A Larger Slice or a Larger Pie? An Empirical Investigation of Bargaining Power in the Distribution Channel

Michaela Draganska
Stanford University
Graduate School of Business
Stanford, CA 94305-5015
draganska_michaela@gsb.stanford.edu

Daniel Klapper
Johann Wolfgang Goethe-Universität Frankfurt
Professur für Konsumgütermarketing
D-60325 Frankfurt am Main
dklapper@wiwi.uni-frankfurt.de

Sofia B. Villas-Boas
University of California, Berkeley
Department of Agricultural and Resource Economics
Berkeley, CA 94720-3310
sberto@are.berkeley.edu

A Larger Slice or a Larger Pie? An Empirical Investigation of Bargaining Power in the Distribution Channel

Abstract

This research aims to provide insights into the determinants of channel profitability and the relative power in the channel by considering consumer demand and the interactions between manufacturers and retailers in an equilibrium model. We formulate a Nash bargaining game to determine wholesale prices and thus how margins are split in the channel. Equilibrium margins are a function of demand primitives and of retailer and manufacturer bargaining power. Bargaining power is itself a function of exogenous retail and manufacturer characteristics. The parties' bargaining positions are determined endogenously from the estimated substitution patterns on the demand side.

We use the proposed bargaining model to investigate the role of the three main factors that have been blamed for the power shift from manufacturers to retailers in recent years (firm size increases, store brand introductions, and service level differentiation). In our empirical analysis of the German market for coffee, we find that bargaining power varies among the different manufacturer-retailer pairs. This result suggests that bargaining power is not an inherent characteristic of a firm but rather depends on the negotiation partner. We are able to confirm empirically previous theoretical findings that there can be cases where the slice of the pie that goes to one of the channel members may decrease but the overall pie increases and compensates for the smaller share of profits.

Key Words: bargaining, distribution channels, competitive strategy, econometric models.

1 Introduction

There has been a great deal of discussion about the purported power shift from manufacturers to retailers due to the consolidation of the retail sector, the increase in trade promotions as well as the rapid growth of store brands (for a comprehensive survey, see Ailawadi 2001). There seems to be a widely held belief that "big-box" retailers are squeezing manufacturer margins. The issue of growing power of large and expanding retailers was raised simultaneously by industry participants, the media,[1] and by the competition authorities in general.[2] Yet there is little evidence that retailers have become more profitable. In fact, it appears that retail margins have fallen over time relative to manufacturer margins, which has been interpreted as evidence that their power has not increased (Messinger & Narasimhan 1995). However, the overall profitability of the distribution channel is not necessarily a zero-sum game. The profitability of manufacturers and retailers is determined both by the total margins in the distribution channel and by the way they are split between them. The question thus is: Do retailers get a larger slice of a smaller pie?

To answer this question, we propose an empirical framework with three key components. The size of the pie is determined by the ability of the channel members to extract surplus from consumers by charging higher prices. The latter is constrained by the possibility of substitution among competing brands and retailers and the option to make no purchase at all. What slice of the pie goes to manufacturers and retailers is a reflection of their relative power in interacting with each other. Many (if not all) of these interactions take the form of often very complex negotiations (Iyer & Villas-Boas 2003). The outcome of such negotiations depends first of all on how big the stakes of the negotiating parties are. A party's stake or its bargaining position

[1] Lynn, B. "Breaking the Chain: The Antitrust Case Against Wal-mart," www.Harpers.org, July 31, 2006.

[2] Schelings, R. and Wright, J. "'Sui Generis'?: An Antitrust Analysis of Buyer Power in the United States and European Union", Law and Economics Working Paper series, George Mason University School of Law; EC, 1999; DG IV. Brussels.

(Dukes, Gal-Or & Srinivasan 2006), in turn, is determined by its profits when the negotiations are successfully concluded and when they fail and the manufacturer's product is not carried by the retailer. A party's bargaining position is weaker the more it loses in case of failure. Besides the bargaining positions, there are numerous other factors such as the negotiation skills of the parties, their patience, and their risk tolerance that affect the outcome of the negotiations between manufacturers and retailers. These factors are what is commonly referred to as bargaining power (Iyer & Villas-Boas 2003, Dukes et al. 2006). Taken together, bargaining position and bargaining power determine total channel margins and their split.

This research aims to provide insights into the determinants of channel profitability and the relative power in the channel by considering consumer demand and the interactions between manufacturers and retailers in an empirically tractable and theoretically consistent equilibrium model. In a departure from the standard empirical channel literature, which assumes that manufacturers set wholesale prices unilaterally, we model the negotiations between manufacturers and retailers. To this end, we formulate a Nash bargaining game to determine wholesale prices and thus how margins are split in the channel. Equilibrium margins are a function of demand primitives and of retailer and manufacturer bargaining power.

Our empirical model of the bargaining process in the distribution channel allows us to assess the determinants of bargaining power and bargaining position. We show how exogenous retailer and manufacturer characteristics affect total margins and their split directly through demand and also through the bargaining process. That is, we look at the pricing power that stems from clout that a particular retailer or manufacturer has vis-à-vis consumers, the bargaining power that is due to exogenous factors related - among other things - to the ability of the negotiating parties to wait, and the parties' bargaining positions that arise endogenously from the substitution patterns on the demand side.

Our empirical analysis focuses on the market for ground coffee in Germany. In this mature product category, several manufacturers compete intensely and sell through a number of retailers. We use sales and marketing-mix data to estimate consumer demand. We then recover retailer and manufacturer margins using our supply-side model and assess power in the channel. As mentioned above, power in the channel has two components: (1) bargaining position, which is endogenously determined based on pricing power vis-à-vis consumers and (2) bargaining power, which comprises exogenous influences on the negotiations. Building on the existing literature, we investigate the three main factors that have been blamed for the power shift from manufacturer to retailers: firm size increases, store brand introductions, and service level differentiation.

Our findings indicate that in the market under investigation, bargaining power lies mainly with manufacturers. On average the manufacturer gets more than half of the pie. In addition, the slice of the retailers increases if retailers become larger or if retailers make their private labels close substitutes to national brands. The slice of the manufacturers increases with an increase in firm size and is also if the retailer they are negotiating with provides an extensive assortment. We also find that the interactions between manufacturers and retailers are not a zero-sum game. There are cases where the slice of the pie that goes to one of the channel members may decrease but the overall pie increases and compensates for the smaller share of profits. This finding is consistent with the theoretical literature, which suggest that a decrease in bargaining power of the manufacturer would decrease the distortion due to double marginalization (Dukes et al. 2006), or that the presence of a powerful retailer may be beneficial to all channel members (Iyer & Villas-Boas 2003).

The remainder of this paper is organized as follows. We review briefly the related literature in the next section. In Section 3 we describe our assumptions and formally develop the theoretical model. Section 4 presents the data used in the empirical analysis. We discuss the econometric specification, identification, and operationalization of the variables in Section 5. Section 6 presents the results from the empirical analysis and Section 7 concludes.

2 Related Literature

Our modeling framework closely follows the recent theoretical contributions by Iyer & Villas-Boas (2003) and Dukes et al. (2006). In addition to empirically validating the main findings of these authors, we obtain further insights through our detailed modeling of demand and supply. By conducting numerical simulations based on our rich empirical setting, we are able to provide comparative statics-type results that cannot be obtained in an analytically tractable model.[3]

We build on several recent empirical models that have devoted attention to the analysis of channel interactions within a product category (e.g., Kadiyali, Chintagunta & Vilcassim 2000, Cotterill & Putsis 2001, Sudhir 2001, Villas-Boas & Zhao 2005, Draganska & Klapper 2007). Since our goal is to study power in the channel and vis-à-vis consumers, clearly the often-made assumption of monopolistic retailers is unappealing. We therefore incorporate retailer competition in our model (similar to Villas-Boas 2007). Moreover, most existing studies posit a specific model of manufacturer-retailer interactions such as Vertical Nash or Manufacturer Stackelberg. However, as Kadiyali et al. (2000) point out, each model directly implies a given relative power of the channel members. They propose to use a conduct parameter approach to let the data determine the appropriate model. Villas-Boas (2007) proposes a menu approach, where non-nested tests are used to determine the best-fitting model among various supply-side specifications.

Similar to the conduct-parameter approach, our model nests the traditional models (see Section 3 for details) and thus allows the data to determine the bargaining power in the channel. Methodologically, therefore, the bargaining model compares favorably to the existing structural models of channel interactions. Moreover, the bargaining power parameter has a clear-cut behavioral interpretation whereas the interpretation

[3]Thanks to the Area Editor for making this point.

of the conduct parameter is less clear.

Our empirical contribution over Kadiyali et al. (2000) and Villas-Boas (2007) is that the bargaining model allows us to differentiate between bargaining position and bargaining power and relate bargaining power to exogenous manufacturer and retailer characteristics. This is important because it allows us to investigate whether the growth of retailers over the past decade has improved their negotiating position. While we leave a thorough investigation to future research, we note here that relating exogenous characteristics to power in the channel and vis-à-vis consumers may also shed light on competition issues. The marketing and IO literature have traditionally estimated demand-and-supply models to assess the impact of a merger on prices and ultimately firm profitability. Our model allows us to assess a second, conceivably just as important effect, namely the incentive to merge in order to strengthen the bargaining position of the merged firm.

Empirical studies of bargaining are sparse. There is an earlier literature in marketing that has studied bargaining experimentally. Neslin & Greenhalgh (1983) conduct a role-playing investigation in the context of media purchasing and find support for the application of Nash's (1950) bargaining theory to buyer-seller negotiations. Gupta (1989) extends the analysis to situations where the parties are bargaining over multiple issues. Closest in spirit to our paper is Misra & Mohanty (2006). These authors formulate a bargaining game with a single retailer and multiple manufacturers. We extend their work by allowing for retailer competition and relating the bargaining power parameter to manufacturer and retailer characteristics. As we explain below, we also consider a different model set up, which follows closely the theoretical literature on bargaining in distribution channels. Contrasting our modeling framework with the one proposed by Misra & Mohanty (2006) highlights the difficulties of combining bargaining over wholesale prices and competition in retail prices in an internally consistent fashion.

3 Model

Consumer demand is modeled using a discrete-choice formulation. On the supply side we model competition between multiple retailers. In addition to retail competition, we model the bargaining between retailers and manufacturers. Retail prices are determined in a Bertrand-Nash fashion and wholesale prices are outcomes of a generalized Nash bargaining game. We derive two specifications of the model. In the first specification, manufacturers do not observe retail prices and thus cannot take into account how retail prices change as a result of the outcome of the bargaining game, while in the second model, retail prices are observed. For both specifications of the supply model we solve the equilibrium conditions and derive the equations to be taken to the data.

3.1 Demand

Consumers choose among different products or decide to make no purchase in the category. We view a product as a particular brand (indexed by b) sold at a particular retailer (indexed by r). The indirect utility U_{ibrt} of consumer i from purchasing brand $b = 1, 2, \ldots, B$ at retailer $r = 1, 2, \ldots, R$ at time $t = 1, 2, \ldots, T$ is

$$U_{ibrt} \quad = \quad \alpha_{ibr} - \beta_i p_{brt} + \gamma_i X_{brt} + \xi_{brt} + \varepsilon_{ibrt}, \tag{1}$$

where α_{ibr} is a brand-retailer fixed effect capturing the intrinsic preference for brand b at a retailer r, p_{brt} denotes the price of brand b in retailer r at time t. Additional factors affecting the choice of brand b at retailer r such as retailer promotions, assortment depth, and manufacturer advertising are included in X_{brt}. To capture consumer heterogeneity, we assume that the vector of brand-retailer constants α_i and the coefficients β_i and γ_i vary across consumers according to

$$\begin{pmatrix} \alpha_i \\ \beta_i \\ \gamma_i \end{pmatrix} = \begin{pmatrix} \alpha \\ \beta \\ \gamma \end{pmatrix} + \Sigma^{\frac{1}{2}} \begin{pmatrix} v_{i,\alpha} \\ v_{i,\beta} \\ v_{i,\gamma} \end{pmatrix}, \begin{pmatrix} v_{i,\alpha} \\ v_{i,\beta} \\ v_{i,\gamma} \end{pmatrix} \sim N(0, I),$$

where α, β, γ, and Σ are parameters to be estimated. The term ξ_{brt} accounts for factors that affect consumer utility, are observed by consumers, retailers, and manufacturers but not by the researcher (Villas-Boas & Winer 1999). Consumer idiosyncratic preferences are captured by ε_{ibrt}, an i.i.d. type I extreme value distributed error term. To allow for category expansion or contraction, we include an outside good (no-purchase option), indexed by $b = r = 0$, with utility

$$U_{i00t} = \varepsilon_{i00t}. \tag{2}$$

We rewrite the utility of consumer i for brand b in retailer r as

$$U_{ibrt} = \delta_{brt}(p_{brt}, X_{brt}, \xi_{brt}; \alpha, \beta, \gamma) + \mu_{ibrt}(p_{brt}, v_{i,\alpha}, v_{i,\beta}, v_{i,\gamma}; \Sigma) + \varepsilon_{ibrt}, \tag{3}$$

where δ_{brt} is mean utility and μ_{ibrt} is the deviation from this mean utility due to consumer heterogeneity in price response (Nevo 2000). Let the deviation from mean utility μ be distributed across consumers according to $F(\mu)$. The aggregate share s_{brt} of brand b in retailer r at time t across consumers is obtained by integrating the consumer level choice probabilities:

$$s_{brt} = \int \frac{\exp(\delta_{brt} + \mu_{ibrt})}{1 + \sum_{k=1}^{B} \sum_{s=1}^{R} \exp(\delta_{kst} + \mu_{ikst})} dF(\mu). \tag{4}$$

This aggregate demand system accounts for consumer heterogeneity and yields more flexible aggregate substitution patterns than the homogeneous logit model.

3.2 Supply

Typically, empirical researchers do not observe wholesale prices or the costs of manufacturers and retailers and therefore cannot calculate channel margins. To this end, we develop a supply model that allows us to recover margins once the demand model has been estimated and then use these margins to infer bargaining power. Retailers maximize profits by choosing retail prices. The price elasticity of demand determines the price demanded from consumers and, in turn, the overall profitability of the distribution channel. Retailers and manufacturers bargain over wholesale prices to determine the split of these profits.

3.2.1 Key Assumptions

Before presenting our formal model, we discuss the key assumptions.

In the vertical channel there are R retailers who bargain with B manufacturers over the wholesale prices of N products. In principle each retailer can bargain with each manufacturer. Moreover, if the negotiations break down, both parties still have the option to negotiate with all the other manufacturers or retailers or they may restart a previously abandoned negotiation in response to the outcome of another negotiation. This process gives rise to an extremely complicated game of interrelated negotiations, which the theory literature has yet to solve. The problem lies in the fact that the decision-relevant variables for one particular negotiation between a retailer and a manufacturer, namely the profits that would be realized if the negotiation is successful and the profits in case the negotiation breaks down, depend on the outcomes of all other negotiations. We therefore follow the literature and focus on one manufacturer-retailer dyad at a time.[4,5]

We follow the literature in modeling the bargaining between a particular retailer and a particular manufacturer as a generalized Nash bargaining solution (Iyer & Villas-Boas 2003, Dukes et al. 2006). Nash (1950) originally derived this solution concept by postulating a number of axioms (invariance to utility representations, Pareto efficiency, and independence of irrelevant alternatives) that a solution to a bargaining problem should satisfy. Later work has written down non-cooperative games that produce exactly the same outcome (see, e.g., Rubinstein 1982).

All manufacturer-retailer pairs bargain at the same time. Alternatively, one could assume that there is some order in which negotiations take place. However, absent any data, it is not clear that it is better; one could easily imagine situations in which

[4]As a result, manufacturers charge different wholesale prices to different retailers. The practice is largely consistent with European competition law. In the U.S. it may, however, conflict with the Robinson Patman Act.

[5]In the case where one manufacturer bargains with two different retailers we use the contract equilibrium as in O'Brien & Shaffer (1992), where contracts are negotiated secretly between each pair and while negotiating both parties have passive conjectures, which means that they take the other pair's terms of negotiations as given.

imposing the wrong order on the bargaining process does more harm than good.[6]

In our main specification, we posit that bargaining between competing manufacturers and retailers over wholesale prices takes place without manufacturers observing the prices retailers set to consumers. This setup reflects the belief that manufacturers do not anticipate retail prices to change as they set wholesale prices and that, conversely, retailers do not anticipate wholesale prices to change as they set retail prices. Manufacturers are therefore not able to commit to maintaining wholesale price levels. This lack of precommitment seems especially appropriate given the advent of big-box retailers, and thus the potential increase of countervailing bargaining power of the retailers (Dukes et al. 2006).

The assumption of retail prices unobservability implies that retail and wholesale prices are determined in a game with simultaneous moves. Put differently, even if we assumed that retail prices are determined after wholesale prices, our model would remain unchanged as long as we maintain that retail prices are unobservable. This is, in fact, the setup that is used in recent theory papers. Iyer & Villas-Boas (2003), for example, note that in their setup "the wholesale price that is the result of the bargaining process is *not* a function of the actual retail price charged by the retailer" (p. 88, our italics). Similarly, the condition that determines wholesale prices in Dukes et al.'s (2006) model "follows from the generalized Nash bargaining solution if retailers' pricing decisions take place simultaneously with negotiations. This implies that the bargaining solution treats retail prices as fixed" (p. 89).

An additional, more subtle point about modeling bargaining with multi-product retailers has been made by Dukes et al. (2006). They note that retailers maximize category profits and as such internalize cross-price effects across competing products. If retail prices were chosen subsequent to negotiations over wholesale prices, then the allocation of this effect across two independent bargaining processes is arbitrary.

[6]Work on sequential bargaining as in Stole & Zwiebel (1996) has been recently developed in Raskovich (2007), where the equilibrium depends on the order of negotiation chosen by the retailers. See also Chambolle & Villas-Boas (2008) for a similar approach when analyzing buyer power.

Our modeling approach ensures that the bargaining processes for the retailers have independent objectives.

Despite these problems, we consider an alternative specification of the supply side assuming that retail prices are observed by the manufacturers when they bargain over wholesale prices with retailers. Formally, the game becomes one of sequential moves.

3.2.2 Bertrand-Nash Competition

For the remainder of the analysis let us define a product j as corresponding to a brand-retailer pair (b, r), i.e., a product corresponds to a brand b sold at a retailer r. To simplify the notation we drop the time subscript for the remainder of this section.

Retailer r maximizes the profit from all products sold given by

$$\pi^r = \sum_{j \in \Omega^r} \left[p_j - p_j^w - c_j^r\right] s_j(p), \tag{5}$$

where Ω^r is the set of products sold by retailer r, p_j is the retail price of product j, and p_j^w is the wholesale price. The marginal cost for product j at the retail level is c_j^r. Finally, $s_j(p)$ is defined in equation (4) as the market share of product j.

Assuming a pure-strategy Nash equilibrium in retail prices, the first-order condition for product j is

$$s_j + \sum_{k \in \Omega^r} [p_k - p_k^w - c_k^r] \frac{\partial s_k}{\partial p_j} = 0. \tag{6}$$

Switching to matrix notation, define $[A * B]$ as the element-by-element multiplication of two matrices A and B of the same dimension. Let T^r be an ownership matrix with the general element $T^r(k, j) = 1$ if products k and j are sold by the same retailer and $T^r(k, j) = 0$ otherwise. Let Δ^r be a matrix with the general element $\Delta^r(k, j) = \frac{\partial s_j}{\partial p_k}$. Δ^r captures demand substitution patterns with respect to changes in the retail prices of all products. Solving equation (6) yields a vector of the retail price-cost margins m^r for all products:

$$m^r = p - p^w - c^r = -[T^r * \Delta^r]^{-1} s(p), \tag{7}$$

where p, p^w, and $s(p)$ are vectors of retail and wholesale prices and market shares, respectively.

3.2.3 Generalized Nash Bargaining

The generalized Nash bargaining solution over the wholesale price of product j is defined as the maximand of the so-called generalized Nash product

$$\left(\pi_j^r(p_j^w) - d_j^r\right)^{\lambda} \left(\pi_j^w(p_j^w) - d_j^w\right)^{1-\lambda}. \tag{8}$$

$\pi_j^r(p_j^w)$ and $\pi_j^w(p_j^w)$ are the profits to the retailer and the manufacturer if the negotiations succeed and d_j^r and d_j^w are the so-called disagreement payoffs that obtain if the negotiations fail. Our notation makes explicit that agreement profits are a function of the wholesale price p_j^w.

The Nash bargaining solution has the property that the outcome is more favorable to a party the higher its disagreement profit. This makes sense: If, say, the incremental profit of product j to the retailer is small, then the manufacturer must charge a relatively low wholesale price in order to motivate the retailer to carry the product in the first place. Hence, disagreement profits are an important determinant of the parties' bargaining position or endogenous bargaining power.

The generalized Nash bargaining solution captures bargaining power in another, equally important, way, namely through the bargaining power parameter λ. This parameter captures factors that may influence the outcome of the bargaining process such as the tactics employed by the parties, the procedure through which the negotiations are conducted, the information structure, and differences in time preference between the parties (Muthoo 1999). In our setting λ is the bargaining power of the retailer and $(1 - \lambda)$ that of the manufacturer. The higher λ, the more favorable is the outcome of the bargaining process to the retailer.

If the negotiations succeed and product j is being sold to consumers, then the payoffs to the retailer and manufacturer are respectively

$$\pi_j^r(p_j^w) = (p_j - p_j^w - c_j^r)s_j(p), \tag{9}$$
$$\pi_j^w(p_j^w) = (p_j^w - c_j^w)s_j(p),$$

where c_j^w is the marginal costs for product j at the wholesale level. Clearly, the wholesale price determines how the total channel profits $\pi_j^r(p_j^w)+\pi_j^w(p_j^w) = (p_j - c_j^r - c_j^w)s_j(p)$ are split between the manufacturer and the retailer. That is, the outcome of the bargaining game determines which slice of the pie goes to retailers and manufacturers. The size of the pie is determined by the retail price as the outcome of Bertrand-Nash competition between retailers and, in turn, depends on demand substitution patterns (see equation (7)). Of course, the size of the pie also depends on the bargaining process between retailers and manufacturers since retail and wholesale prices are determined jointly in equilibrium.

Turning to disagreement profits, recall our assumption that bargaining takes place pairwise between one manufacturer and one retailer at a time. Taken literally, this implies that if the negotiations over the wholesale price of product j break down, then product j simply will not be sold, resulting in disagreement profits of $d_j^r = d_j^w = 0$. In general, disagreement payoffs and the bargaining power parameter jointly affect the outcome. As a consequence of setting disagreement profits to zero, we would capture the power of the parties by the bargaining power parameter alone. That is, our estimate of the bargaining power parameter will reflect both the relative skills of the bargaining parties and the value of their disagreement profits to the extent that they are nonzero. Of course, since it reflects both the exogenous bargaining skills and the endogenous disagreement payoffs, it is unclear how to interpret the resulting parameter estimate. Also, if disagreement profits are actually nonzero, contrary to our assumption, then we expect the estimates of all our parameters to suffer from misspecification bias.

To relax this assumption, we next exploit the structure of our model to derive alternate expressions for the disagreement profits. In the most general (yet intractable) setting, the disagreement payoffs are endogenously determined as the option value of all the negotiations that take place in the future given that the current negotiation breaks down. To arrive at a tractable solution, we restrict attention to the current negotiation and assume away the future negotiations that may or may not be triggered in response to a breakdown.

To define the disagreement profits, we need to figure out what proportion of the market share of product j, which is the subject of the negotiation between a given retailer r and manufacturer b, will get allocated to the other products that the retailer/manufacturer has and how. Obviously, the way the market share will be allocated to the other products will depend on the estimated demand substitution patterns. In other words, we need to define the difference between the market share of the other products if brand j is offered and if it is not. The difference is then

$$\Delta s_k^{-j}(p) = \int \frac{\exp(\delta_k + \mu_{ik})}{1 + \sum_{l \in \Omega \setminus \{j\}} \exp(\delta_l + \mu_{il})} - \frac{\exp(\delta_k + \mu_{ik})}{1 + \sum_{l \in \Omega} \exp(\delta_l + \mu_{il})} dF(\mu). \tag{10}$$

Hence, the disagreement profits of a given retailer and manufacturer are given by:

$$\begin{aligned} d_j^r &= \sum_{k \in \Omega^r \setminus \{j\}} (p_k - p_k^w - c_k^r) \Delta s_k^{-j}(p), \\ d_j^w &= \sum_{k \in \Omega^w \setminus \{j\}} (p_k^w - c_k^w) \Delta s_k^{-j}(p), \end{aligned} \tag{11}$$

where Ω^w is the set of products sold by manufacturer w. In essence, what matters is the incremental profit generated by product j when it is sold over when it is not sold.

3.2.4 Bargaining under Retail Price Unobservability

Below we solve the bargaining game under the alternative specifications of zero and nonzero disagreement profits and derive our estimation equations for the case when retail prices are not perfectly observed by the manufacturers. In the appendix we show how the bargaining game nests the vertical Nash and the manufacturer Stackelberg specifications that have been widely used to model channel interactions.

Zero disagreement profits. Assuming $d_j^w = d_j^r = 0$ in equation (8), the first-order condition with respect to the wholesale price p_j^w is given by

$$-\lambda(p_j - p_j^w - c_j^r)^{(\lambda-1)}(p_j^w - c_j^w)^{(1-\lambda)}s_j(p) + (1-\lambda)(p_j - p_j^w - c_j^r)^{\lambda}(p_j^w - c_j^w)^{-\lambda}s_j(p) = 0. \tag{12}$$

Solving equation (12) yields a relationship between wholesale and retail margins:

$$m_j^w = p_j^w - c_j^w = \frac{1-\lambda}{\lambda}(p_j - p_j^w - c_j^r) = \frac{1-\lambda}{\lambda}m_j^r. \tag{13}$$

Note that in this case the split of profits is solely driven by the exogenous bargaining power parameter. In fact, equation (13) immediately implies that

$$\frac{m_j^r}{m_j^r + m_j^w} = \lambda,$$

so that the exogenous bargaining power parameter is the share of the channel margin accruing to the retailer.

Switching to vector notation and substituting for retail margins m^r using equation (7) yields

$$m^w = -\frac{1-\lambda}{\lambda}\left[T^r * \Delta^r\right]^{-1} s(p). \tag{14}$$

Adding equations (7) and (14) and using the fact that channel margins are the sum of wholesale and retail margins, $m = m^w + m^r$, we have

$$p - c^w - c^r = -\frac{1}{\lambda}[T^r * \Delta^r]^{-1}s(p). \tag{15}$$

Once we specify the marginal costs as a function of observable cost factors and an unobservable shock, equation (15) becomes the basis for the estimation, see Section 5 for details.

Nonzero disagreement profits. Taking the derivative of equation (8) with respect to p_j^w and setting it equal to zero yields the first-order condition:

$$\lambda(\pi_j^r - d_j^r)^{\lambda-1}\frac{\partial \pi_j^r}{\partial p_j^w}(\pi_j^w - d_j^w)^{1-\lambda} + (\pi_j^r - d_j^r)^{\lambda}(1-\lambda)(\pi_j^w - d_j^w)^{-\lambda}\frac{\partial \pi_j^w}{\partial p_j^w} = 0. \tag{16}$$

Note that the disagreement payoffs in the negotiations for product j are not a function of p_j^w. Because the Bertrand-Nash competition between the retailers and the Nash bargaining between manufacturers and retailers take place at the same time, a change in wholesale prices has no direct effect on retail prices.[7] Hence, in the bargaining process we can treat retail prices as fixed, i.e., they are the same for the agreement and disagreement scenario (see also Dukes et al. 2006).

Simplifying equation (16) and rearranging terms we obtain

$$\lambda \left(\pi_j^w - d_j^w\right) \frac{\partial \pi_j^r}{\partial p_j^w} + (1-\lambda) \left(\pi_j^r - d_j^r\right) \frac{\partial \pi_j^w}{\partial p_j^w} = 0. \tag{17}$$

Substituting for the derivatives $\frac{\partial \pi_j^r}{\partial p_j^w} = -s_j(p)$ and $\frac{\partial \pi_j^w}{\partial p_j^w} = s_j(p)$ and solving for $\pi_j^w - d_j^w$ leads to

$$\pi_j^w - d_j^w = \frac{1-\lambda}{\lambda}(\pi_j^r - d_j^r). \tag{18}$$

Equation (18) relates wholesale to retail margins. To see this, recall from equation (9) that

$$\begin{aligned} \pi_j^r &= m_j^r s_j(p), \\ \pi_j^w &= m_j^w s_j(p) \end{aligned}$$

and from equation (11) that

$$\begin{aligned} d_j^r &= \sum_{k \in \Omega^r \setminus \{j\}} m_k^r \Delta s_k^{-j}(p), \\ d_j^w &= \sum_{k \in \Omega^w \setminus \{j\}} m_k^w \Delta s_k^{-j}(p). \end{aligned}$$

[7] Of course, retail and wholesale prices are determined jointly from a system of equations and are therefore not independent of each other. What we want to emphasize is that retail prices do not react to wholesale prices as in a Stackelberg game.

Stacking equation (18) for all products thus yields

$$T^w * \begin{bmatrix} s_1 & -\Delta s_2^{-1} & \dots & -\Delta s_N^{-1} \\ -\Delta s_1^{-2} & s_2 & \dots & -\Delta s_N^{-2} \\ \vdots & \vdots & \ddots & \vdots \\ -\Delta s_1^{-N} & -\Delta s_2^{-N} & \dots & s_N \end{bmatrix} \begin{bmatrix} m_1^w \\ m_2^w \\ \vdots \\ m_N^w \end{bmatrix} \tag{19}$$

$$= \frac{1-\lambda}{\lambda} T^r * \begin{bmatrix} s_1 & -\Delta s_2^{-1} & \dots & -\Delta s_N^{-1} \\ -\Delta s_1^{-2} & s_2 & \dots & -\Delta s_N^{-2} \\ \vdots & \vdots & \ddots & \vdots \\ -\Delta s_1^{-N} & -\Delta s_2^{-N} & \dots & s_N \end{bmatrix} \begin{bmatrix} m_1^r \\ m_2^r \\ \vdots \\ m_N^r \end{bmatrix},$$

where the ownership matrix T^w has the general element $T^w(k,j) = 1$ if products k and j are sold by the same manufacturer and $T^w(k,j) = 0$ otherwise. Switching to matrix notation, we have

$$m^w = \frac{1-\lambda}{\lambda}[T^w * S]^{-1}[T^r * S]m^r,$$

where S is the matrix of shares and changes in shares defined above. Comparing the above expression to equation (13) nicely shows the difference between this formulation and the one where disagreement profits are normalized to zero. In this case, the split of channel profits depends not only on the exogenous bargaining power parameter but also on the relative bargaining positioning that comes from the substitution patterns on the demand side (how likely that the unit of demand in case of disagreement goes to another set of products in one's portfolio) and product market competition. Note that if both manufacturers and retailers are single-product firms, then $T^r = T^w = I$, where I is the identity matrix, and the above equation reduces to equation (13) in the case of zero disagreement profits.

Substituting for retail margins m^r using equation (7) yields

$$m^w = -\frac{1-\lambda}{\lambda}[T^w * S]^{-1}[T^r * S]\,[T^r * \Delta^r]^{-1}\, s(p). \tag{20}$$

Adding equations (7) and (20) and using the fact that channel margins are the sum of wholesale and retail margins, $m = m^w + m^r$, we have

$$p - c^w - c^r = -\left(\frac{1-\lambda}{\lambda}[T^w * S]^{-1}[T^r * S] + I\right)[T^r * \Delta^r]^{-1}\, s(p), \tag{21}$$

where I is the identity matrix. Once we specify the marginal costs as a function of observable cost factors and an unobservable shock, equation (21) becomes the basis for the estimation, see Section 5 for details.

3.2.5 Bargaining Model under Observed Retail Prices

Because retail prices are observed, the parties take into account retail price reactions to wholesale prices. Below we solve the bargaining game for the nonzero disagreement profits case and derive our estimation equations. The zero disagreement profits specification is a special case and thus relegated to the appendix.

Taking the derivative of equation (8) with respect to p_j^w and setting it equal to zero yields the first-order condition (17). The difference to the case of unobserved retail prices is that from equation (9) we now have

$$\frac{\partial \pi_j^r}{\partial p_j^w} = s_j(p)\left(\frac{\partial p_j}{\partial p_j^w} - 1\right) + m_j^r \frac{\partial s_j}{\partial p_j^w}$$

and

$$\frac{\partial \pi_j^w}{\partial p_j^w} = s_j(p) + m_j^w \frac{\partial s_j}{\partial p_j^w},$$

whereas in the case of retail price unobservability above we had $\frac{\partial \pi_j^r}{\partial p_j^w} = -s_j(p)$ and $\frac{\partial \pi_j^w}{\partial p_j^w} = s_j(p)$. Substituting the above derivatives into equation (17) yields

$$\begin{aligned} &\lambda\left(\pi_j^w - d_j^w\right)\left(s_j(p)\left(\frac{\partial p_j}{\partial p_j^w} - 1\right) + m_j^r \frac{\partial s_j}{\partial p_j^w}\right) \\ &= (1-\lambda)\left(\pi_j^r - d_j^r\right)\left(s_j(p) + m_j^w \frac{\partial s_j}{\partial p_j^w}\right), \end{aligned} \tag{22}$$

where from equations (9) and (11) we have

$$\pi_j^r - d_j^r = m_j^r s_j(p) - \sum_{k \in \Omega^r \setminus \{j\}} m_k^r \Delta s_k^{-j}(p),$$
$$\pi_j^w - d_j^w = m_j^w s_j(p) - \sum_{k \in \Omega^w \setminus \{j\}} m_k^w \Delta s_k^{-j}(p).$$

Note that we continue to maintain our assumption that there are no derivatives of disagreement profits with respect to wholesale prices. While this assumption is natural if the Bertrand-Nash competition and the Nash bargaining take place at the same time, in the current sequential setup there is really no justification for it other than it renders the model intractable.

Equation (22) relates wholesale to retail margins. Stacking equation (22) for all products yields a system of equations that is linear in wholesale margins. Hence, we can solve it to obtain wholesale margins as a function of retail margins:

$$m^w = m^w\left(m^r; \lambda, \Delta^r, \Delta^p\right),$$

where λ is the exogenous bargaining power parameter, Δ^r is the above-defined matrix of derivatives of market shares with respect to retail prices and Δ^p is the matrix of derivatives of retail prices with respect to wholesale prices to be defined shortly. Using the fact that channel margins are the sum of wholesale and retail margins and substituting for retail margin from equation (7), we obtain

$$p - c^w - c^r = \underbrace{-[T^r * \Delta^r]^{-1}s(p)}_{m^r} + \underbrace{m^w(-[T^r * \Delta^r]^{-1}s(p); \lambda, \Delta^r, \Delta^p)}_{m^w}. \tag{23}$$

Once we specify the marginal costs as a function of observable cost factors and an unobservable shock, equation (23) becomes the basis for the estimation.

We finally have to compute $\frac{\partial p_j}{\partial p_j^w}$ in equation (22). The matrix Δ^p with general element of $\Delta^p(i,j) = \frac{\partial p_j}{\partial p_i^w}$ contains the pass-through of wholesale prices to retail prices. To get the expression for Δ^p, we totally differentiate equation (6) with respect to all prices p_k, $k = 1, \ldots, N$ (with variation dp_k) and a wholesale price p_f^w (with variation dp_f^w):

$$\sum_{k=1}^{N} \underbrace{[\frac{\partial s_j}{\partial p_k} + \sum_{i=1}^{N}(T^r(i,j)\frac{\partial^2 s_i}{\partial p_j \partial p_k}(p_i - p_i^w - c_i^r)) + T^r(k,j)\frac{\partial s_k}{\partial p_j}]}_{g(j,k)} \, dp_k - \underbrace{T^r(f,j)\frac{\partial s_f}{\partial p_j}}_{h(j,f)} \, dp_f^w = 0. \tag{24}$$

Putting all $j = 1, \ldots, N$ products together, let G be the matrix with general element $g(j,k)$ and let H_f be the N dimensional vector with general element $h(j,f)$. Then

$G\ dp - H_f\ dp^w_f = 0$. Solving for the derivatives of all retail prices with respect to the wholesale price, the f-th column of Δ^p is obtained:

$$\frac{dp}{dp^w_f} = G^{-1} H_f. \tag{25}$$

Stacking all N columns together, $\Delta^p = G^{-1}H$ contains the derivatives of all prices with respect to all wholesale prices.[8]

Note that to compute a reaction of a retail price to a certain wholesale price in the current sequential setup the parties involved in a pairwise negotiation take into account the direct impact on retail price but also the retail price reaction to the retail prices of competing products (see equation (24)). This reaction is inconsistent with the bilateral bargaining setup, where each retailer-manufacturer pair negotiates independently from the others. The main modeling contribution of the present paper is thus to show that these issues can be resolved in a model with unobserved retail prices.

4 Data

Sales and marketing mix data. To estimate the demand system, we use data collected by MADAKOM, Germany, from a national sample of stores belonging to six major retail chains, Edeka, Markant, Metro, Rewe, Spar and Tengelmann. The data contain weekly information on the sales, prices, and promotional support for all brands in the ground coffee category from 2000-2001. In addition, we received from an anonymous manufacturer monthly brand-level advertising expenditures data collected by AC Nielsen. Because strategic pricing and promotion decisions are made at the chain (key account) level, we aggregate the data correspondingly. In what follows, the terms chain and retailer are used interchangeably.

We focus on seven major national brands: Jacobs, Onko, Melitta, Idee, Dallmayr,

[8]Inspection of equation (22) shows that we also have to compute $\frac{\partial s_j}{\partial p^w_j}$. Let Δ^w be the matrix with general element $\Delta^w(k,j) = \frac{\partial s_j}{\partial p^w_k}$ and note that $\Delta^w = \Delta^{p\prime}\Delta^r$.

Tchibo, and Eduscho[9], which together comprise more than 95% of the market. Table 1 gives an overview of the data. At first glance, there are no major differences in the brand shares, price and promotions among the six retailers we include in the analysis. Overall, Jacobs is the market leader, followed by Melitta and Tchibo. However, Tchibo is the top-selling brand at Rewe. Melitta, Jacobs, Onko, and Eduscho are somewhat lower-priced, whereas Idee, Dallmayr and Tchibo occupy the upper end of the market. There are four variables in the data set describing the presence or absence of different promotional activities in a given week and store: display, in-store demo, store-front ad, and feature. In-store demo and store-front ad are used very infrequently, while display and feature are very highly correlated. Therefore, in the interest of parsimony, we drop the first two and combine feature and display in one promotion variable. Advertising expenditures vary dramatically between the smaller brands Idee and Onko and the larger players Jacobs, Dallmayr, Melitta, Tchibo and Eduscho, while the differences within this latter group are relatively small. The market leader Jacobs has the greatest advertising expenditures (about 106,000 DEM versus approximately 97,000 DEM for the next biggest spender, Melitta).

For the empirical analysis we include an outside good as well. To calculate its share, we use the total sales within each week in each retailer. From the LZ-Lebensmittelreport we collected data about the average amount spent per shopping trip in each of the six different retailers. We used this information to estimate store traffic and apply this number to calculate market potential (Besanko, Dubé & Gupta 2003).

Cost. We obtained commodity prices of coffee from the New Yorker Stock Exchange.[10] We then adjusted these dollar prices for the exchange rate. Another ad-

[9]Jacobs and Onko are offered by the same manufacturer, as are Tchibo and Eduscho. We model these brands as separate products from the point of view of consumers but consider them jointly on the supply side.

[10]There are five contracts: coffee price mean high near by, coffee price mean high second near by, coffee price mean high third near by, coffee price mean high fourth near by, and coffee price mean high fifth near by. These contracts differ in the time of expiration, which varies from one day to

justment needed was for the tax of 4.328 DEM/kilogramm of coffee. Further, there is a 15% weight loss in the process of roasting the coffee which also needs to be taken into account when calculating the cost for one unit of roast coffee. Figure 1 plots a time series of the coffee prices for the period of the data. We also tested the inclusion of cost shifters related to packaging costs, transportation, wages and energy costs. However, it turned out that their inclusion yielded either insignificant or meaningless results so that we decided to retain only coffee cost.

Manufacturer and retailer characteristics. While our model allows us to derive the bargaining positions (disagreement profits) endogenously, the bargaining power parameter λ is exogenous and relates to numerous other factors that affect the outcome of the negotiations between manufacturers and retailers such as the negotiation skills of the parties, their patience, and their risk tolerance. We proxy these factors by taking advantage of the fact that the MADAKOM data set contains information on quantities and revenues for over 900 product categories in the six chains. We use this information to derive measures describing both the manufacturers and the retailers. The exact operationalization of these additional variables is presented in the next section.

5 Empirical Strategy

5.1 Econometric Specification

Demand. To estimate demand as given by equation (4), we include the following variables in the specification of the utility of product j or, equivalently br (representing

several months. We selected the contract with the highest correlation with shelf prices, coffee price mean high second near by.

a brand-retailer combination):

$$\begin{aligned} U_{ibrt} &= \text{const}_{br} - \beta_i \text{Price}_{brt} + \gamma_1 \text{Promo}_{brt} + \gamma_2 \text{Advert}_{bt} \\ &\quad + \gamma_3 \text{AssortDepth}_{rt} + \gamma_4 \text{SBshare}_{rt} + \gamma_5 \text{SBposit}_{rt} \\ &\quad + \gamma_6 \text{Trend}_t + \xi_{brt} + \varepsilon_{ibrt} \end{aligned} \tag{26}$$

We model demand as a function of price and marketing-mix variables. Because industry evidence from Germany shows that yearly per capita consumption has fallen by 10% from 1990 to 2002, we also include a time trend.

We finally include in the demand specification variables related to the private label program of the retailer (across categories except for coffee) and the level of service (measured by assortment depth). We elaborate on these variables below in Section 5.2. The variety offered in a store does not affect the preference for a particular brand but affects the preference for a retailer. In this sense it affects the attractiveness of a store and therefore affects consumers choices where to buy ground coffee. Store attractiveness and store choice are also affected by the private label program of the retailer. Stores that provide a store brand across their entire or almost entire assortment usually attract a different kind of consumers than stores that primarily offer national brands. On the other hand, stores whose store brands are similar to national brands may be regarded as a good choice when consumers want to buy lower-priced high-quality products.

Our model formulation explicitly acknowledges the presence of factors unobserved to the researcher that may affect demand such as changes in shelf space allocation (Besanko, Gupta & Jain 1998, Villas-Boas & Winer 1999). To account for the potential endogeneity of prices due to the presence of these changes in unobserved attributes and because we use a random-coefficients specification, we use a GMM procedure with the price of raw coffee along with the other exogenous demand shifters interacted with brand and retailer dummies as instruments. The price of raw coffee is determined in world-wide commodity markets and can thus be taken as exogenous to German coffee manufacturers. Further note that assortment depth, store-brand share and store-brand positioning are exogenous by construction as they are calculated from categories other than coffee. Our results suggest that the instruments used are important in order to consistently estimate demand parameters. The R^2 of the first-stage regression is .831 and the F-test rejects the null hypothesis that the instruments have no explanatory power ($F(12, 4259) = 30.75$ with p-value $< .0001$).

Supply. Without additional data we cannot separate the marginal cost at the retail level from that at the wholesale level. We therefore follow the empirical literature and specify the overall marginal cost of product j as $c_{jt} = c^r_{jt} + c^w_{jt} = z_{jt}\theta + \eta_{jt}$, where z is a vector of cost shifters. We include the following variables:

$$\text{Cost}_{bt} \quad = \quad \text{RawCoffeeCost}_t + \theta_{1b}\text{Trend}_t + \theta_2\text{Trend}_t^2 + \theta_3\text{Trend}_t^3 + \eta_{bt}. \qquad (27)$$

We also include a nonlinear trend to capture in a flexible way industry-wide changes in marginal cost levels over time.

With this specification, our estimation equation on the supply side has the form

$$p = z\theta + \frac{1-\lambda}{\lambda}\tilde{m}^w + m^r + \eta, \qquad (28)$$

where the retail margins m^r are given by equation (7) and the part of the wholesale margins that is independent of λ, $\tilde{m}^w$, is given by $-\left[T^r * \Delta^r\right]^{-1} s(p)$ in case of zero disagreement profits and by $[T^w * S]^{-1}[T^r * S]\left[T^r * \Delta^r\right]^{-1} s(p)$ in case of nonzero disagreement profits. As equation (28) emphasizes, what we have to estimate on the supply side are the cost parameters θ and the bargaining power parameter λ that enters nonlinearly into equation (28).

Identification. Following an argument analogous to Bresnahan (1982) for identification of oligopoly models, we can establish that the parameters in the demand system are identified. The identification of the price parameter, which is critical for our margin calculation, relies on the fact that unobserved determinants of demand are uncorrelated with input prices. Our estimation procedure ensures that this is indeed the case (please also see the above discussion on the instruments used).

Given that demand is identified, we turn to supply and argue that the bargaining power parameter λ is identified given the assumptions on the nature of retail competition. With the substitution patterns from the demand model in hand, our assumptions on retail competition determine m^r (see equation (7)). At the same time, the substitution patterns and retail competition also determine m^w up to a scale factor of $\frac{1-\lambda}{\lambda}$ (see equations (14) and (20)). That is, we have $\tilde{m}^w$. Since we have constant marginal cost, an argument analogous to Nevo (1998) for the identification of the conduct parameter in oligopoly models with differentiated products establishes that λ is identified. Clearly, under a different retail-level game, different retail margins m^r would be calculated and, in turn, a different bargaining power parameter λ would obtain. For example, collusive retailers with high bargaining power may be observationally equivalent to competitive retailers with low bargaining power. To identify the bargaining power parameter λ separately from retail competition, what is needed are wholesale prices and data on the marginal costs of both manufacturers and retailers (Misra & Mohanty 2006). Especially the latter two are often impossible to obtain. However, considering the institutional reality of the market analyzed, we feel comfortable with our assumption that retailers compete in a Bertrand-Nash fashion as opposed to colluding, for example.

5.2 Determinants of Bargaining Power

Bargaining power as defined in the generalized Nash bargaining model captures exogenous factors that affect the negotiations and thus the share of the profits that goes to the retailers and manufacturers. Unlike bargaining position, which is endogenously determined in the model (and thus a function of the shares, prices, costs and competition in the coffee market), bargaining power is driven by factors outside the coffee category that influence the negotiation outcome.

We first estimate a fixed-effects only model where we replace the bargaining power parameter λ with a separate λ_{br} for each manufacturer and retailer pair. This formulation implies that each dyad has its own negotiation dynamic, which drives the split of profits. We also test a formulation with separate manufacturer and retailer fixed effects, i.e. $\lambda_{br} = \lambda_b + \lambda_r$.

The existing literature suggests three major drivers of power: (1) firm size, (2) store brands, and (3) service level. In a second step we therefore relate the bargaining power parameter λ to a set of exogenous manufacturer and retailer characteristics:

$$\begin{aligned} &\lambda_b + \lambda_1 \log(\text{RetSize}_{rt}) + \lambda_2 \log(\text{ManuSize}_{bt}) \\ &+\lambda_3 \text{SBshare}_{rt} + \lambda_4 \text{SBposit}_{rt} + \lambda_5 \text{AssortDepth}_{rt}. \end{aligned} \tag{29}$$

There is extreme variation in the manufacturer size variable. For this reason we include brand-specific fixed effects λ_b in the estimation to control for giant manufacturers such as Kraft-Jacobs-Suchard and Tchibo/Eduscho.

Below we explain how the above manufacturer and retailer characteristics relate to bargaining power and how we capture them in our empirical analysis (for a summary of the exact operationalization, please see Table 3). Some of the variables are also allowed to influence the bargaining position of the negotiating parties by affecting demand substitution patterns. In addition, equation (29) can be used to conduct counterfactuals. We perform a series of such what-if simulations in Section 6 to investigate the drivers of total margins and margin splits.

Firm size. Firm size is one of the main determinants of profitability and negotiating power. A small manufacturer has less of an impact on a retailer's profitability and is therefore more likely to offer the retailer better terms than a large manufacturer. We expect that larger manufacturers would command a larger share of channel profits (see e.g. Hall & Weiss 1967, Kaen & Baumann 2003). The size of a retailer is also an important determinant of its share of channel profits. Larger retailers may be better able to extract price concessions from manufacturers, a phenomenon known as countervailing power (Galbraith 1952). The literature offers a number of explanations. A simple one is that the per unit cost of serving a large retailer may be lower due to reductions in distribution or production costs. As Dhar & Hoch (1997) point out, higher sales volumes decrease costs through lower printing costs for package labels, lower inventory cost, and better prices from suppliers. Other explanations are based on the strategic nature of the negotiation process in the channel. A larger retailer may have better outside options and therefore a stronger position to obtain quantity discounts (Katz 1987, Inderst & Shaffer 2004). Taken together, these cost savings should lead to improved overall channel profitability but we would expect that the retailers will enjoy a larger share of the increased total margins.

Our data allowed us to test various operationalizations of retailer size. The MADAKOM store panel reports sales of more than 900 product categories. This information has been used to calculate the weekly total store sales. Additional measures of retailer size are for example the total floor space, the number of check outs, the total number of categories carried or the total number of UPCs offered. These measures are highly correlated as one can imagine. However, we are also interested in the growth rates of these variables so that we can provide some intuition how changes in retailer size affect the bargaining power of retailers and manufacturers. Typically floor space and the number of check outs do not change across time and if they change these changes are step-wise changes. Similar arguments also hold for the number of product categories (which are usually constrained by floor space) as well as the number of UPCs hold. However, the total sales are able to pick up growth rates in retailer size. Total sales are also able to take up increases in retailer size due to seasonal demand and enable us to better project likely changes in retailer size for the future.

Table 4 shows that manufacturers differ substantially in terms of size. Jacobs/Onko is the biggest manufacturer with an average number of 239 UPCs (with a standard deviation of 8 UPCs per week) whereas Dallmayr only carries about 19 UPCs (standard deviation 2). A similar picture emerges from looking at the sales in substitute categories. While Jacobs/Onko has over 46,000 DEM (standard deviation 9,000 DEM), Dallmayr and Melitta have only about more than 1,700 DEM (standard deviations 650 DEM and 1,150 DEM, respectively). Interestingly the gap between the largest (Jacobs/Onko) and the second largest manufacturer (Tchibo) is much smaller in terms of sales in substitute categories than in terms of sheer size.

Table 5 shows that retailers also differ substantially in terms of size. Metro is the biggest retailer with an average revenue of more than 11 million DEM per week (standard deviation 2 million DEM) whereas Spar only generates revenues of 0.65 million DEM (standard deviation 0.14 million DEM). Edeka and Markant are smaller than Metro but still much bigger than Rewe, Tengelmann and Spar. Metro, Rewe and Tengelmann have a sizeable share of store brands - about 12 to 15% on the average (standard deviation about 1% in both cases) compared to about 3% for Markant (standard deviation 0.3%).

Store brands. Because one of the major reasons for the alleged shift in retailer power is the growth of store brands in the last decades, store brands have been at the center of attention of existing empirical studies of distribution channels (Raju, Sethuraman & Dhar 1995, Narasimhan & Wilcox 1998, Scott-Morton & Zettelmeyer 2004, Ailawadi & Harlam 2004). Manufacturers have responded to the wide introduction of store brands by adjusting their pricing strategies, mostly by lowering their prices or introducing lower-priced alternatives.

Besides the share of the store brands, another important factor is therefore their positioning vis-à-vis national brands (Scott-Morton & Zettelmeyer 2004). In an extensive empirical study Pauwels & Srinivasan (2004) find that prices of premium-priced brands increase after the store brand entry, while those of second-tier brands decrease. Arguably, the higher the perceived quality of the store brand, i.e., the more similar it is to the leading brands, the higher the margins that would accrue to the retailer. The more similar store brands are to the national brands, the more likely manufacturers will be to differentiate their products and due to increased differentiation increase retail prices leading to higher margins.

Table 5 provides descriptive statistics on the importance of store brands and their positioning. The larger share of store brands in Metro, Rewe and Spar is the result of strong private label programs in both stores. For example, Metro carries the private label “Goldhand Tip”, which is sold in 414 product categories with an average of 4.34 UPCs per category. The mean values for our store-brand positioning measure reveal remarkable differences across retailers. Edeka, Markant and Spar offer store brands that are positioned much closer to national brands than for example store brands in Metro. Metro’s dominant store brand “Goldhand Tip” is an inexpensive brand with moderate quality offered at the lowest prices in the category. On the other hand, Edeka offers store brands for special consumer needs such as organic products. Rewe has a medium value on store-brand positioning. An interesting development is that Rewe recently introduced a high-priced store brand called “Rewe Bio” (not covered in our data).

Service level. In addition to retailer size and store brands, merchandise assortment is a further dimension of retail differentiation (Dhar & Hoch 1997). In choosing a retailer, consumers trade off the time and effort required to visit the outlet with the probability of finding the items on their shopping list (Baumol & Ide 1956). The assortment of products carried by a retailer increases consumer willingness to pay and thus overall margins, at least up to a point (for an example of decreasing returns to assortment, see Broniarczyk, Hoyer & McAlister 1998). Because it increases store loyalty, it also may give retailers more clout vis-à-vis manufacturers in negotiating the way profits are split.

Assortment depth has been operationalized as the average number of UPCs across all product categories (see again Table 5). This measure has some overlap with the size of the retailer. The biggest retailer Metro also offers the most UPCs per category. The second largest retailer, Markant, offers the second most UPCs per category. This observation also holds for the third largest retailer, Edeka. However, the degree of assortment depth is not linearly related to retailer size. For example Tengelmann, which is smaller than Spar offers more UPCs per category than Rewe and Spar. Big retailers offer more UPCs per category, however, this results does not hold for the smaller retailers, Rewe, Spar and Tengelmann.

6 Estimation Results

6.1 Demand and Cost Estimates

The demand model estimates are presented in Table 6. Retailer constants are largely related to retailer market share (cf. Table 2). However, the main effect of Edeka is much bigger relative to its market share than that of the other retailers. This seems to indicate a superiority of Edeka vis-à-vis the other retailers. The rank order of the brand constants is not fully in line with market shares. For example, Tchibo is the highest valued brand but it only ranks third in observed market shares. Hence, the model reflects brand preferences that are not revealed entirely by the market shares.

On average, price has a significant and negative impact on utility. Consumers are very price sensitive. Our model implies own price elasticities of about -7.4. They are in the range of -6.1 to -8.9 found in Guadagni & Little (1983), Krishnamurthi & Raj (1991), and others. Moreover, there is a fair amount of unobservable heterogeneity in price sensitivity. Promotion and advertising coefficients are significant and positive, and are thus factors that expand demand. There is a significant and negative time trend in line with the evidence that the overall attractiveness of the category has been diminishing over time in the German coffee market.

Assortment depth is positive and significant, consistent with the idea that the service level of a retailer increases consumer willingness to pay. Consumers seem to prefer stores with smaller private label programs and if private label programs are offered they should be cheap. In our time period (2000-2001) consumers did not value high-quality private label programs.

As evident from Table 7, the cost parameters are significant. They are also different across some brands, indicating that costs are indeed brand specific. The upper panel of Figure 2 shows the estimated costs of the 7 brands across time. The lower panel shows the mean of the cost estimates and contrasts it to the minimum price charged by a brand in a given week. In addition, we show the raw coffee cost over time. Figure 2 suggests that the cost estimates are plausible. Prices are always above the raw coffee cost and very rarely are they close to marginal costs. Encouragingly, the cost parameters differ only slightly with the different specifications of the exogenous bargaining power parameter and the disagreement profits.

6.2 Bargaining Power

As outlined in Section 5, we estimate three different specifications of bargaining power parameter:

- brand-retailer specific fixed effects (λ_{br});
- brand-specific and retailer-specific fixed effects ($\lambda_b + \lambda_r$);
- bargaining power as a function of exogenous characteristics (see equation (29)).

Each of these specifications is estimated first for zero and then for nonzero disagreement profits, thus yielding a total of six specifications. We discuss the results below.

Bargaining position. Comparing the estimates for the specifications with zero and nonzero disagreement profits reported in Table 7, we see that the differences in the estimates are small. The same is true for the implied margin splits and total margins (not reported). In sum, a model with zero disagreement profits fits the data as well as a model with non-zero disagreement profits. The reason is that in our data the outside good is rather large, so that shares within the category (i.e. the 42 brand by retailer combinations) change little if a product is not being offered. However, the model with nonzero disagreement profits is preferable on theoretical grounds and we therefore focus on it for our subsequent analyses.

Magnitude of bargaining power. To impose as little structure as possible on the bargaining dynamics between the different parties, we specify the bargaining power parameter as brand-retailer specific fixed effects. All estimates of the bargaining power parameter are statistically significant, see Table 8. They are also statistically different for many brand by retailer pairs. Our estimates thus suggest that bargaining power is not an inherent characteristic of a retailer or a manufacturer but varies depending on the identity of the negotiating parties. That is, one manufacturer can be powerful vis-à-vis a particular retailer but not another.

Bargaining power varies significantly across manufacturers. With the exception of Melitta and Eduscho, manufacturers are significantly more powerful than retailers ($1 - \lambda > \lambda \Leftrightarrow \lambda > \frac{1}{2}$). Among all manufacturers, Dallmayr has the highest degree of bargaining power vis-à-vis retailers, closely followed by Idee and Tchibo. It thus appears that market share does not entirely explain bargaining power, especially since we also observe that the top-selling brand, Jacobs, has average bargaining power. Retailer bargaining power also varies significantly. Again, market share does not correlate perfectly with the ability to extract more profits in the channel: the biggest retailer, Metro, does not have the highest overall bargaining power. In fact, Metro has a medium bargaining power parameter that is comparable in size and statistically not different from the bargaining power parameter of Rewe. Large retailers such as Edeka and Markant show the highest bargaining power parameters.

It is very interesting to note that the magnitude of the bargaining power parameter for both manufacturers and retailers is only weakly correlated with the brand and retailer constants. This means that brand and store equity do not fully translate into bargaining power. For example, Onko has the lowest brand constant but not the lowest bargaining power. On the other hand, Tchibo has the highest brand preference but its bargaining power is below that of other brands. Similarly, the bargaining power parameter is only loosely connected to the inherent store preference as measured by the store fixed effect. Three retailers have a high store constant but only Edeka and Markant also possess high bargaining power. Metro, which has the highest constant, has similar bargaining power to Rewe, which has a much smaller constant.

In sum, bargaining power is not an inherent characteristic of a manufacturer and retailer but is specific to a manufacturer-retailer pair. Moreover, bargaining power is distinct from market share, brand equity, and store equity. Below we will further inquire into the determinants of bargaining power.

Determinants of bargaining power. To gain further insights into the determinant of bargaining power between particular pairs of manufacturers and retailers, we directly relate the exogenous bargaining power parameter to manufacturer and retailer characteristics (see equation (29)). The results in Table 9 are largely in line with our expectations. A larger retailer has more bargaining power as does a larger manufacturer (the effect of an increase in manufacturer size on the estimated bargaining power parameter is negative). The effects of retailer size and that of manufacturer size are comparable in magnitude.

The presence of store brands affects the relative bargaining power of retailers. However, the effect is different from what we might expect at first. Store-brand share has a negative impact on the bargaining power of the retailer (significant at the 10% level). Hence, retailers that engage in private label programs do not strengthen their bargaining power by doing so. One possible explanation is that these stores become less attractive to consumers (see the negative effect of store-brand share on demand in Table 6). On the other hand, store-brand positioning has a strong positive impact on the bargaining power of the retailer, i.e., retailers gain bargaining power by making their store brands close substitutes to national brands. Since the coefficient of store-brand positioning in demand is not significantly different from zero (see Table 6), retailers can improve their bargaining power through store-brand positioning and this does not seem to hurt demand for national brands.

Service at the retail level, measured by assortment depth, also provides interesting results that work in opposite directions. Assortment depth positively affects demand and in this way the bargaining position of a retailer. On the other hand, assortment depth has a negative impact on bargaining power. It seems that a service orientation makes the retailer bargain less aggressively.

Bargaining position, bargaining power, and margins in the channel. Tables 10 and 11 present separately for manufacturers (averaged across retailers) and retailers (averaged across manufacturers) the total margins, share of margins, and bargaining power parameters along with market shares as well as wholesale prices and retail prices for comparison purposes.

Table 10 shows that manufacturer margins vary substantially across brands. We estimate a very small margin for Melitta (0.76) and Eduscho (0.80), whereas the margin goes up to 1.94 for both Idee and Tchibo and 2.06 for Dallmayr. Further, we observe that the ratios of the manufacturer margin to the total margin and the bargaining power of the manufacturer $(1-\lambda)$ are almost identical within each brand. This result indicates the absence of a strong effect of the bargaining position of a manufacturer. Margins and profits are split between manufacturers and retailers according to the respective bargaining power of manufacturers and retailers. Idee, Dallmayr, and Tchibo have the highest bargaining power. They get approximately two-thirds of the pie, a much bigger slice than the retailers they negotiate with. This is intuitive, because Idee, Dallmayr, and Tchibo are highly valued brands as we can see from the estimated demand constants (see Table 6). Interestingly, manufacturer of Onko gets half of the pie. Onko is an inferior brand with a small market share but it belongs to Jacobs-Suchard along with the Jacobs brand. It seems that Jacobs possesses bargaining power that transfers to Onko. Overall, the margin split is not related to market share, e.g. Tchibo has a large market share (but not the highest power) and Idee a very small market share (but is relatively powerful). At the other end of the spectrum, Melitta and Eduscho have much less bargaining power on average though they sell well.

It seems that more bargaining power at the manufacturer goes hand-in-hand with an increase of the total margin. Of course, what we observe may be just a correlation between bargaining power and the size of the pie. To determine this effect and its causality more precisely, we need to look at the total effect in equilibrium, which we do below in our counterfactual simulations.

Table 11 reveals that, unlike manufacturer margins, average retailer margins are almost identical across stores. No retailer possesses the market power to charge fundamentally different markups than its competitors. This result shows the importance of relaxing the commonly made assumption of monopolistic retailers and considering retail competition.

The bargaining power of the retailer and the ratio of the retailer margin to the total margin are almost identical within retailers. Again, this result is driven by the absence of a strong bargaining position of the retailers due to the importance of the outside good relative to the inside goods. Interestingly, the smallest retailer, Spar, has the lowest bargaining power but the largest retailer, Metro, does not have the highest bargaining power.[11] Markant is the only retailer obtaining more than half of the pie. All other retailers get a smaller share than the manufacturer.

Total margins vary across retailers. They are smaller for the larger retailers than for the smaller retailers. This finding suggests the following: When the total margin decreases, then the slice of the retailer increases. Hence, retailers get a larger piece of a smaller pie or the same piece of a larger pie.

[11] A possible explanation why Metro, the largest retailer in our study, does not have the highest bargaining power may be that non-food items are a large part of the offering at that retailer. Metro makes more than 50% of its sales in non-food categories. It also has primarily large stores whereas the other retailers have both small and large stores.

Counterfactual simulations. The estimated supply-side parameters give us an idea of the marginal effects on total margins and margin splits from changing exogenous manufacturer and retailer characteristics. Moreover, some of these characteristics affect both bargaining power and demand and thus indirectly also bargaining position. The goal now is to assess the total effects in market equilibrium. Using our parameter estimates we therefore perform what-if analyses to assess how changes in the exogenous manufacturer and retailer characteristics affect the endogenous variables such as total margins and margin splits in equilibrium.

We proceed in three steps. First, we subtract the estimated retail and manufacturer margins from the retail price to recover marginal costs $\hat{c}$. Second, we compute the equilibrium after a change in the exogenous variables by solving for the fixed point of the supply-side equation

$$p^* = \hat{c} + \hat{m}^w(p^*) + \hat{m}^r(p^*), \tag{30}$$

where our notation emphasizes that margins are a function of prices. Third, we assess the impact of the change by comparing the counterfactual equilibrium prices p^* with the observed equilibrium prices p (base case), and similarly for the other endogenous variables of interest.

Tables 12 and 13 report the estimated effects of increasing one exogenous variable at a time by 50% on manufacturer and retailer margins, total margins, margin splits, and channel profits in equilibrium. We first report the base case from the data and then the results of changing one of the five exogenous variables (retailer size, manufacturer size, store brand market share, store-brand positioning, and assortment depth). Table 12 reports averages over retailers for each manufacturer and Table 13 reports averages over manufacturers for each retailer.

As expected from our previous discussion, an increase in retailer size or a decrease in manufacturer size adds to retailer bargaining power. While these two characteristics enter only in the specification of the bargaining power parameter, the nevertheless affect the size of the pie: The overall profitability of the channel increases with retailer size but decreases with manufacturer size. To better understand these effects, consider an increase in retailer size. This moves us further away from a Stackelberg game and thus lowers the wholesale margin relative to the baseline case. Given that the wholesale margin is lower, there is a smaller double marginalization distortion and total profits in the channel increase. Nevertheless, the impact of retail and manufacturer size on total profits is relatively small compared to the other characteristics (store-brand share, store-brand positioning, and assortment depth). We therefore conclude that the preeminent role of retail and manufacturer size is to redistribute profits in the channel.

While retailer and manufacturer size affect the bargaining power parameter alone, the next three factors enter in the demand system in addition to the bargaining power parameter. Thus their total effect on the endogenous variables is more complex. Recall that store-brand share has a negative effect on demand while assortment depth has a positive effect (see Table 6). On the supply side, store-brand share has a negative effect on retailers' bargaining power and store-brand positioning and assortment depth have positive effects (see Table 9).

The overall profitability of the distribution channel is not a zero-sum game. A case in point is assortment depth. Since assortment depth has a direct, positive effect on demand, an increase in assortment depth leads too much more profitable channel. While the increase in assortment depth weakens the bargaining power of the retailer and hence diminishes the retailer's slice of the pie, the profit of the retailer nevertheless increase. That is, the retailer gets smaller slice of a larger pie. The manufacturer gets a larger slice of a larger pie. In sum, both parties win from more service at the retail level.

Our counterfactual simulations suggest a similar conclusion for store-brand positioning. In contrast, both parties lose from a higher store-brand share. Positioning store brands close to national brands increase retail bargaining power, reduces wholesale margins and thus the double marginalization distortion. This boost demand and with it the overall profitability of the distribution channel. Whereas the retailer gets a larger slice of a larger pie, the manufacturer gets a smaller slice of a larger pie. All this suggest that great care is warranted when it comes to introducing store brands and positioning them vis-à-vis national brands.

7 Conclusions

In this paper, we develop a bargaining model to obtain insights into the determinants of power in the channel. We integrate bargaining between multiple manufacturers and retailers with Bertrand-Nash competition between multiple retailers and a model of consumer demand. The resulting framework is internally consistent and empirically tractable.

Our bargaining model provides a rationalization of the conduct parameter approach that is often used to relax the assumptions of a particular vertical interaction between manufacturers and retailers. Our interpretation of the generalized Nash bargaining model follows the theoretical papers by Iyer & Villas-Boas (2003) and Dukes et al. (2006). Part of our contribution is to draw a distinction between bargaining position and bargaining power. A party's bargaining position is endogenously determined from the substitution patterns on the demand side. Besides the bargaining positions, there are numerous other factors such as the negotiation skills of the parties, their patience, and their risk tolerance that affect the outcome of the negotiations between manufacturers and retailers. The factors are together captured in the estimated bargaining power parameter. This parameter thus has a clear-cut behavioral interpretation.

We use the proposed bargaining model to investigate the role of the three main factors that have been blamed for the power shift from manufacturers to retailers in recent years (firm size increases, store brand introductions, and service level differentiation). In our empirical analysis of the German market for coffee, we find that bargaining power varies among the different manufacturer-retailer pairs. This is an interesting result, suggesting that bargaining power is not an inherent characteristic of a firm but rather depends on the negotiation partner. We find that firm size, store-brand positioning and assortment depth can affect the way profits are split in the channel. Moreover, they can also lead to a change in total demand, thus affecting the overall profitability in the channel. We are able to confirm empirically that there can be cases where the slice of the pie that goes to one of the channel members may decrease but the overall pie increases and compensates for the smaller share of profits. This finding is consistent with the theoretical literature, which suggest that a decrease in bargaining power of the manufacturer would decrease the distortion due to double marginalization (Dukes et al. 2006). That is, manufacturers and retailers are not playing a zero-sum game and should not only focus on the share of profits they obtain but also on total demand. It seems that this is what is happening with the push towards cooperation between manufacturers and retailers by assigning category captains.

In sum, the proposed bargaining framework provides a flexible way to investigate empirically channel interactions. We see a number of ways in which future work can apply and extend our model. While research on mergers traditionally assesses their potential competitive effects on prices and market power, one could apply our model to investigate the additional consequences of, say, a proposed retail merger for bargaining between manufacturers and retailers. In particular, an increase in post-merger bargaining power is likely to be important consideration for the merging parties. This may work to lower manufacturer margins, thereby boosting demand and ultimately the overall profitability of the distribution channel. At the same time, the change in bargaining power may constitute a countervailing effect for competition authorities to take into account.

A fruitful avenue for future research would be to explore how to incorporate quantity discounts in the negotiation process. While not relevant for the German market, this issue is very important in order to allow for abiding by the restrictions imposed by the Robinson-Patman act. Another question that has been raised in earlier work (Gupta 1989) is that bargaining may take place over multiple issues. Retailer and manufacturers may negotiate not just wholesale price but also other terms, or they may bargain over multiple products (or even categories) simultaneously. Capturing the full complexity of the negotiations requires extending our bargaining model.

References

Ailawadi, K. (2001). The retail power-performance conundrum: What have we learned?, *Journal of Retailing* **77**(3): 299–318.

Ailawadi, K. and Harlam, B. (2004). An empirical analysis of the determinants of retail margins: The role of store-brand share, *Journal of Marketing* **68**: 147–165.

Baumol, W. and Ide, E. (1956). Variety in retailing, *Management Science* **3**(1): 93–101.

Besanko, D., Dubé, J.-P. and Gupta, S. (2003). Competitive price discrimination strategies in a vertical channel with aggregate data, *Management Science* **49**(9): 1121–1138.

Besanko, D., Gupta, S. and Jain, D. (1998). Logit demand estimation under competitive pricing behavior: An equilibrium framework, *Management Science* **44**: 1533–1547.

Bresnahan, T. (1982). The oligopoly solution is identified, *Economics Letters* **10**: 87–92.

Broniarczyk, S., Hoyer, W. and McAlister, L. (1998). Consumers perceptions of the assortment offered in a grocery category: The impact of item reduction, *Journal of Marketing Research* **35**: 166–176.

Chambolle, C. and Villas-Boas, S. (2008). Buyer power through producer differentiation, *working paper*, UC Berkeley.

Choi, C. (1991). Price competition in a channel structure with a common retailer, *Marketing Science* **10**: 271–296.

Cotterill, R. and Putsis, W. (2001). Do models of vertical strategic interaction for national and store brands meet the market test?, *Journal of Retailing* **77**: 83–109.

Dhar, S. and Hoch, S. (1997). Why store brand penetration varies by retailer, *Marketing Science* **16**(3): 208–227.

Draganska, M. and Klapper, D. (2007). Retail environment and manufacturer competitive intensity, *Journal of Retailing* .

Dukes, A., Gal-Or, E. and Srinivasan, K. (2006). Channel bargaining with retailer assymetry, *Journal of Marketing Research* **18**: 84–97.

Galbraith, J. (1952). *American Capitalism: The Concept of Countervailing Power*, Houghton Mifflin.

Guadagni, P. and Little, J. D. C. (1983). A logit model of brand choice calibrated on scanner data, *Marketing Science* **2**(3): 203–238.

Gupta, S. (1989). Modeling integrative, multiple issue bargaining, *Management Science* **35**(7): 788–806.

Hall, M. and Weiss, L. (1967). Firm size and profitability, *Review of Economics and Statistics* **49**(3): 319–331.

Inderst, R. and Shaffer, G. (2004). Retail mergers, buyer power, and product variety, *Technical report*, University of Rochester.

Iyer, G. and Villas-Boas, M. (2003). A bargaining theory of distribution channels, *Journal of Marketing Research* **40**: 80–100.

Kadiyali, V., Chintagunta, P. and Vilcassim, N. (2000). Manufacturer-retailer channel interactions and implications for channel power: An empirical investigation of pricing in a local market, *Marketing Science* **19**: 127–148.

Kaen, F. and Baumann, H. (2003). Firm size, employees and profitability in U.S. manufacturing industries, *Technical report*, U. New Hampshire.

Katz, M. (1987). The welfare effect of third degree price discrimination in intermediate goods markets, *American Economic Review* **77**: 154–167.

Krishnamurthi, L. and Raj, S. (1991). An empirical analysis of the relationship between brand loyalty and consumer price elasticity, *Marketing Science* **10**(2): 172–183.

Messinger, P. and Narasimhan, C. (1995). Has power shifted in the grocery channel?, *Marketing Science* **14**(2): 189–223.

Misra, S. and Mohanty, S. (2006). Estimating barganing games in distribution channels, *working paper*, University of Rochester.

Muthoo, A. (1999). *Bargaining Theory with Applications*, Cambridge University Press.

Narasimhan, C. and Wilcox, R. (1998). Private labels and the channel relationship: A cross-category analysis, *Journal of Business* **71**(4): 573–600.

Nash, J. F. (1950). The barganing problem, *Econometrica* **18**: 155–162.

Neslin, S. A. and Greenhalgh, L. (1983). Nash's theory of cooperative games as a predictor of the outcomes of buye-seller negotiations: An experiment in media purchasing, *Journal of Marketing Research* **20**(4): 368–379.

Nevo, A. (1998). Identification of the oligopoly solution concept in a differentiated-products industry, *Economics Letters* **59**: 391–395.

Nevo, A. (2000). Mergers with differentiated products: The case of the ready-to-eat cereal industry, *RAND Journal of Economics* **31**(3): 395–421.

O'Brien, D. and Shaffer, G. (1992). Vertical control with bilateral contracts, *Rand Journal of Economics* **23**(3): 728–746.

Pauwels, K. and Srinivasan, S. (2004). Who benefits from store brand entry?, *Marketing Science* **23**(3): 364–390.

Raju, J., Sethuraman, R. and Dhar, S. (1995). The introduction and performance of store brands, *Management Science* **41**(6): 957–978.

Raskovich, A. (2007). Ordered bargaining, *International Journal of Industrial Organization* **25**: 244û261.

Rubinstein, A. (1982). Perfect equilibrium in a bargaining model, *Econometrica* **50**: 97–110.

Scott-Morton, F. and Zettelmeyer, F. (2004). The strategic positioning of store brands in retailer-manufacturer negotiations, *Review of Industrial Organization* **24**: 161–194.

Stole, L. and Zwiebel, J. (1996). Intra-firm bargaining under non-binding contracts, *The Review of Economic Studies* **63**(3): 375–410.

Sudhir, K. (2001). Structural analysis of competitive pricing in the presence of a strategic retailer, *Marketing Science* **20**(3): 244–264.

Villas-Boas, M. and Winer, R. (1999). Endogeneity in brand choice models, *Management Science* **45**: 1324–1338.

Villas-Boas, M. and Zhao, Y. (2005). Retailers, manufacturers, and individual consumers: Modeling the supply side in the ketchup marketplace, *Journal of Marketing Research* **42**(1): 83–95.

Villas-Boas, S. B. (2007). Vertical relationships between manufacturers and retailers: Inference with limited data, *Review of Economic Studies* **74**(2): 625–652.

Table 1: Mean values and standard deviations (in parentheses) of sales and marketing-mix data.

	Share		Price		Promotion		Advertising	
Jacobs	30.57	(13.49)	7.01	(0.64)	32.65	(26.71)	106.42	(48.91)
Onko	8.39	(8.53)	6.36	(0.81)	25.31	(30.88)	12.93	(19.48)
Melitta	19.67	(14.62)	6.47	(0.65)	31.24	(28.45)	97.56	(49.19)
Idee	1.97	(3.18)	7.93	(0.62)	18.20	(25.97)	9.09	(10.30)
Dallmayr	12.06	(10.56)	7.79	(0.71)	25.52	(29.50)	88.72	(29.40)
Tchibo	14.42	(8.23)	8.03	(0.43)	22.75	(8.39)	83.47	(45.57)
Eduscho	12.92	(7.66)	6.82	(0.42)	28.01	(11.95)	71.65	(52.74)

Table 2: Average shares of brands within retailers.

	Edeka	Markant	Metro	Rewe	Spar	Tengelmann	# obs
Jacobs	31.81	30.76	26.73	23.31	28.30	29.64	618
Onko	8.66	7.46	8.14	7.57	5.62	0.10	557
Melitta	12.65	19.79	20.79	15.88	13.70	28.44	618
Idee	2.37	1.97	3.22	1.77	1.85	1.63	618
Dallmayr	15.14	11.54	11.23	6.88	9.93	12.17	618
Tchibo	17.59	15.47	12.75	27.99	26.03	16.92	618
Eduscho	11.77	13.01	17.12	16.59	14.57	11.10	618
# obs	721	721	721	721	655	720	4259

Table 3: Manufacturer and retailer characteristics. Variable operationalization.

Variable	Operationalization
Manufacturer size	number of UPCs per manufacturer across all product categories carried by the six retailers
Retailer size	total sales in million DEM across all product categories for each week
Store-brand share	unit volume share of store brand sales in 36 representative categories within each retailer
Store-brand positioning	price ratio of store brand to the national brands averaged across a representative set of 36 product categories
Assortment depth	average number of UPCs across all product categories

Table 4: Manufacturer size (Number of UPCs)

	Average	Std. Dev.	Minimum	Maximum
Jacobs/Onko	238.73	(8.29)	223	259
Melitta	47.86	(2.24)	42	53
Idee	20.48	(1.32)	17	23
Dallmayr	19.37	(1.94)	15	24
Tchibo/Eduscho	47.59	(3.68)	39	57

Table 5: Retailer characteristics. Averages and standard deviations (in parentheses).

	Size of Retailer		Store Brand Share		Store Brand Positioning		Assortment Depth	
Edeka	7,057,104	(988,523)	7.87	(0.47)	0.752	(0.027)	9.519	(0.271)
Markant	9,631,890	(1,380,622)	3.54	(0.47)	0.746	(0.065)	10.806	(0.480)
Metro	11,431,924	(1,902,021)	12.15	(1.19)	0.556	(0.019)	14.056	(0.353)
Rewe	1,679,360	(277,300)	14.75	(1.50)	0.665	(0.012)	7.778	(0.396)
Spar	651,485	(138,856)	8.93	(1.03)	0.701	(0.017)	8.415	(0.408)
Tengelmann	2,801,372	(629,895)	15.55	(1.61)	0.588	(0.010)	6.941	(0.339)

Table 6: Parameter estimates of demand model.

Parameter	Estimate	Std. Error
Marketing Mix		
Price	-1.0329	(0.1335)
Standard deviation	0.1344	(0.0847)
Promotion	0.8507	(0.0547)
Advertising	0.7813	(0.1451)
Trend	-0.0083	(0.0005)
Store-brand share	-2.3334	(0.7504)
Store-brand positioning	-0.1724	(0.2245)
Assortment depth	0.1055	(0.0250)
Brand Effects		
Jacobs	0.5105	(0.5622)
Onko	-1.9000	(0.5444)
Melitta	-0.5733	(0.5498)
Idee	-1.2904	(0.5756)
Dallmayr	0.1467	(0.5725)
Tchibo	1.1852	(0.5773)
Eduscho	-0.3207	(0.5608)
Retailer Effects		
Edeka	0.5046	(0.0903)
Markant	0.4837	(0.1269)
Metro	0.5479	(0.1771)
Rewe	-0.2852	(0.0352)
Spar	-1.3634	(0.0722)
SSE	0.03885	

Table 7: Supply estimates with nonzero and zero disagreement profits. Fixed effects specification.

	Zero disagreement profit		Nonzero disagreement profit	
Parameter	Estimate	Std. Error	Estimate	Std. Error
Marginal cost				
Trend				
Jacobs	0.0104	(0.0027)	0.0113	(0.0028)
Onko	0.0030	(0.0028)	0.0040	(0.0028)
Melitta	0.0105	(0.0027)	0.0116	(0.0028)
Idee	0.0170	(0.0028)	0.0182	(0.0028)
Dallmayr	0.0114	(0.0028)	0.0124	(0.0028)
Tchibo	0.0218	(0.0028)	0.0232	(0.0028)
Eduscho	0.0182	(0.0027)	0.0195	(0.0028)
Trend^2	-0.0001	(0.0000)	-0.0001	(0.0000)
Trend^3	8.011E-7	(3.857E-7)	9.318E-7	(3.87E-7)
Bargaining power				
Brand effects				
Jacobs	0.4010	(0.0086)	0.4102	(0.0087)
Onko	0.4571	(0.0111)	0.4668	(0.0113)
Melitta	0.5182	(0.0141)	0.5246	(0.0143)
Idee	0.3212	(0.0058)	0.3224	(0.0059)
Dallmayr	0.3046	(0.0053)	0.3071	(0.0054)
Tchibo	0.3469	(0.0066)	0.3562	(0.0067)
Eduscho	0.5402	(0.0153)	0.5534	(0.0156)
Retailer Effects				
Edeka	0.0552	(0.0047)	0.0522	(0.0048)
Markant	0.0823	(0.0052)	0.0766	(0.0053)
Metro	0.0199	(0.0040)	0.0133	(0.0041)
Rewe	-0.0035	(0.0038)	-0.0036	(0.0039)
Spar	-0.0421	(0.0035)	-0.0421	(0.0036)
SSE	1154.7		1164.0	

Table 8: Brand-retailer fixed effect estimates of λ (standard errors in parentheses.)

	Edeka	Markant	Metro	Rewe	Tengel.	Spar	Average
Jacobs	**0.461**	**0.538**	**0.418**	**0.417**	**0.376**	**0.397**	0.434
	(0.014)	(0.025)	(0.028)	(0.009)	(0.010)	(0.008)	
Onko	**0.615**	**0.623**	**0.463**	**0.512**	**0.418**	**0.437**	0.511
	(0.020)	(0.019)	(0.026)	(0.041)	(0.010)	(0.011)	
Melitta	**0.656**	**0.804**	**0.513**	**0.534**	**0.453**	**0.573**	0.589
	(0.008)	(0.022)	(0.011)	(0.014)	(0.017)	(0.009)	
Idee	**0.377**	**0.395**	**0.358**	**0.317**	**0.274**	**0.333**	0.342
	(0.007)	(0.008)	(0.021)	(0.011)	(0.017)	(0.019)	
Dallmayr	**0.392**	**0.404**	**0.325**	**0.301**	**0.263**	**0.320**	0.334
	(0.007)	(0.006)	(0.007)	(0.021)	(0.009)	(0.012)	
Tchibo	**0.344**	**0.353**	**0.358**	**0.343**	**0.338**	**0.332**	0.345
	(0.013)	(0.005)	(0.005)	(0.007)	(0.018)	(0.010)	
Eduscho	**0.566**	**0.590**	**0.577**	**0.570**	**0.524**	**0.541**	0.561
	(0.016)	(0.021)	(0.007)	(0.007)	(0.007)	(0.019)	
Average	0.487	0.530	0.430	0.428	0.378	0.419	
SSE	1059.00						

Table 9: Supply estimates controlling for manufacturer effects. Nonzero disagreement profits. Bargaining power as a function of manufacturer and retailer factors.

Parameter	Estimate	Std. Error
Bargaining power		
Retailer Size	0.0413	(0.0018)
Manufacturer Size	-0.0535	(0.0166)
Store Brand Share	-0.0974	(0.0580)
Store Brand Positioning	0.1965	(0.0331)
Assortment Depth	-0.0060	(0.0009)
Brand effects		
Jacobs	0.6091	(0.0955)
Onko	0.6657	(0.0956)
Melitta	0.6385	(0.0716)
Idee	0.3871	(0.0580)
Dallmayr	0.3729	(0.0580)
Tchibo	0.4707	(0.0715)
Eduscho	0.6671	(0.0722)
Marginal cost		
Trend		
Jacobs	0.0121	(0.0028)
Onko	0.0047	(0.0028)
Melitta	0.0122	(0.0028)
Idee	0.0188	(0.0029)
Dallmayr	0.0139	(0.0028)
Tchibo	0.0245	(0.0028)
Eduscho	0.0201	(0.0028)
Trend^2	-0.0001	(0.0000)
Trend^3	8.618E-7	(3.912E-7)
SSE	1155.00	

Table 10: Manufacturers shares, profits and bargaining power. Calculations based on fixed-effects specification with nonzero disagreement profits.

	Jacobs	Onko	Melitta	Idee	Dallm.	Tchibo	Eduscho
Market share (s)	30.01	7.81	19.51	2.16	12.20	15.01	13.29
Retail price (p)	7.01	6.45	6.47	7.93	7.79	8.03	6.82
Wholesale price (p^w)	6.00	5.45	5.46	6.93	6.78	7.02	5.82
Manufacturer margin (m^w)	1.37	1.03	0.76	1.94	2.06	1.94	0.80
Total margin ($m^r + m^w$)	2.37	2.03	1.77	2.95	3.06	2.94	1.80
Manufacturer margin/							
Total margin ($\frac{m^w}{m^r+m^w}$)	0.57	0.49	0.41	0.65	0.66	0.66	0.44
Bargaining power ($1 - \lambda$)	0.57	0.49	0.41	0.66	0.67	0.66	0.44

Table 11: Retailer shares, profits and bargaining power. Calculations based on fixed-effects specification with nonzero disagreement profits.

	Edeka	Markant	Metro	Rewe	Spar	Tengelm.
Market share (s)	19.60	30.39	37.45	5.18	1.60	5.78
Retail price (p)	6.97	6.85	7.24	7.26	7.58	7.37
Wholesale price (p^w)	5.88	5.74	6.13	6.19	6.50	6.22
Retailer margin (m^r)	1.01	1.02	1.02	0.99	0.99	0.99
Total margin ($m^r + m^w$)	2.19	2.07	2.46	2.48	2.80	2.51
Retailer margin/						
Total margin ($\frac{m^r}{m^r+m^w}$)	0.49	0.53	0.43	0.42	0.37	0.41
Bargaining power (λ)	0.49	0.53	0.43	0.43	0.38	0.42

Table 12: Effects of exogenous changes in bargaining power on manufacturer margins, the size of the pie and the split of the pie.

	Jacobs	Onko	Melitta	Idee	Dallm.	Tchibo	Eduscho
Manufacturer margin (m^w)							
base case	1.36	1.08	0.84	1.94	2.06	1.68	0.75
50% increase in $RetSize$	1.28	1.01	0.79	1.80	1.91	1.57	0.70
50% increase in $ManuSize$	1.49	1.18	0.92	2.14	2.28	1.85	0.82
50% increase in $SBshare$	1.39	1.10	0.86	1.99	2.11	1.72	0.77
50% increase in $SBposit$	1.26	1.00	0.77	1.77	1.89	1.55	0.69
50% increase in $AssortDepth$	1.56	1.23	0.96	2.21	2.37	1.93	0.86
Total margin ($m^r + m^w$)							
base case	2.37	2.08	1.85	2.94	3.06	2.69	1.76
50% increase in $RetSize$	2.28	2.02	1.80	2.81	2.92	2.58	1.71
50% increase in $ManuSize$	2.49	2.18	1.92	3.15	3.28	2.85	1.82
50% increase in $SBshare$	2.39	2.10	1.86	2.99	3.12	2.72	1.77
50% increase in $SBposit$	2.27	2.00	1.78	2.78	2.90	2.56	1.70
50% increase in $AssortDepth$	2.57	2.24	1.97	3.23	3.38	2.94	1.87
Manufacturer margin/ Total margin ($\frac{m^w}{m^r+m^w}$)							
base case	0.57	0.51	0.45	0.65	0.67	0.62	0.43
50% increase in $RetSize$	0.56	0.50	0.44	0.64	0.65	0.61	0.41
50% increase in $ManuSize$	0.59	0.54	0.48	0.68	0.69	0.64	0.45
50% increase in $SBshare$	0.58	0.52	0.46	0.66	0.67	0.63	0.43
50% increase in $SBposit$	0.55	0.49	0.43	0.63	0.64	0.60	0.40
50% increase in $AssortDepth$	0.60	0.55	0.48	0.68	0.70	0.65	0.46
Total profits in 1000 DEM ($(m^r + m^w)s_bM$)							
base case	14.82	2.00	6.47	1.16	6.65	8.53	4.06
50% increase in $RetSize$	15.20	2.03	6.52	1.22	7.06	8.89	4.08
50% increase in $ManuSize$	14.26	1.95	6.39	1.06	6.09	8.02	4.03
50% increase in $SBshare$	13.59	1.84	5.95	1.05	6.04	7.70	3.71
50% increase in $SBposit$	16.85	2.20	6.87	1.45	8.55	10.27	4.26
50% increase in $AssortDepth$	22.15	3.09	10.34	1.63	9.10	12.13	6.49

Table 13: Effects of exogenous changes in bargaining power on retailer margins, the size of the pie and the split of the pie.

	Edeka	Markant	Metro	Rewe	Spar	Tengelm.
Retailer margin (m^r)						
base case	1.01	1.02	1.02	0.99	0.99	0.99
50% increase in $RetSize$	1.01	1.03	1.03	0.99	0.99	0.99
50% increase in $ManuSize$	1.01	1.02	1.02	0.99	0.99	0.99
50% increase in $SBshare$	1.01	1.02	1.02	0.99	0.99	0.99
50% increase in $SBposit$	1.01	1.03	1.03	0.99	0.99	0.99
50% increase in $AssortDepth$	1.02	1.04	1.04	0.99	0.99	0.99
Total margin ($m^r + m^w$)						
base case	2.13	2.11	2.41	2.52	2.74	2.45
50% increase in $RetSize$	2.06	2.04	2.32	2.42	2.62	2.35
50% increase in $ManuSize$	2.24	2.21	2.54	2.67	2.92	2.59
50% increase in $SBshare$	2.15	2.12	2.44	2.56	2.77	2.50
50% increase in $SBposit$	1.97	1.94	2.17	2.46	2.83	2.34
50% increase in $AssortDepth$	2.29	2.30	2.73	2.70	2.97	2.60
Retailer margin/ Total margin ($\frac{m^r}{m^r+m^w}$)						
base case	0.49	0.50	0.44	0.41	0.38	0.42
50% increase in $RetSize$	0.51	0.52	0.46	0.43	0.40	0.44
50% increase in $ManuSize$	0.47	0.48	0.42	0.39	0.36	0.40
50% increase in $SBshare$	0.49	0.50	0.44	0.41	0.38	0.42
50% increase in $SBposit$	0.53	0.55	0.49	0.42	0.37	0.44
50% increase in $AssortDepth$	0.46	0.47	0.40	0.39	0.35	0.40
Total profits in 1000 DEM ($(m^r + m^w)s_r M$)						
base case	7.68	11.30	13.27	2.31	0.82	2.07
50% increase in $RetSize$	7.86	11.53	13.75	2.41	0.87	2.15
50% increase in $ManuSize$	7.42	10.95	12.60	2.16	0.75	1.95
50% increase in $SBshare$	7.10	11.02	11.64	1.95	0.74	1.73
50% increase in $SBposit$	8.95	12.81	14.72	3.02	1.22	2.52
50% increase in $AssortDepth$	10.82	16.89	21.47	2.91	1.03	2.53

Figure 1: Raw coffee price.

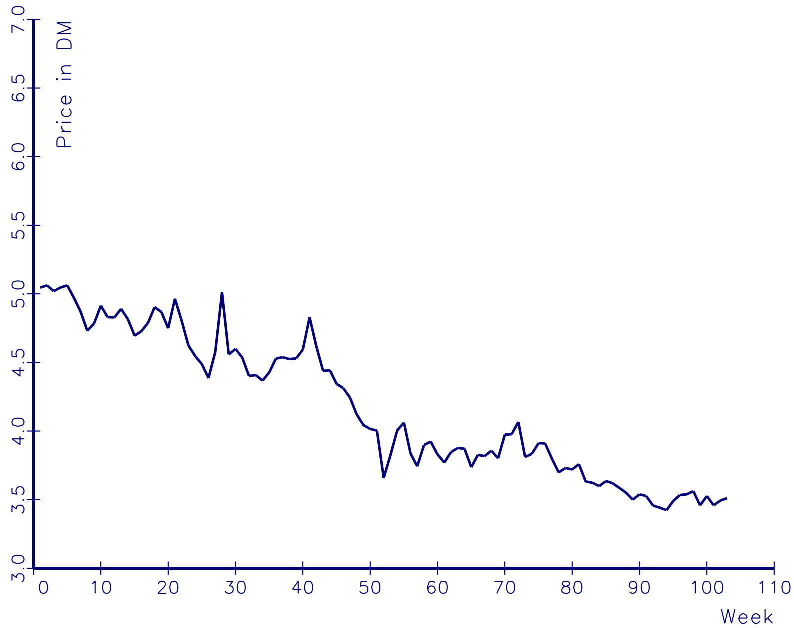
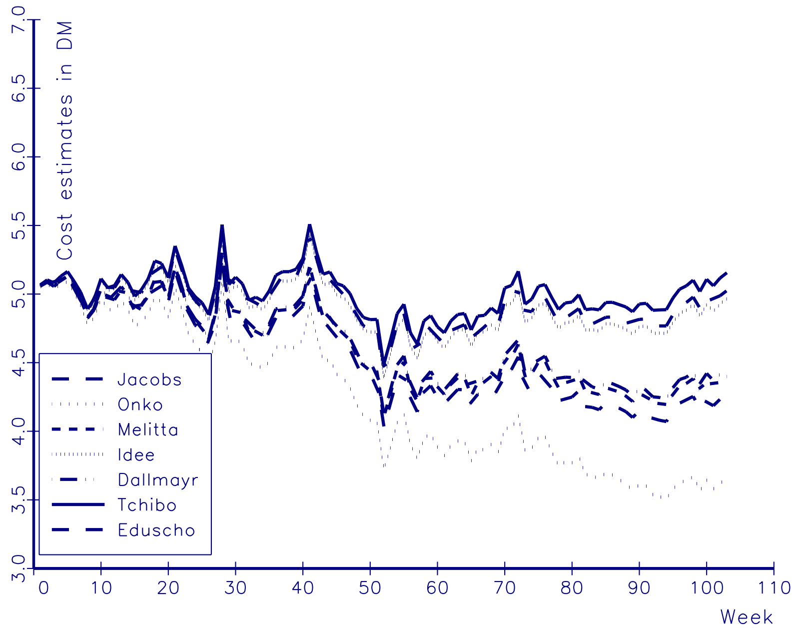
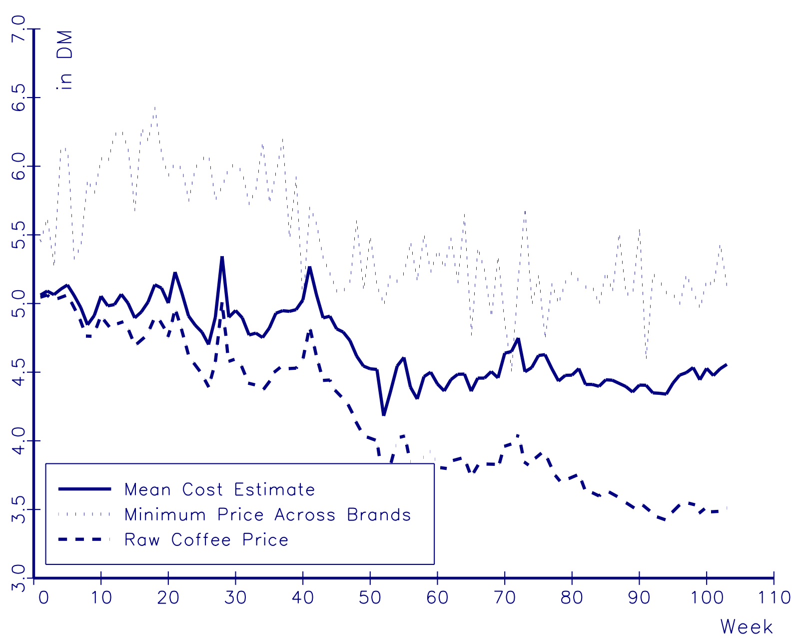


Figure 2: Estimated costs of the brands, mean cost, minimal prices and raw coffee cost over time.





Appendix A: Vertical Nash and Manufacturer Stackelberg as Special Cases

In a vertical Nash game, retail and wholesale prices are determined at the same time (Choi 1991). That is, retailers set their prices to maximize retail profits without knowing wholesale prices and manufacturers set their prices to maximize their profits without knowing retail prices. Manufacturers choose wholesale prices taking retail margins on their own products as given. In contrast, in a manufacturer Stackelberg game, wholesale prices are set first and then retail prices are set after wholesale prices are observed. Manufacturers choose wholesale prices in the knowledge that retail prices will adjust to wholesale prices. Exploiting this, manufacturers are able to commit to maintaining wholesale price levels.

As we show in the remainder of this section, our bargaining game nests the vertical Nash specification as a special case. Perhaps more surprisingly, it also nest the manufacturer Stackelberg game.[12] Throughout we restrict attention to single-product firms ($T^r = T^w = I$) or, equivalently, assume that firms treat each product as a separate profit center.

In the vertical Nash and manufacturer Stackelberg games, the retail price is chosen according to the first-order condition

$$s_j + \left[p_j - p_j^w - c_j^r\right] \frac{\partial s_j}{\partial p_j} = 0. \tag{31}$$

This coincides with the first-order condition in equation (6) for our bargaining game. In the vertical Nash and manufacturer Stackelberg games, the wholesale price is chosen according to the first-order

$$s_j + \left[p_j^w - c_j^w\right] \frac{\partial s_j}{\partial p_j} \frac{\partial p_j}{\partial p_j^w} = 0, \tag{32}$$

where the derivative $\frac{\partial p_j}{\partial p_j^w}$ captures the impact of the wholesale price on the retail price:

$$\frac{\partial p_j}{\partial p_j^w} = \begin{cases} 1 & \text{if vertical Nash,} \\ \dfrac{\frac{\partial s_j}{\partial p_j}}{2\frac{\partial s_j}{\partial p_j} + (p_j - p_j^w - c_j^r)\frac{\partial^2 s_j}{\partial p_j^2}} & \text{if manufacturer Stackelberg.} \end{cases} \tag{33}$$

Intuitively, $\frac{\partial p_j}{\partial p_j^w} = 1$ in the vertical Nash game means that retail and wholesale prices move in lock step, thereby ensuring that retail margins remain fixed. In the manufacturer Stackelberg game, by contrast, the expression for $\frac{\partial p_j}{\partial p_j^w}$ is found by implicitly differentiating equation (31) to determine how the retail price optimally adjusts to the wholesale price. Equilibrium retail and wholesale prices in the vertical Nash and manufacturer Stackelberg games are obtained by jointly solving equations (31) and (32).

[12] Similar results have also been obtained by Iyer and Villas-Boas (2003), albeit in a simpler model with a single manufacturer and a single retailer. Misra and Mohanty (2006) also show that the manufacturer Stackelberg game is a special case of their setup where the retail price is set after bargaining has taken place.

To see how the vertical Nash and manufacturer Stackelberg games are related to our bargaining game, we combine equations (31) and (32) to yield

$$m_j^w = \frac{1}{\frac{\partial p_j}{\partial p_j^w}} m_j^r. \tag{34}$$

Recall that in our bargaining game wholesale and retail margins are related according to

$$m_j^w = \frac{1-\lambda}{\lambda} m_j^r. \tag{35}$$

Therefore our bargaining game yields the same equilibrium prices if

$$\frac{1-\lambda}{\lambda} = \frac{1}{\frac{\partial p_j}{\partial p_j^w}} \Leftrightarrow \lambda = \frac{\frac{\partial p_j}{\partial p_j^w}}{1+\frac{\partial p_j}{\partial p_j^w}}. \tag{36}$$

In the vertical Nash game, in particular, $\frac{\partial p_j}{\partial p_j^w} = 1$ implies $\lambda = \frac{1}{2}$. We therefore have

Proposition 1 *Equilibrium prices and margins in the bargaining game with the bargaining power parameter λ set to $\frac{1}{2}$ are identical to those in the vertical Nash game.*

Turning to the manufacturer Stackelberg game, inspecting equation (33) shows that prices and margins cannot generally be matched unless we allow the value of the bargaining power parameter to vary across products. To construct the appropriate bargaining power parameter, consider retail and wholesale prices p^{MS} and $p^{w,MS}$ in the equilibrium of the manufacturer Stackelberg game and define

$$\lambda_j = \left. \frac{\frac{\partial s_j}{\partial p_j}}{3\frac{\partial s_j}{\partial p_j} + (p_j - p_j^w - c_j^r)\frac{\partial^2 s_j}{\partial p_j^2}} \right|_{p^{MS}, p^{w,MS}}, \tag{37}$$

where the right-hand side is evaluated at the equilibrium of the manufacturer Stackelberg game. Using these product-specific values for the bargaining power parameter we obtain

Proposition 2 *Equilibrium prices and margins in the bargaining game with product-specific bargaining power parameters λ_j set according to equation (37) are identical to those in the manufacturer Stackelberg game.*

Of course, the manufacturer Stackelberg game leads to double marginalization. Hence, our bargaining game can (but does not have to) replicate the double-marginalization solution.

To gain further insights, assume that demand is linear. Then the curvature of the demand function $\frac{\partial^2 s_j}{\partial p_j^2} = 0$ and we have $\frac{\partial p_j}{\partial p_j^w} = \frac{1}{2}$ independent of the slope of the demand function $\frac{\partial s_j}{\partial p_j}$. We thus obtain

Corollary 1 *If demand is linear, then equilibrium prices and margins in the bargaining game with the bargaining power parameter λ set to $\frac{1}{3}$ are identical to those in the manufacturer Stackelberg game.*

As expected, the manufacturer Stackelberg game, which allows the manufacturer to precommit, gives less bargaining power to the retailer than the vertical Nash game.

From an empirical perspective, Propositions 1 and 2 and Corollary 1 are important because they show that our bargaining model is strictly more general than either the vertical Nash or the manufacturer Stackelberg specification. Moreover, we can test whether the data are consistent with the restrictions on the bargaining power parameter that these two games entail. As the data reject either one these restrictions, it becomes evident that bargaining over wholesale prices plays a crucial role in "splitting the pie" between manufacturers and retailer. That is, assuming either a vertical Nash or a manufacturer Stackelberg game unduly restricts how overall channel profits are split between manufacturers and retailers.

Appendix B: Zero disagreement profits when retail prices are observed

Assuming $d_j^w = d_j^r = 0$ in equation (8), the first-order condition with respect to the wholesale price p_j^w is given by

$$\begin{aligned}&\lambda(\tfrac{\partial p_j}{\partial p_j^w} - 1)(p_j - p_j^w - c_j^r)^{(\lambda-1)}(p_j^w - c_j^w)^{(1-\lambda)} s_j(p) + \\ &(1-\lambda)(p_j - p_j^w - c_j^r)^{\lambda}(p_j^w - c_j^w)^{-\lambda} s_j(p) + \\ &(p_j - p_j^w - c_j^r)^{\lambda}(p_j^w - c_j^w)^{1-\lambda}\tfrac{\partial s_j(p)}{\partial p_j^w} = 0.\end{aligned} \tag{38}$$

Solving equation (38) yields a relationship between wholesale and retail margins:

$$m_j^w = p_j^w - c_j^w = \frac{1-\lambda}{-\frac{\partial s_j/\partial p_j^w}{s_j} + \frac{\lambda}{p_j - p_j^w - c_j^r}(1 - \frac{\partial p_j}{\partial p_j^w})} = \frac{1-\lambda}{-\frac{\partial s_j/\partial p_j^w}{s_j} + \frac{\lambda}{m_j^r}(1 - \frac{\partial p_j}{\partial p_j^w})}. \tag{39}$$

Note that in the case where $\frac{\partial p}{\partial p^w} = 0$ then the above equation (39) simplifies to (13).

Adding equations (7) and a vector stack of (39) for all j and using the fact that channel margins are the sum of wholesale and retail margins, we have

$$p - c^w - c^r = \underbrace{-[T^r * \Delta^r]^{-1} s(p)}_{m^r} + m^w(m^r, \lambda, \Delta^w, \Delta^p). \tag{40}$$

Once we specify the marginal costs as a function of observable cost factors and an unobservable shock, equation (40) becomes the basis for the estimation.