward integration is stated as the discounted value of the future stream of payoffs:

$$v^i_{Out} := \max_{\Delta^i_B} \left\{ \frac{1}{r} n^i \max_q \left[R(q, q_S) - (\bar{c}_{Out} - \Delta^i_B) q \right] - K_B(\Delta^i_B) - F \right\}. \tag{32}$$

In what follows, we focus on equilibria where all negotiations lead to immediate agreement.[60] The net surplus in each bilateral negotiation is again $n^i[R(q_S, q_S) - cq_S] - V^i_{In}$, though this is now in terms of flows. As $z \to 0$, we find that the surplus is split equally given that both sides are equally impatient. This together with $w^i = c$, which holds from Lemma 1, pins down τ^i for each buyer i, that is unless τ^i is determined by the binding outside option.

Proposition. *The non-cooperative bargaining game has a unique equilibrium without delay. All contracts specify $w^i = c$, while as $z \to 0$, all τ^i are determined as follows. If*

$$\frac{1}{2} \left[n^i \left[R(q_S, q_S) - cq_S \right] + V^i_{In} \right] \frac{1}{r} \geq V^i_{Out}, \tag{33}$$

then τ^i satisfies

$$\tau^i = \frac{1}{2} n^i [R(q_S, q_S) - q_S c] - \frac{1}{2} V^i_{In}. \tag{34}$$

Otherwise, we have that

$$\tau^i = n \left[{}^i R(q_S, q_S) - q_S c \right] - r V^i_{Out}. \tag{35}$$

i.e., when there is delay with buyer i or when the two sides have split up unsuccessfully, all firms that are not controlled by buyer i will still choose q_S. This can be supported by beliefs that attribute any other observable quantity choice (or a change in price) to a temporary deviation by the respective firm and not to final break-up of negotiations between the supplier and the respective buyer.

[59] It is straightforward to incorporate some fixed real time $Z > 0$ that it could take to, say, build up own production facilities.

[60] The equilibrium without delay is not the unique sequential equilibrium. In particular, under repeated interaction firms could collude in the final market, while if we either allowed for also short-term contracts or renegotiations, then also the opportunism problem may be overcome or at least mitigated through repeated interaction.

Proof. Given that we focus on equilibria without delay, in a bilateral negotiation with buyer i we can take all contracts with buyers j and $j \neq i$ as given. Also, as already argued for Lemma 1, the agreement with buyer i has no implication for the supplier's payoff from all other buyers j. Consequently, we can consider the negotiations with buyer i in isolation, which in turn allows us to draw on results from standard bilateral alternating-offer bargaining.[61]

There is a unique (subgame perfect) pair of offers that are made whenever it is the turn of buyer i or of the supplier's agent (though, in equilibrium the game will end in $h = 0$ with the immediate acceptance of the supplier's offer). Both offers are efficient in that they specify $w^i = c$. Denote the transfer offered by the buyer by τ_B^i and that offered by the supplier by τ_S^i. The respective offer makes the other side just indifferent between acceptance and rejection. We first ignore the outside option. Then, the buyer's alternative is to rely on its inside option for one (more) period and offer τ_B^i in the next period, which the supplier will accept. The buyer's discounted value of using the inside option over a period of time z equals $(1 - e^{-rz})/r$ times V_{In}^i (as defined in (17)). Hence, τ_B^i and τ_S^i are determined by the two indifference conditions

$$\begin{aligned} \frac{1}{r} n^i \left[R(q_S, q_S) - cq_S - \tau_S^i \right] &= \frac{1 - e^{-rz}}{r} V_{In}^i + \frac{e^{-rz}}{r} n^i \left[R(q_S, q_S) - cq_S - \tau_B^i \right], \\ \frac{1}{r} \tau_B^i &= \frac{e^{-rz}}{r} \tau_S^i, \end{aligned}$$

respectively. Solving out and taking limits for $z \to 0$ yields $\tau_B^i \to \tau^i$ and $\tau_S^i \to \tau^i$, where τ^i is given by (34). Finally, if τ_S^i does not match the value of the buyer's outside option, then in the unique equilibrium $\tau^i = \tau_S^i$ is determined by (35).[62] **Q.E.D.**

It is now easily checked that after discounting payoff flows (by dividing through r), (33)-(35) transform into (18)-(20) and vice versa.

References

Athey, S. and Schmutzler, A. (2001), Investment and Market Dominance, Rand Journal of Economics 32, 1-26.

[61] See Rubinstein (1982) for the seminal paper on the open-horizon alternating-offer game.

[62] There is no need to take the limit as we specified that a buyer who decides to quit negotiations can take up its outside option immediately.

Battigalli, P., Fumagalli, C., and Polo, M. (2006), Buyer Power and Quality Improvement, mimeo.

Binmore, K., Rubinstein, A., and Wolinsky, A. (1986), The Nash Bargaining Solution in Economic Modelling, Rand Journal of Economics 17, 176-188.

Caprice, S. (2006), Multilateral Vertical Contracting with an Alternative Supply: The Welfare Effects of a Ban on Price Discrimination, Review of Industrial Organization 28, 63-80.

Chen, Z. (2003), Dominant Retailers and the Countervailing Power Hypothesis, Rand Journal of Economics 34, 612-625.

Chen, Z. (2004), Countervailing Power and Product Diversity, mimeo.

Chipty, T. and Snyder, C.M. (1999), The Role of Outlet Size in Bilateral Bargaining: A Study of the Cable Television Industry, Review of Economics and Statistics 81, 326-340.

Chiu, S. (1998), Noncooperative Bargaining, Hostages, and Optimal Asset Ownership, American Economic Review 88, 882-901.

Competition Commission (2000), Supermarkets: A Report on the Supply of Groceries from Multiple Stores in the United Kingdom, Inquiry Reports Series of the Competition Commission Cm 4842 (10/10/00), London.

Competition Commission (2003), Safeway plc and Asda Group Limited (Owned by Wal-Mart Stores Inc); Wm Morrison Supermarkets PLC; J Sainsbury plc; and Tesco plc: A Report on the Mergers in Contemplation, Inquiry Reports Series of the Competition Commission Cm 5950 (26/09/03), London.

Competition Commission (2007), Groceries Market Investigation: Provisional Findings Report.

Competition Commission (2008), The Supply of Groceries in the UK: Market Investigation.

deFontenay, C. and Gans, J. (2005), Vertical Integration in the Presence of Upstream Competition, Rand Journal of Economics.36, 544-572.

deFontenay, C. and Gans, J. (2006), Bilateral Bargaining with Externalities, mimeo.

DeMeza, D. and Lockwood, B. (1998), Does Asset Ownership Always Motivate Managers? Outside Options and the Property Rights Theory of the Firm, Quarterly Journal of Economics 113, 361-386.

Dobson, P.W. (2002), Retail Buyer Power in European Markets: Lessons from Grocery Supply, Research Series Paper 2002: 2, Loughborough University.

Dobson, P.W. (2005), Exploiting Buyer Power: Lessons from the British Grocery Trade, Antitrust Law Journal 72, 529-562.

Dobson, P.W. and Waterson, M. (1997), Countervailing Power and Consumer Prices, Economic Journal 107, 418-430.

European Commission, 1999, Buyer power and its impact on competition in the food retail distribution sector of the European Union. DG IV. Brussels.

FTC (2001), Report on the Federal Trade Commission Workshop on Slotting Allowances and Other Marketing Practices in the Grocery Industry, A Report by Federal trade Commission Staff, February 2001, FTC, Washington D.C.

Fumagalli, C. and Motta, M. (2007), Buyers' Miscoordination, Entry, and Downstream Competition, mimeo.

Hart, O. and Tirole, J. (1990), Vertical Integration and Market Foreclosure, Brooking Papers on Economic Activity: Microeconomics, 205-276.

Inderst, R. and Mazzarotto, N. (2006), Buyer Power in Distribution, chapter prepared for the ABA Antitrust Section Handbook, Issues in Competition Law and Policy (W.D. Collins, ed., in preparation).

Inderst, R. and Valletti, T. (2007), Price Discrimination in Input Markets, mimeo.

Inderst, R. and Wey, C. (2003), Bargaining, Mergers, and Technology Choice in Bilaterally Oligopolistic Industries, Rand Journal of Economics 34, 1-19.

Inderst, R. and Wey, C. (2007), Buyer Power and Supplier Incentives, European Economic Review 51, 647-667.

Katz, M.L. (1986), An Analysis of Cooperative Research and Development, Rand Journal of Economics 17, 527-43.

Katz, M.L. (1987), The Welfare Effects of Third Degree Price Discrimination in Intermediate Goods Markets, American Economic Review 77, 154-167.

McAfee, R.P. and Schwartz, M. (1994), Opportunism in Multilateral Vertical Contracting: Nondiscrimination, Exclusivity, and Uniformity, American Economic Review 84, 210-230.

O'Brien, D.P. and Shaffer, G. (1994), The Welfare Effects of Forbidding Discriminatory Discounts: A Secondary Line Analysis of Robinson-Patman, Journal of Law, Economics and Organization 10, 296-317.

OECD (1999), Buying Power of Multiproduct Retailers, Series Roundtables on Competition Policy, DAFFE/CLP(99)21, OECD, Paris.

Pitofsky, R. (1997), Thoughts on "Leveling the Playing Field" in Health Care Markets, Federal Trade Commission (February 13, 1997), Washington D.C.

Rey, P. and Vergé, T. (2004), Bilateral Control with Vertical Contracts, Rand Journal of Economics 35, 728-746.

Rubinstein, A. (1982), Perfect Equilibrium in a Bargaining Model, Econometrica 50, 97-109.

Smith H. and Thanassoulis, J. (2006), Upstream Competition and Downstream Buyer Power, University of Oxford mimeo.

Snyder, C.M. (2005), Countervailing Power, manuscript prepared for the New Palgrave Dictionary.

Vieira-Montez, J. (2005), Downstream Concentration and Producer's Capacity Choice: Why Bake a Larger Pie when Getting a Smaller Slice, forthcoming Rand Journal of Economics.

Vives, X. (1999), Oligopoly Pricing, MIT Press, Cambridge Mass.

von Ungern-Sternberg, T. (1996), Countervailing Power Revisited, International Journal of Industrial Organization 14, 507-520.

PREVIOUS DISCUSSION PAPERS

01 Inderst, Roman and Wey, Christian, Countervailing Power and Dynamic Efficiency, September 2010.

.

Heinrich-Heine-University of Düsseldorf

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

Universitätsstraße 1 _ 40225 Düsseldorf
www.dice.uni-duesseldorf.de

ISSN 2190-9938 (online)
ISBN 978-3-86304-000-0