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ABSTRACT

Measuring Unilateral Effects in Partial Acquisitions*

Recent years have witnessed an increased interest, by competition agencies, in assessing the competitive effects of partial acquisitions. We propose an empirical structural methodology to examine quantitatively the unilateral impact of partial acquisitions involving pure financial interests and/or effective corporate control on prices, market shares,firm profits and consumer welfare. The proposed methodology can deal with differentiated products industries, with both direct and indirect partial ownership interests and nests full mergers (100% financial and control acquisitions) as a special case. We provide an empirical application to several acquisitions in the wet shaving industry.

JEL Classification: C54, D12, L13, L41 and L66
Keywords: antitrust, demand estimation, differentiated products, oligopoly, partial acquisitions and unilateral effects

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1 Introduction

Recent years have witnessed a phenomenal growth of private-equity investment that formed a perfect storm in which firms often hold partial ownership interests in competing firms (Wilkinson and White, 2007). This led competition agencies to take an increased interest in assessing the competitive effects of partial acquisitions. For example, in 2007, the European Commission assessed and rejected a request by Aer Lingus to order Ryanair to divest its 29.4% shareholding in the Irish flag carrier. Also in 2007, the UK Competition Commission assessed the BskyB's acquisition of a 17.9% shareholding in ITV (with no board representation) and found that would substantially lessen competition in the UK TV market. More recently, in 2008, the European Commission assessed and approved subject to conditions, the acquisition by News Corporation of an approximately 25% shareholding in Premiere.

To what extent does partial ownership unilaterally lessen competition and decrease consumer welfare? This paper proposes an empirical structural methodology to quantitatively answer this question by evaluating partial acquisitions in a differentiated products setting. This question is economically relevant for competition policy issues and has not been, to our knowledge, examined in any other academic study.

In analyzing the competitive effects of partial ownership arrangements, we need to identify and distinguish two distinct rights: financial interest and corporate control. *Financial interest* refers to the right to receive the stream of profits generated by the firm from its operations and investments, while *corporate control* refers to the right to make the decisions that affect the firm. Firms sometimes have quite complex corporate financial and governance structures that distinguishes the two rights in voting and non-voting (preferred) stock, with the latter giving the holder financial interest with no corporate control.

Partial horizontal acquisitions that do not result in effective control present competitive concerns distinct from partial acquisitions involving effective control. When a firm acquires a partial financial interest in a rival, it acquires a share of its profits. Such acquisition can lessen competition by reducing the incentive of the *acquiring firm* to compete aggressively because it shares in the losses thereby inflicted on that rival. On the other hand, when a firm acquires corporate control in a rival, it acquires the ability to influence the competitive conduct of the target firm. Such influence can lessen competition because it may be used to induce the *rival* to compete less aggressively against the acquiring firm.

This paper considers an empirical structural methodology to evaluate (quantitatively) the unilateral effects of *actual* and *hypothetical* partial acquisitions in a differentiated products

setting, which can prove a key advantage in competition policy issues. The methodology can be used to examine the unilateral impact on prices, market shares, firm profits and consumer welfare of partial acquisitions involving only financial interests, corporate control or both. Furthermore, it can deal with direct and indirect partial ownership interests and nests full mergers (100% financial and control acquisitions) as a special case.

The proposed methodology relates to two strands of the literature. The first strand of literature examines the unilateral impact of partial competitor ownership on competition. In one of the earliest contributions, Reynolds and Snapp (1986) analyze the unilateral competitive effects of partial financial interests and small joint ventures in the context of a Cournot homogeneous-product model. They show that, in markets where entry is difficult, partial financial interests (even if relatively small) could result in lower equilibrium market output and higher equilibrium market prices. They quantify such effects using a summary measure of the state of competition: an adjusted Herfindahl–Hirschman index (HHI). Bresnahan and Salop (1986) build on Reynolds and Snapp (1986) by introducing the distinction between financial interest and corporate control. They evaluate the unilateral competitive effects of a joint venture among competitors, considering different financial interest and control arrangements. They propose a set of modified HHIs to quantify the effects of each alternative arrangement.

O'Brien and Salop (2000) extend Bresnahan and Salop (1986)'s modified HHI to a richer set of corporate control scenarios and multiple, overlapping joint ventures. Furthermore, they propose an extension of the analysis to the context of a Bertrand oligopoly model with differentiated products, building on Shapiro (1996)'s diversion ratio approach. They quantify the effects of partial ownership interests on competitive incentives in this context using a summary measure of the economic pressure to change prices in response to a change in the corporate control scenario or joint venture. They refer to this measure as a Price Pressure Index (PPI). Brito *et al.* (2013, hereafter BCV) investigate what is the best way to implement a divestiture of control rights in a context where firms compete in prices and prices are strategic complements, which encompasses the case of a Bertrand oligopoly model with differentiated products. They contribute to this literature by proposing sufficient statistics for the effects of partial ownership (and divestiture of partial ownership) within a duopoly on consumer welfare.

Reynolds and Snapp (1986), Bresnahan and Salop (1986), O'Brien and Salop (2000), and BCV confine their analysis to *direct* partial ownership interests. Flath (1992) builds on Bresnahan and Salop (1986) and extends the literature by treating the more general case in which *indirect* partial ownership interests are also present. Firm A has an indirect partial

ownership interest in firm C if it holds a partial ownership interest in firm B and, in turn, firm B holds a partial ownership interests in firm C. This issue is particularly important for antitrust purposes because indirect partial ownership interests may constitute a way of evading antitrust rules that limit direct ownership in rivals. Dietzenbacher, Smid and Volkerink (2000) extends this analysis to the context of a Bertrand oligopoly model with differentiated products.

The second strand of literature relates to merger simulation. The models within this second strand of the literature simulate the unilateral price effects of mergers in differentiated product markets. These unilateral effects flow from the incentive to increase prices after a merger, an incentive that results from the internalization of consumer substitution among the products of the merging firms. The procedure typically involves the identification of the patterns of consumer substitution, which are then used with a Nash-Bertrand equilibrium assumption to simulate (either explicit or implicitly recovering unobserved marginal costs) the unilateral price effects of mergers.

The identification of the patterns of consumer substitution is key and creates a dimensionality problem. In an industry with J differentiated products, this requires the estimation of at least J^2 demand price elasticities, a formidable task. In one of the earliest contributions, Baker and Bresnahan (1985) propose an econometric procedure to analyze the unilateral price effects of a merger by considering that the effects of all non-merging firms in the industry can be summed together. The proposed procedure reduces the dimensionality of the problem since it involves the estimation of a *partial residual* demand system consisting only of the products of the merging firms, rather than the J products in the industry. However, the reduction of the dimensionality is only apparent since each partial residual estimating equation must still include all cost and demand shift control variables for all non-merging products (for which no demand equation is estimated).

Hausman *et al.* (1994, hereafter HLZ) propose to analyze the unilateral price effects of a merger by using Gorman (1995)'s approach to multi-level demand. This approach reduces the dimensionality of the consumer's utility maximization problem (that involves J different products) by modelling it as a sequence of separate, but related decision problems. At the top level, the consumer decides the overall category demand. At a middle level, the consumer decides the demand for specific sub-groups (segments) of products. And finally, at a bottom level, the consumer decides the demand for particular products within each sub-group (or segment). This solves the dimensionality problem because, at each level, the decision involves only a reduced number of options (products or sub-groups). Furthermore, this multi-level procedure is rich enough in parameters to allow flexible substitution patterns and it can be

shown to be equivalent to solving a single one-level consumer's utility maximization problem. As a consequence of the latter, it constitutes a structural procedure in the sense it can be empirically estimated and used not just to simulate the unilateral price effects of mergers, but also to analyze the corresponding change in consumer welfare. However, the procedure can not be used to identify the patterns of consumer substitution from markets with significant entry and exit of products, which substantively limits its empirical applications.

Werden and Froeb (1994) address the limitation of HLZ by analyzing the unilateral price effects of a merger in the context of a random utility model: McFadden (1974)'s standard multinomial Logit model. The procedure is also fully structural and can be used also to analyze the corresponding change in consumer welfare. Consumers are assumed to make a discrete choice among the set of J product alternatives (plus an additional outside option), selecting *the* alternative yielding the greatest utility. The framework builds on Lancaster (1966) and postulates that consumers derive utility from the properties or characteristics of the products, rather than directly from the products themselves. This setting can deal with markets with significant entry and exit of products, and solves the dimensionality problem by reducing the relevant size from J^2 to the (typically smaller) dimension of the space of characteristics. However, the substitution patterns of consumers implied by this standard model tend to be model- instead of data-driven. Nevo (2000) overcomes this drawback by considering a random-coefficients multinomial Logit model in the lines of McFadden and Train (2000) that introduces unobserved consumer heterogeneity in order to allow flexible substitution patterns.

We specify a methodology that attempts to link these two strands of the literature. The general strategy models supply competition in a setting similar to O'Brien and Salop (2000) and BCV, where partial ownership may or may not correspond to control and uses a procedure similar to Nevo (2000) to simulate the unilateral effects of actual and hypothetical partial acquisitions: demand side estimates are used jointly with a Nash-Bertrand equilibrium assumption to recover (unobserved) marginal costs, which are then used to simulate the unilateral impact of partial acquisitions on prices, market shares, firm profits and consumer welfare. This structural approach to partial acquisitions may be a preferable method for competition policy issues to the current indirect methods in the literature of using summary measures like modified HHIs or PPIs suitable or relevant only in certain particular economic conditions. Extensions of this methodology to measure (i) the coordinated effects of partial acquisitions, and (ii) the unilateral and coordinated effects of partial acquisitions that involve firms in the vertical chain are provided in two companion papers (Brito *et al.*, 2013a,b).

We provide an empirical application of the methodology to several acquisitions in the wet shaving industry. On December 20, 1989, the Gillette Company, which had been the market leader for years and accounted for 50% of all razor blade units sales, contracted to acquire the wet shaving businesses of Wilkinson Sword in the United States (among other operations) to Eemland Management Services BV (Wilkinson Sword's parent company) for $72 million. It also acquired a 22.9 percent of the nonvoting equity shares of Eemland for about $14 million. On January 10, 1990, the Department of Justice instituted a civil proceeding against Gillette. The complaint alleged that the effect of the acquisition by Gillette may have been substantially to lessen competition in the sale of wet shaving razor blades in the United States. Shortly after the case was filed, Gillette voluntarily rescinded the acquisition of Eemland's wet shaving razor blade business in the United States, but went through with the acquisition of 22.9% nonvoting equity interest in Eemland. The Department of Justice approved the acquisition after being assured that this stake would be passive. On March, 22, 1993, the Warner-Lambert Company acquired Wilkinson Sword (full merger) for $142 million to Eemland, that had put the razor blade company up for sale the year before. The sale was prompted after the European Commission, in November, ordered the Gillette Company to sell its stake in Eemland because of antitrust concerns. These two acquisitions (one involving a partial interest and another a full merger), and two additional hypothetical ones, are evaluated below.

This paper is organized as follows: Section 2 presents the empirical structural methodology used to evaluate the unilateral effects of partial acquisitions, Section 3 provides the above mentioned empirical application and Section 4 concludes.

2 Empirical Structural Methodology

This section introduces the empirical structural methodology. We study the implications of partial acquisitions on competition in a setting similar to O'Brien and Salop (2000) and BCV where partial ownership may or may not correspond to control. Unlike O'Brien and Salop (2000), we provide a structural model that can be empirically estimated and used not just to simulate the equilibrium that would result from several partial acquisition counterfactuals, but also to analyze the corresponding change in consumer welfare, generalizing the dupololy sufficient statistic of BCV.

The methodology involves four steps similar to Nevo (2000). Step 0 consists of estimating consumer demand and assess the degree of substitutability between the competing products.

Step 1 models supply competition in a setting similar to O'Brien and Salop (2000) and BCV, where two distinct partial ownership rights are identified: financial interest and corporate control. Step 2 uses a Nash-Bertrand equilibrium assumption jointly with demand side estimates to recover (unobserved) marginal costs, and finally step 3 uses that information to simulate the unilateral effects of actual and hypothetical partial acquisitions. A structural methodology to evaluate direct and indirect partial acquisitions in a differentiated products setting can prove a key advantage in competition policy issues and has not been, to our knowledge, examined in any academic study.

We now move on to describe steps 1-3 in more detail. We defer the description of step 0 to the next section when we introduce the consumer demand model in the context of our empirical application.

Step 1: Model Supply Competition

We introduce here the firm's objective function and the assumptions of the supply side of the model in a setting similar to O'Brien and Salop (2000) and BCV.

The Setup

There are F firms, indexed by f, each of which produces some subset, Γ_f, of the J alternative products available in the market. There are also K shareholders, indexed by k, who can own shares in more than one firm. Let $\Theta \equiv \{1, \ldots, K\}$ denote the set of shareholders, which can include not just owners that are external to the industry, but also owners from the subset $\Im \equiv \{1, \ldots, F\}$ of firms within the industry that can engage in rival *cross-shareholding*.

The implications of partial acquisitions on competition depends critically on two separate and distinct elements: financial interest and corporate control. Financial interest refers to the right of the (partial) owner to receive the stream of profits generated by the firm from its operations and investments, while corporate control refers to the right of the (partial) owner to make the decisions that affect the firm.

In order to capture the distinction between financial interest and corporate control, we consider firm f's total stock is composed of voting stock and non-voting (preferred) stock, with the latter giving the holder a share of the profits but no right to vote for the Board or participate in other decisions. The financial interest of shareholder k in firm f is represented by $t_{kf} \geq 0$ which denotes the shareholder's holdings of total stock in the firm, regardless of

whether it be voting or non-voting stock. The degree of corporate control of shareholder k over the decision making of firm f is a function of $v_{kf} \geq 0$ which denotes the shareholder's holdings of voting stock in firm f. The larger the holdings of voting stock in a firm, the greater the degree of control over the decision making will typically be. However the relationship may not necessarily be linear. For example, a shareholder holding 49 percent of voting stock in a firm may have no control over the decision making of the firm if one other shareholder has 51 percent. In contrast, a shareholder holding 10 percent of voting stock in a firm may have effective control over the decision making of the firm if each of the remaining shareholders holds a very small amount of voting stock. As a consequence, we denote the degree of corporate control of shareholder k in firm f by $\gamma_{kf} \geq 0$, a measure of shareholder k's degree of control over the decision making of firm f that does not necessarily correspond to v_{kf}.

Firm's Operating Profit

The profits generated by a multi-product firm f from its operations are defined over the subset Γ_f of products produced by the firm:

$$\pi_f = \sum_{j \in \Gamma_f} (p_j - mc_j) \, M s_j (\mathbf{p}) - C_f, \tag{1}$$

where $s_j(\mathbf{p})$ is the market share of product j, which is a function of the $J \times 1$ vector $\mathbf{p}$ of prices for all products available in the market, M is the size of the market, mc_j is the marginal cost of product j assumed to be constant, and C_f is the fixed cost of production of firm f.

Firm's Aggregate Profit

In an industry characterized by rival cross-shareholding, the aggregate profits of firm f include not just the stream of profits generated by the firm from its operations, but also a share in its rivals' aggregate profits due to its ownership stake in these firms. We make the following assumption regarding the distribution of those profits among shareholders:

Assumption 1 *Each firm's aggregate profit is distributed among shareholders proportionally to the total stock owned, regardless of whether it be voting stock or preferred stock.*

Under Assumption 1, firm f receives a profit stream from its ownership stake in firm g

that corresponds to the percentage t_{fg} of firm g's total stock owned. The aggregate profit of firm f can, therefore, be written as:

$$\Pi_f = \pi_f(\mathbf{p}) + \sum_{g \in \Im/f} t_{fg}\Pi_g, \tag{2}$$

where the first term denotes the operating profit and the second term denotes the returns of equity holding by firm f in any of the other firms (the set $\Im/f$ denotes the set $\Im$ not including firm f). This set of F equations implicitly defines the aggregate profit for each firm.

Let $\mathbf{D}^*$ denote the $F \times F$ cross-shareholding matrix with zero diagonal elements, $t_{ff} = 0$, and off diagonal elements $t_{fg} \geq 0$ (if $f \neq g$) representing the percentage held by firm f on firm g's total stock. In vector notation, the aggregate profit equation becomes:

$$\mathbf{\Pi} = \boldsymbol{\pi}(\mathbf{p}) + \mathbf{D}^*\mathbf{\Pi}, \tag{3}$$

where $\mathbf{\Pi}$ and $\boldsymbol{\pi}(\mathbf{p})$ are $F \times 1$ vectors of aggregate and operating profits, respectively. In order to solve for those profits explicitly, we make the following assumption regarding the shareholder structure of the firms in the market:

Assumption 2 *The rank of* $(\mathbf{I} - \mathbf{D}^*)$ *equals the number of firms in the market.*

Under Assumption 2, matrix $(\mathbf{I} - \mathbf{D}^*)$ is invertible, which implies it is possible to solve for the aggregate profit equation:

$$\mathbf{\Pi} = (\mathbf{I} - \mathbf{D}^*)^{-\mathbf{1}} \boldsymbol{\pi}(\mathbf{p}), \tag{4}$$

where $\mathbf{I}$ denotes the identity matrix.

Manager's Objective Function

In a standard oligopoly model with no partial ownership interests, barring any market imperfections that preclude efficient contracting between the shareholders and the manager, the former will typically agree, and give the appropriate incentives, that the manager should maximize profits. However, as O'Brien and Salop (2000) argue:

> When multiple owners have partial ownership interests, (...) they may not agree on the best course of action for the firm. For example, an owner of firm f

who also has a large financial interest in rival firm g typically wants firm f to pursue a less aggressive strategy than the strategy desired by an owner with no financial interest in firm g. In this situation, where the owners have conflicting views on the best strategy to pursue, the question arises as to how the objective of the manager is determined. Ultimately, the answer turns on the corporate-control structure of the firm, which determines each shareholder's influence over decision-making within the firm. (page 609)

We make the following assumption regarding the objective of the manager of the firm:

Assumption 3 *The manager of the firm maximizes a weighted sum of the shareholder's returns.*

The formulation implied by Assumption 3 constitutes a parsimonious way to model shareholder influence since it includes a wide variety of plausible assumptions about the amount of influence each owner has over the manager of the firm. Under this formulation, a higher weight on the return of a particular owner is associated with a greater degree of influence by that owner over the manager. Different control scenarios then correspond to different sets of control weights for the different owners. Under Assumption 3, the objective function of the manager of firm f can therefore be written as follows:

$$\varpi_f = \sum_{k \in \Theta} \gamma_{kf} R_k, \tag{5}$$

where γ_{kf} measures (as described above) the degree of control of shareholder k over the manager of firm f, and R_k is the return of shareholder k.

In a setting where each firm's aggregate profit is, under Assumption 1, distributed among shareholders proportionally to the total stock owned (regardless of whether it be voting stock or preferred stock) and each shareholder can have ownership stakes in more then one firm, the return of shareholder k can be written as:

$$R_k = \begin{cases} \sum_{g \in \Im} t_{kg} \Pi_g & \text{if } k \in \Theta, k \notin \Im \\ \varpi_k & \text{if } k \in \Im \end{cases}. \tag{6}$$

Combining equations (5) and (6), the objective function of the manager of firm f becomes:

$$\varpi_f = \sum_{k \in \Im / f} \gamma_{kf} \varpi_k + \sum_{\substack{k \in \Theta \\ k \notin \Im}} \gamma_{kf} \sum_{g \in \Im} t_{kg} \Pi_g, \tag{7}$$

where the first term involves the return of rival firms within the industry that engage in cross-shareholding (as above, the set $\Im/f$ denotes the set $\Im$ not including firm f) and the second term involves shareholders that are external to the industry ($k \notin \Im$). This set of F equations implicitly defines the objective function for each firm.

Let $\mathbf{C}^*$ denote the $F \times F$ cross-shareholding matrix with zero diagonal elements, $\gamma_{ff} = 0$, and off diagonal elements $\gamma_{fg} \geq 0$ (if $f \neq g$) representing the measure of firm f's degree of control over the manager of firm g. Let also $\mathbf{C}$ and $\mathbf{D}$ denote the $(K - F) \times F$ control interest and finance interest shareholding matrices with typical element γ_{kf} and t_{kf}, respectively.[5] In vector notation, the objective function equation becomes:

$$\boldsymbol{\varpi} = \mathbf{C}^{*\prime}\boldsymbol{\varpi} + \mathbf{C}'\mathbf{D}\boldsymbol{\Pi}, \tag{8}$$

where $\boldsymbol{\varpi}$ denotes the $F \times 1$ vector of objective functions. In order to solve for those functions explicitly, we make the following assumption regarding the shareholder control structure of the firms in the market:

Assumption 4 *The rank of* $(\mathbf{I} - \mathbf{C}^{*\prime})$ *equals the number of firms in the market.*

Under Assumption 4, matrix $(\mathbf{I} - \mathbf{C}^{*\prime})$ is invertible, which implies it is possible to solve for the objective function equation:

$$\boldsymbol{\varpi} = (\mathbf{I} - \mathbf{C}^{*\prime})^{-\mathbf{1}} \mathbf{C}'\mathbf{D}\boldsymbol{\Pi} = (\mathbf{I} - \mathbf{C}^{*\prime})^{-\mathbf{1}} \mathbf{C}^{'}\mathbf{D} (\mathbf{I} - \mathbf{D}^{*})^{-1} \boldsymbol{\pi}(\mathbf{p}) = \mathbf{L}\boldsymbol{\pi}(\mathbf{p}), \tag{9}$$

where $\mathbf{I}$ denotes the identity matrix and the second equality is obtained by simple substitution of the aggregate profit equation (4). The last equality rewrites the objective function vector in terms of the $F \times F$ matrix $\mathbf{L} = (\mathbf{I} - \mathbf{C}^{*\prime})^{-\mathbf{1}} \mathbf{C}'\mathbf{D} (\mathbf{I} - \mathbf{D}^{*})^{-\mathbf{1}}$ with typical element l_{fg}.

Competitive Setting and Equilibrium Prices

Having described the objective function of the manager of the firm, we now address the competitive setting:

Assumption 5 *Firms compete in prices. Furthermore, a pure-strategy Bertrand-Nash equilibrium exists, and the prices that support it are strictly positive.*

[5] Note that both $\mathbf{C}$ and $\mathbf{D}$ matrices are defined only in terms of the set of shareholders external to the industry, since the interests of the set of shareholders $\Im$ of firms within the industry that can engage in rival cross-shareholding are taken into account in matrices $\mathbf{C}^*$ and $\mathbf{D}^*$.

Let $\mathbf{p}_f$ denote the set of prices controlled by firm f, i.e., the prices of the subset Γ_f of products produced by the firm. Following the objective function equation (9) and under Assumption 5, the manager of firm f solves:

$$\max_{\mathbf{p}_f} \varpi_f = \sum_{g \in \Im} l_{fg} \pi_g = \sum_{g \in \Im} l_{fg} \left\{ \sum_{j \in \Gamma_g} (p_j - mc_j) \, Ms_j(\mathbf{p}) - C_g \right\}. \tag{10}$$

The first-order conditions yield that the price p_j of any product $j \in \Gamma_f$ must satisfy the following:[6]

$$l_{ff} s_j(\mathbf{p}) + \sum_{g \in \Im} l_{fg} \sum_{r \in \Gamma_g} (p_r - mc_r) \frac{\partial s_r(\mathbf{p})}{\partial p_j} = 0. \tag{11}$$

This set of J equations implies price-cost margins for each product. The markups can be solved for explicitly by defining a $J \times J$ matrix $\mathbf{\Omega}$ with the jr element given by $\Omega_{rj} = -l_{fg} \partial s_r(\mathbf{p}) / \partial p_j$ for $r \in \Gamma_g$ and $j \in \Gamma_f$. In vector notation, the first-order conditions become:

$$\mathbf{G}\mathbf{s}(\mathbf{p}) - \mathbf{\Omega}(\mathbf{p})(\mathbf{p} - \mathbf{mc}) = 0, \tag{12}$$

where $\mathbf{s}(\mathbf{p})$ and $\mathbf{mc}$ are $J \times 1$ vectors of shares and marginal cost, respectively, and $\mathbf{G}$ denotes a $J \times J$ diagonal matrix with diagonal elements $g_{jj} = l_{ff}$ for $j \in \Gamma_f$.

Step 2: Recovering (Unobserved) Marginal Costs

The set of J first-order conditions described imply the following markup equation, from which the corresponding marginal costs can be derived:

$$(\mathbf{p} - \mathbf{mc}) = \mathbf{\Omega}(\mathbf{p})^{-1} \mathbf{G}\mathbf{s}(\mathbf{p}) \Leftrightarrow \mathbf{mc} = \mathbf{p} - \mathbf{\Omega}(\mathbf{p})^{-1} \mathbf{G}\mathbf{s}(\mathbf{p}). \tag{13}$$

We have been assuming constant marginal costs. However, the methodology can easily be extended to deal with non-constant marginal costs. In this case, the set of J first-order conditions differ slightly from the above and the marginal costs can be recovered by estimating a marginal cost function using, for example, a method of moments approach. Furthermore, note also that although we derived the set of first-order conditions under Assumption 5 of Nash-Bertrand behaviour, in principle, the methodology idea is not constrained to that assumption.

[6] Under Assumption 5, a Nash equilibrium exists. Allon *et al.* (2010) established the conditions under which a Nash equilibrium, in fact a unique equilibrium, exists for the general multi-product price competition model with random coefficients multinomial logit demand functions, see Theorem 6.1 therein.

Let $\mathbf{\Omega}^{pre}$ denote the matrix with the jr element given by $\Omega_{rj}^{pre} = -l_{fg}^{pre}\partial s_r\left(\mathbf{p}^{pre}\right)/\partial p_j^{pre}$ for $r \in \Gamma_g$ and $j \in \Gamma_f$, and $\mathbf{G}^{pre}$ denote the matrix with diagonal elements $g_{jj} = l_{ff}^{pre}$ for $j \in \Gamma_f$, where l_{fg}^{pre} represents the typical element of matrix $\mathbf{L}^{pre} = \left(\mathbf{I} - \mathbf{C}^{*pre\prime}\right)^{-1}\mathbf{C}^{pre\prime}\mathbf{D}^{pre}\left(\mathbf{I} - \mathbf{D}^{*pre}\right)^{-1}$ computed under the pre-partial acquisition (corporate control and financial interest) shareholder's weights. Using demand estimates to evaluate $\partial s_r\left(\mathbf{p}^{pre}\right)/\partial p_j^{pre}$, the marginal costs implied by the current ownership structure, $\widehat{\mathbf{mc}}$, are given by:

$$\widehat{\mathbf{mc}} = \mathbf{p}^{pre} - \mathbf{\Omega}^{pre}\left(\mathbf{p}^{pre}\right)^{-1}\mathbf{G}^{pre}\mathbf{s}\left(\mathbf{p}^{pre}\right), \tag{14}$$

where $\mathbf{p}^{pre}$ denote the actual observed price vector pre-partial acquisition.

The empirical structural methodology just described to recover the (unobserved) marginal costs (and we will see below to simulate counterfactuals) relies on the ability to consistently estimate the own- and cross-price elasticities required for every jr element of matrix Ω: $\Omega_{rj} = -l_{fg}\partial s_r\left(\mathbf{p}\right)/\partial p_j$ in step 0. We defer an analysis of this aspect of the procedure to the next section when we introduce the consumer demand model in the context of our empirical application.

Step 3: Counterfactual Equilibrium

Assuming the partial-acquisition does not alter the competitive setting among firms, we can make use of the set of first-order conditions to solve for the predicted (counterfactual) post-partial acquisition equilibrium price vector, $\mathbf{p}^{post}$. The procedure uses demand estimates to evaluate $\partial s_r\left(\mathbf{p}^{post}\right)/\partial p_j^{post}$, the marginal costs computed from equation (14) and the new post-partial acquisition structure as follows:[7]

$$\mathbf{p}^{post} = \widehat{\mathbf{mc}} + \mathbf{\Omega}^{post}\left(\mathbf{p}^{post}\right)^{-1}\mathbf{G}^{post}\mathbf{s}\left(\mathbf{p}^{post}\right), \tag{15}$$

where l_{fg}^{post} denotes the typical element of matrix $\mathbf{L}^{post} = \left(\mathbf{I} - \mathbf{C}^{*post\prime}\right)^{-1}\mathbf{C}^{post\prime}\mathbf{D}^{post}\left(\mathbf{I} - \mathbf{D}^{*post}\right)^{-1}$ computed under the post-partial acquisition (corporate control and financial interest) shareholder's weights (actual or hypothetical), $\mathbf{\Omega}^{post}$ denotes a matrix with jr element given by $\Omega_{rj}^{post} = -l_{fg}^{post}\partial s_r\left(\mathbf{p}^{post}\right)/\partial p_j^{post}$ for $r \in \Gamma_g$ and $j \in \Gamma_f$, and finally $\mathbf{G}^{post}$ denotes a diagonal matrix with diagonal elements $g_{jj} = l_{ff}^{post}$ for $j \in \Gamma_f$. Note that the marginal costs used to solve the new equilibrium price vector can also incorporate eventual cost efficiencies emerging

[7] Note that Ω^{post} does not necessarily imply that price elasticities are invariant to the ownership structure in the industry, since elasticities may vary with price. In equilibrium, the jr element of Ω^{post} is given by $\Omega_{rj}^{post} = -l_{fg}^{post}\partial s_r\left(\mathbf{p}^{post}\right)/\partial p_j^{post}$.

from the post-partial acquisition.

The proposed methodology is not constrained to having the same assumption of firm behaviour before and after the partial acquisition. If the partial-acquisition does alter the competitive setting among firms, the methodology idea remains valid, the only difference being that the post-partial acquisition equilibrium price vector must solve the corresponding (new) set of first-order conditions.

After solving for $\mathbf{p}^{post}$, we can then use it as input, given that the model is structural, to examine the (unilateral) impact of partial acquisitions on market shares, firm profits and consumer welfare. We defer the description of a measure of change in consumer welfare to the next section when we introduce the consumer demand model in the context of our empirical application. Having described the supply side of the model and the empirical structural methodology that can be used to simulate the equilibrium that would result from several partial acquisition counterfactuals, we move on to address the empirical illustration.

3 Empirical Application

In this section, we present an illustration of the structural methodology used to evaluate the unilateral effects of partial acquisitions. We apply our framework to several acquisitions in the wet shaving industry. On December 20, 1989, the Gillette Company, contracted to acquire the wet shaving businesses of Wilkinson Sword trademark outside of the 12-nation European Community (which included the United States operations) to Eemland Management Services BV (Wilkinson Sword's parent company) for $72 million. It also acquired a 22.9 percent of the nonvoting equity shares of Eemland for about $14 million. Gillette said that its reason for participating in Eemland was solely its wish to acquire various Wilkinson Sword trade marks and wet-shaving activities in certain countries outside the 12-nation European Community.

At the time, consumers in the United States annually purchased over $700 million of wet shaving razor blades at the retail level. Five firms supplied all but a nominal amount of these blades. The Gillette Company, which had been the market leader for years, accounted for 50% of all razor blade units sales. The next closest competitor was BIC Corporation (BIC brand) with 20%, followed by Warner-Lambert Company (Shick brand) with 14%, Wilkinson Sword Inc. with 3%, and American Safety Razor Company (Personna brand) with less than 1% of unit sales (Department of Justice, 1990).

On January 10, 1990, the Department of Justice instituted a civil proceeding against

Gillette. The complaint alleged that the effect of the acquisition by Gillette may have been substantially to lessen competition in the sale of wet shaving razor blades in the United States. Shortly after the case was filed, Gillette voluntarily rescinded the acquisition of Eemland's wet shaving razor blade business in the United States. Gillette said it decided to settle the case to avoid the time and expense of a lengthy trial. However, Gillette still went through with the acquisition of 22.9% nonvoting equity interest in Eemland and of all worldwide assets and businesses of Wilkinson Sword trademark from Eemland, apart from the United States and the European Community. Because Eemland kept the Wilkinson Sword's United States wet shaving razor blades business, Gillette had became one of the largest, if not the largest, shareholder in a competitor. The Department of Justice (1990) allowed the acquisition provided that:

> Gillette and Eemland shall not agree or communicate an effort to persuade the other to agree, directly or indirectly, regarding present or future prices or other terms or conditions of sale, volume of shipments, future production schedules, marketing plans, sales forecasts, or sales or proposed sales to specific customers ... (page 7)

In other words, the Department of Justice approved Gillette's 22.9% stake in Wilkinson Sword after being assured that this stake would be passive. However, even when the acquiring firm cannot influence the conduct of the target firm, the partial acquisition may still reduce the incentive of the acquiring firm to compete aggressively because it shares in the losses thereby inflicted on that rival. We examine this question by quantifying the unilateral impact of partial acquisitions on prices, market shares, firm profits and consumer welfare of such acquisition.

On March, 22, 1993, the Warner-Lambert Company acquired Wilkinson Sword for $142 million to Eemland, that had put the razor blade company up for sale the year before. The sale was prompted after the European Commission, the executive arm of the European Community, in November ordered the Gillette Company to sell its stake in Eemland because of antitrust concerns. A full merger constitutes the extreme case of a partial acquisition, which is nested in our empirical structural methodology. As an illustration we also examine this question and quantify the corresponding unilateral effects.

These two acquisitions, and two additional hypothetical ones, are evaluated below. In this analysis, we make the following assumption regarding the measure of shareholder k's degree of control over the manager of the firm:

Assumption 6 *The control weight each owner has over the manager of the firm equals the corresponding voting shares, i.e.,* $\gamma_{kf} = v_{kf}$.

The paper proceeds by describing the data and performing some preliminary analysis. We then move on to describe the demand model, the estimation procedure and discuss the identifying assumptions. Finally, we present the demand estimation results that we use to compute the implied marginal costs and then simulate the unilateral effects of different acquisitions.

Data Description and Preliminary Analysis

We use scanner data collected from July 1994 to June 1996 from the Dominick's Finer Foods (DFF) chain in the Chicago metropolitan area. The dataset covers 29 different product categories at the store level. It includes weekly sales, prices and retail profit margins for each universal product code (UPC) and store of the chain. We supplemented the data with ZIP code (*i*) demographic information obtained from the Decennial Census 2000, and (*ii*) industry structure obtained from the Business Patterns 1998 databases.

In order to investigate the implications of Gillette 22.9% nonvoting equity interest acquisition in Eemland and Warner-Lambert merger with Wilkinson Sword, we focus on the grooming category. In particular, we focus on disposable razor products to avoid the complications that the tied-goods nature of demand poses for modeling in other razor products.

The sample covers 6 brands in 81 stores (across 7 counties in the Chicago metropolitan area) for 104 weeks. Gillette is the dominant brand with an average share of 59.5% of the total number of razors sold in each market, which we define as a store-week combination. DFF private label is the second biggest-selling brand with an average share of 20.6%, followed by Shick (14.0%) and BIC (5.6%). Personna and Wilkinson Sword have very residual average market shares.

We define a product on the basis of two attributes: gender segment (men or women) and brand so that, for example, Schick Slim Twin and Schick Slim Twin Women are classified as distinct products. Women products account for an average share of 17.3% of the total number of razors sold in every market. The choice set available to consumers is relatively limited. Although the sample covers 30 products, DFF stores carry only an average of 13.2 different products in each market. In contrast with the substantial brand concentration, at the product level there is slightly more fragmentation. Gillette Good News is the market leader with an average share of 14.2% of the total number of razors sold in each market.

TABLE 1
*Volume Market Shares (%)**

	Mean	Median	Std	Min	Max
Panel A: Brand Level					
1. G Gillette	59.538	61.538	14.737	0.000	95.037
2. PL Private Label	20.562	18.634	10.837	0.000	100.000
3. WL Schick	14.043	12.753	8.832	0.000	66.154
4. B BIC	5.551	0.000	14.392	0.000	93.776
5. ASR Personna	0.275	0.000	0.770	0.000	11.990
6. WS Wilkinson Sword	0.032	0.000	0.314	0.000	9.284
Panel B: Product Level					
1. G Good News	14.210	12.975	8.387	0.000	74.850
2. G Good News Plus	11.173	10.504	6.535	0.000	52.941
3. G Daisy Plus	9.553	8.467	6.767	0.000	45.455
4. WL Schick Slim Twin	8.832	7.634	6.988	0.000	56.893
5. G Good News Pivot Plus	6.959	6.094	5.313	0.000	48.980
6. G Good News Microtrac	6.891	6.061	5.552	0.000	54.545
Panel C: Package Size Level					
1. 10 Razors	41.482	41.667	13.978	0.000	97.162
2. 5 Razors	41.438	40.650	13.348	2.080	100.000
3. 12 Razors	11.328	10.480	7.384	0.000	56.376
4. 15 Razors	5.247	0.000	10.677	0.000	71.942
5. 3 Razors	0.378	0.000	0.886	0.000	12.060
6. 2 Razors	0.121	0.000	0.556	0.000	11.538

* The statistics presented are computed across the 8,346 (store-week) markets. Volume market share denotes the percentage of the number of razors sold by brand, product and package size in the total number of razors sold in each market. B: BIC, G: Gillette, ASR: American Safety Razor, PL: Private Label, WL: Warner-Lambert, WS: Wilkinson Sword.

Each product is typically offered in several package sizes, with the top four sizes accounting for an average share of more than 99% of the total number of razors sold in each market: 10 razors packages (41.5%), 5 razors packages (41.4%), 12 razors packages (11.3%) and 15 razors packages (5.2%). A product-package size combination defines an UPC. The sample covers 56 UPCs and DFF stores carry an average of 17.3 different UPCs in each market. Table 1 details the volume market shares for the top-6 brands, products and package sizes.

An important question is obviously whether the dataset is representative of the whole population buying disposable razor products. For purposes of Gillette 22.9% nonvoting equity interest acquisition in Eemland, the Department of Justice (1990) characterized the industry as follows:

> Gillette accounts for 50% of all razor blade units (...). The next closest competitor is BIC with 20%, followed by Warner-Lambert with 14%, Wilkinson with 3%, and American Safety Razor with less than 1% of unit sales. (page 9)

Because this industry characterization does not account for private labels, we must be cautious in a straithforward comparison with our dataset. However, it does suggest that our data is reasonably representative, although slightly overrepresenting Gillette and underrepresenting BIC and Wilkinson Sword.

We now move on to describe the dataset in more detail. Table 2, Panel A presents summary purchase statistics at the UPC level. Although there is evidence of substantial heterogeneity across markets, the median store in the sample sells 2 packages of 5 men razors per week at a price of \$3.10 per package, generating 38.9% gross retail margin. This margin is computed with reference to the average acquisition cost of the items in inventory, an issue we will address in more detail below.

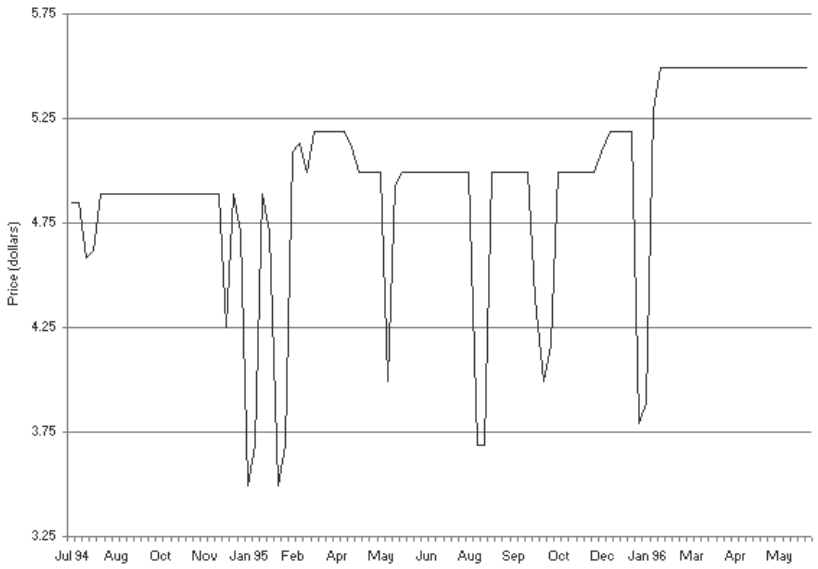
Table 2, Panel B presents summary statistics at the store level. 17,539 households visit and purchase something in the median store per week. The potential market size is defined in terms of the number of purchases of razor packages and assumed to be proportional to the weekly number of household visits of each store. The proportionality factor is assumed to be the percentage of households buying razor products times the probability of a purchase in any given visit. According to IRI Builders Suite (Bronnenberg *et al.*, 2008), 28.5% of US households purchase razor blades products every 106 days. Furthermore, according to Food & Beverage Marketing (Degeratu *et al.*, 2000), US households visit regular grocery stores about 7.9 times per month on the average. This translates into a median potential market of 181.7 package purchases per store and week, a potential market that a median of 7 grocery

TABLE 2
*Summary Statistics**

	Mean	Median	Std	Min	Max
Panel A: UPC Level					
Quantity (number of packages)	3.297	2.000	3.951	1.000	308.000
Price ($)	3.272	3.090	1.393	0.460	6.390
Gross Retail Margin (%)	41.108	38.890	15.889	-97.570	74.910
Package Size (number of razors)	7.377	5.000	3.052	1.000	20.000
Women Segment	0.209	0.000	0.407	0.000	1.000
Panel B: Store Level					
Number of Household Visits (000's)	17.481	17.539	4.675	1.686	30.640
Potential Market (number of packages)	181.079	181.684	48.431	17.465	317.395
Number of Grocery Stores	9.765	7.000	8.784	1.000	46.000
Number of Convenience Stores	4.296	3.000	3.404	0.000	16.000
Number of Pharmacies	5.556	5.000	3.637	0.000	14.000
Panel C: Demographic Level					
Age	41.537	40.221	19.228	10.000	79.000
Household Size	2.660	2.000	1.552	1.000	9.000
Household Income ($ 000's)	79.544	57.457	87.337	0.002	599.999

* Panel A statistics are based on 144,325 store-week-UPC observations. Gross Retail Margins denotes the margin in percent that DFF makes on the dollar for each item sold. Panel B Number of Household Visits and Potential Market statistics are based on 8,346 (store-week) market observations. Panel B competition statistics are based on 81 store observations. Panel C statistics are based on 2,000 simulated consumers for each of the 8,346 (store-week) markets under analysis.

FIGURE 1
Price Example: G Good News 10 razors



stores, 3 convenience stores and 5 pharmacies compete for. We explored the sensitivity of our results to the proportionality factor assumption and all the main conclusions were found to be robust.

Finally, Table 2, Panel C presents summary demographic statistics of each store surrounding area (same ZIP code). The median consumer is 40-year-old within an household consisting of two members and an annual income of $57,457.

Having described the main data summary statistics, we now examine in more detail the price variable. Temporary price promotions are important marketing tools in the pricing strategy of many nondurable goods and disposable razors are no exception, as the high price variance and the (occasional) negative gross retail margin reported in Table 2, Panel A suggest.

Prices in the sample display a classic high-low pattern: products have a *regular level* that remains constant for long periods of time with occasional temporary reductions. High-low pricing allows firms to discriminate between (*i*) informed and uninformed consumers; (*ii*) consumers with different inventory holding costs; and (*iii*) price-sensitive switchers and store-loyal consumers. Figure 1 displays, as an illustration, the price of *Gillette Good News 10 razors* package over the sample weeks at DFF, Western Ave. store. The regular price level was $4.89 from August 1994 to January 1995, $4.99 from April 1995 to December 1995,

TABLE 3
*Temporary Price Promotions Characterization**

UPC Level	Mean	Median	Std	Min	Max
Promotion	0.115	0.000	0.319	0.000	1.000
Promotion Discount (%)	22.864	20.761	12.113	5.010	74.874
Duration from Last Promotion (weeks)	11.833	4.000	17.823	1.000	94.000

* Promotion statistics are based on 137,808 store-week-upc observations (since our temporary price promotion definition makes use of the first and last observation of the sequence of prices of each UPC in a given supermarket). Promotion Discount and Duration from Last Promotion statistics are conditional on a promotion and therefore are based on the corresponding 15,869 store-week-upc observations.

and finally \$5.49 from February 1996 onwards.[8]

While the classic high-low pattern is easy to spot, regular price levels are hard to define because they may change over time. Following Dossche *et al.* (2010), we define a temporary price promotion as any sequence of prices that is below at least 95 percent of the most left and the most right adjacent prices. Table 3 characterizes DFF's temporary price promotions. Following the typical pattern of setting regular price levels that remain constant for long periods of time, the median prices set by this supermarket chain across all UPCs, stores and weeks are non-promoted. Occasional temporary reductions account for only 11.5% of all price observations and, although there is evidence of substantial heterogeneity, consist of a median 20.8% discount every 4 weeks.

In an environment characterized by temporary price discounts, it is important to examine how consumers respond to price cuts. As Hendel and Nevo (2006a) show, demand estimation based on temporary price reductions may mismeasure the long-run responsiveness to prices. This is of fundamental importance in a setting like ours that relies on the ability to consistently estimate own- and cross-price elasticities. The first two columns in Table 4 addresses this issue by comparing, per package size, the percentage of weeks that a UPC was on promotion and the percentage of razors sold during those weeks. The results suggest that consumers do respond to temporary price discounts: the percentage of quantity sold on promotion is larger than the percentage of weeks that the promoted price is available.

This is consistent with the hypothesis that consumers respond to temporary price cuts by accelerating (anticipating) purchases and hold inventories for future consumption (i.e. stockpile). The main alternative explanation that consumers simply increase their consumption in response to a price reduction is less valid in the wet shaving setting. In order to avoid mismeasuring the long-run responsiveness to prices due to temporary price reductions, we

[8] We can also identify two short-spanned time periods when the regular price level was \$5.19.

TABLE 4
*Temporary Price Promotions and Quantity Discount**

Package Size	Weeks on Promotion (%)	Quantity Sold on Promotion (%)	Quantity Discount (%)
5 Razors	11.427	19.027	–
10 Razors	11.967	23.959	29.635
12 Razors	11.755	15.489	52.555
15 Razors	6.199	7.875	61.278

* Weeks on Promotion and Quantity Sold on Promotion denote, conditional on package size, the percentage of weeks a promotion was offered and the percentage of number of packages sold on promotion, respectively. Figures are computed across all stores, weeks and UPCs. Quantity discount computed as the ratio of each dummy variable coefficient to the constant, from a regression of the price per 5 razors on size dummy variables, controlling for temporary price promotions as well as product and store fixed effects.

aggregate the data quarterly.

Having characterized the price discrimination induced by temporary price promotions, we now address a second form of discrimination: discrimination induced by price nonlinearity in package size. Nonlinear pricing can be used by oligopolistic firms as a screening mechanism to price discriminate between types of consumers that hold private information about their tastes by nudging consumers to self-select (according to their tastes) into a given price-package size combination. Disposable razors are once again no exception. Prices in the sample display a non-linear schedule in package size, which is reported in Table 4. The last column of the table presents the quantity discount associated with the biggest-selling package sizes. In a context where not all products are sold in all package sizes and all DFF's stores, we analyzed the nonlinearity in package size in the lines of Hendel and Nevo (2006b), using a regression of the price per 5 razors on size dummy variables, controlling for temporary price promotions as well as product and store fixed effects. The quantity discount of each package size is then computed as the ratio of the coefficient on the corresponding size dummy variable to the constant. The results show that prices do exhibit quantity discounting. As a consequence, price nonlinearity constitutes a feature of the market that must be incorporated into the structural model.

Step 0: Model Consumer Demand

The supply-side of our empirical structural methodology outlined in the previous section relies on the ability to consistently estimate own- and cross-price elasticities in step 0. Here, we introduce the consumer's utility function and the assumptions of the demand side of the model. We model consumer demand using the multinomial random-coefficients Logit model

in the lines of McFadden and Train (2000), where consumers are assumed to purchase at most one unit of one of the products available in the market. We consider a differentiated products setting similar to Berry *et al.* (1995, hereafter BLP). The estimation approach allows for consumer heterogeneity and controls for price endogeneity.

The Setup

In each market $m = 1, \ldots, N$, there are I_m consumers, indexed by i, each of which chooses among J_m UPC alternatives. In the estimation below a market will be defined as a quarter-store combination. Let $j = 1, \ldots, J_m$ index the inside UPC alternatives to the consumer in market m. The no purchase choice (outside alternative) is indexed by $j = 0$.

Consumer Flow Utility

The consumer flow utility is expressed in terms of the indirect utility from each of the available alternatives. We begin by specifying the indirect utility from choosing an inside alternative. The utility derived by consumer i from purchasing UPC j in market m is assumed to be of the form:

$$\begin{aligned} u_{ijm} &= \bar{u}_{ijm}\left(p_{jm}, q_j, x_{jm}, w_m, \xi_{jm}\right) + \varepsilon_{ijm} \\ &= \alpha_i p_{jm} + \varphi\left(q_j\right) + \beta_i x_{jm} + \tau_i w_m + \xi_{jm} + \varepsilon_{ijm}, \end{aligned} \tag{16}$$

where p_{jm} denotes the price of UPC j in market m, q_j denotes the number of disposable razors included (package size) in UPC j, x_{jm} denotes a K_x-dimensional vector of observed characteristics of UPC j in market m (observed by the consumer and the econometrician), w_m denotes a K_w-dimensional vector of observed characteristics of the competitive environment of each market m to account for variations in the shopping alternatives that consumers have for making their purchases, and ξ_{jm} denotes the mean utility derived from the unobserved characteristics of UPC j in market m (observed by the consumer, but unobserved by the econometrician), which may be potentially correlated with price. Finally, ε_{ijm} is a random shock to consumer choice. α_i denotes consumer i's price sensitivity. β_i denotes the parameters representing consumer i's preference for the observed characteristics included in the vector x_{jm}, and τ_i denotes consumer i's valuation of shopping alternatives.

Disposable razor products come in several package sizes and prices are typically non-linear in size. $\varphi\left(q_j\right)$ denotes the component of the utility function associated to package

size. We assume non-linear functional forms for $\varphi(q_j)$. Following McManus (2007), a linear specification for both price and package size would be inappropriate. If the marginal utility from increasing size is constant, then given that price schedules are typically concave in size, then (if the random shock is omitted from the model) all consumers with sufficiently high valuation to purchase a small size would prefer a larger size to the small one.

The estimation approach allows for general parameter heterogeneity. In particular, we allow for observed and unobserved heterogeneity in price sensitivity, α_i:

$$\alpha_i = \alpha + \eta d_i + \gamma v_i, \tag{17}$$

where d_i is a vector of demographic variables and v_i is a vector of random-variables drawn from a normalized multivariate normal distribution that allows for unobserved heterogeneity. η is a vector of parameters that represent how price sensitivity varies with demographics, while γ is a scaling vector. We allow for the price sensitivity to depend on the *age* of the consumer, as well as on her *household size* and annual *household income*. For the remaining parameters, we have $\beta_i = \beta$ and $\tau_i = \tau$.

We now move on to specify the indirect utility from not purchasing. The utility derived by consumer i from this outside option in market m is assumed to be of the form:

$$\begin{aligned} u_{i0m} &= \bar{u}_{i0m}(\xi_{0m}) + \varepsilon_{i0m} \\ &= \xi_{0m} + \sigma_0 v_i + \varepsilon_{i0m}, \end{aligned} \tag{18}$$

where ξ_{0m} denotes the mean utility derived from not purchasing in market m and ε_{i0m} is a random shock to consumer choice. Because utility is ordinal, the preference relation is invariant to positive monotonic transformations. As a consequence, the model parameters are identifiable up to a scalar, which implies that a normalization is required. The standard practice is to normalize the mean utility of the outside option, ξ_{0m}, to zero.

Having described the indirect utility from the different alternatives available to the consumer, we now address her maximization problem: consumers are assumed to purchase one unit of the alternative that yields the highest utility. Because consumers are heterogeneous (d_i, v_i, ε_{im}), the set of consumers that choose UPC j in market m is given by:

$$A_{jm} = \{(d_i, v_i, \varepsilon_{im}) \,|\, u_{ijm} \geq u_{ilm} \forall l = 0, 1, \ldots, J_m\}, \tag{19}$$

where $\varepsilon_{im} = (\varepsilon_{i0m}, \ldots, \varepsilon_{iJ_m m})$. If we assume a zero probability of ties, the aggregate market

share of UPC j at market m is just the integral over the mass of consumers in region A_{jm}:

$$s_{jm} = \int_{A_{jm}} dP^*(d, v, \varepsilon) = \int_{A_{jm}} dP_d^*(d)\, dP_v^*(v)\, dP_\varepsilon^*(\varepsilon), \tag{20}$$

where $P^*(d, v, \varepsilon)$ denotes the population distribution function of the consumer types $(d_i,\ v_i,\ \varepsilon_{im})$. We assume d, v and ε to be independent. The last equality is just a consequence of this assumption. Having computed the aggregate market shares, the aggregate demand of UPC j at market m is given by $q_{jm} = M_m s_{jm}$, where M_m denotes the size of the market (potential market) m.

Estimation Procedure

Having described the consumer demand model, we address the estimation procedure. We estimate the parameters of the demand model assuming the empirical distribution of demographics for $P_d^*(d)$, independent normal distributions for $P_v^*(v)$ and a Type I extreme value distribution for $P_\varepsilon^*(\varepsilon)$. The latter assumption allows us to integrate the ε's analytically which implies that the unobserved characteristics, ξ, constitute the only source of sampling error. This gives an explicit structural interpretation to the error term and, thereby, circumvents the critique provided by Brown and Walker (1989) related to the addition of ad-hoc errors and their induced correlations. After integrating the ε's, the aggregate market share of UPC j at market m is given by:

$$s_{jm} = \int_{A_{jm}} \left[\frac{\exp(\bar{u}_{ijm})}{\sum_{k=0}^{J_m} \exp(\bar{u}_{ijm})} \right] dP_d^*(d)\, dP_v^*(v). \tag{21}$$

We estimated the parameters of the model by following the algorithm used by BLP and Nevo (2000). The general estimation procedure involves searching for the parameters that equate *observed* and *predicted* aggregated market shares at the market level.

Price Endogeneity and Identification

The pricing decision of firms takes into account *all* characteristics of a UPC. This introduces correlation between prices and UPC characteristics and, in particular, between prices and the *unobserved* UPC characteristics that constitute the structural error term of the demand model. As a consequence, instrumental variable techniques are required for consistent estimation. Controlling for the (market-invariant) mean unobserved UPC characteristics and for

UPC-invariant market deviations from that mean by using fixed effects decreases the requirements on the instruments, since the correlation between prices and those specific unobserved UPC characteristics is fully accounted for and does not require an instrument. In order to understand why this is the case, note that we can model $\xi_{jm} = \xi_j + \xi_m + \Delta\xi_{jm}$ and capture ξ_j and ξ_m by UPC and market fixed effects, where ξ_j denotes the (market-invariant) mean valuation for the unobserved characteristics of UPC j and ξ_m denotes the UPC-invariant market deviation from that mean. However, it does not completely eliminate the need for instrumental variable techniques since UPC-specific market deviations from that mean $\Delta\xi_{jm}$ are still expected to be correlated with prices.

We now provide an informal discussion of identification. We have already noted that because utility is ordinal, the preference relation is invariant to positive monotonic transformations. As a consequence, the model parameters are identifiable up to a scalar, which implies that a normalization is required. Without loss of generality, we normalize the mean utility of the outside option, ξ_{0m}, to zero. Given this restriction, the identification of the remaining parameters is standard given a large enough sample. The fixed effects ξ_j and ξ_m are identified from variation in market shares across the different UPC and markets, respectively. The taste parameters β and the parameters in $\varphi(q_j)$ are identified from variations in the observed UPC characteristics and package sizes. The mean value of the price coefficient, α, is identified from variation in prices. The competition environment coefficients, τ, are identified from variation in the number of grocery stores, convenience stores and pharmacies across ZIP codes. The parameters in vector η are identified from variation in demographics across ZIP codes and, finally, the parameters in vector γ and σ_0 are identified from variation in market shares due to unobserved factors.

Because of price endogeneity, it will be appropriate to use instruments rather than the variation in the actual prices to empirically identify the model's parameters. We follow Davis and Huse (2010) in using three types of price instruments. First, we instrument the price of UPC j in market m by the median price of that UPC across stores in other counties, in the lines of HLZ. Second, we instrument the price of UPC j in market m by the number of other same firm UPCs and the number of rival firms UPCs that are offered in that market, as well as by the sum of package sizes of other same firm UPCs and the sum of package sizes of rival firms UPCs that are offered in that market, in the lines of BLP. Third, we instrument the price of UPC j in market m by the BLP-type instruments above within the same gender segment, in the lines of Bresnahan *et al.* (1997, hereafter BST): the number of other same segment and firm UPCs and the number of same segment rival firms UPCs that are offered in that market, as well as by the sum of package sizes of other same segment and

firm UPCs and the sum of package sizes of same segment rival firms UPCs that are offered in that market.

In order for an instrument to be valid, it needs to be simultaneously (1) correlated with the endogenous variable price p_{jm} and (2) uncorrelated with the unobserved UPC characteristics variations $\Delta\xi_{jm}$. The validity of the former condition can be tested by regressing the endogenous variable on the full set of instruments: the instruments excluded from the demand equation plus all the exogenous explanatory variables in the demand equations, with a statistic commonly used being the F-test of the joint significance of the excluded instruments. The validity of the latter condition is more difficult to test and, although, if the demand equations are over-identified (the number of excluded instruments exceeds the number of included endogenous variables), the overidentifying restrictions may be tested via the J statistic of Hansen (1982), there are limits to the extent to which the uncorrelation condition in itself can be tested in an entirely convincingly way.

Consumer Welfare

The main contribution of the paper is to provide a structural model that can be empirically estimated and used not just to simulate the price equilibrium that would result from several partial acquisition counterfactuals, but also to analyze the corresponding change in consumer welfare. Under the assumptions of the consumer demand model, the expected maximum utility of consumer i in market m, from the choice set of UPC alternatives available, prior to observing the vector of random shocks $\varepsilon_{im} = (\varepsilon_{i0m}, \ldots, \varepsilon_{iJ_m m})$ is given by McFadden (1981)'s inclusive value:

$$\omega_{im} = \ln \left[\sum_{k=0}^{J_m} \exp\left(\bar{u}_{ijm}\right) \right]. \tag{22}$$

A partial acquisition in a rival impacts equilibrium prices and, as a consequence, it also impacts the expected maximum utility of consumers. As long as there is no change in the observed and unobserved characteristics of the choice set and the marginal utility of income of each consumer α_i is fixed, the expected difference in the maximum utility of consumers before and after the partial acquisition equals the difference in inclusive values: $\omega_{im}^{post} - \omega_{im}^{pre}$, where ω_{im}^{pre} and ω_{im}^{post} are computed using the equilibrium prices before and after the aforesaid acquisition, respectively. When the utility is linear in price, as in our discrete choice model setting, we can normalize this difference by the consumer's marginal utility of income and compute the corresponding compensating variation, converting it into the monetary equivalent that compensates consumer i in market m for enduring the shareholder

ownership change (Small and Rosen, 1981):

$$CV_{im} = \frac{\omega_{im}^{post} - \omega_{im}^{pre}}{\alpha_i}. \tag{23}$$

The average compensating variation is just the integral over the mass of consumers, and the aggregate compensating variation in the population of market m is just the product of the average compensating variation and the size of the market:

$$CV_m = M_m \int CV_i dP_d^* (d) \, dP_v^* (v) \,, \tag{24}$$

where $P_d^* (d)$ and $P_v^* (v)$ denote the assumed empirical distribution of demographics and independent normal distributions for unobserved heterogeneity, respectively, and M_m denotes the size of market m.

Consumer Demand Estimation Results

Table 5 presents the demand estimation results, with the different columns reporting distinct specifications that vary on both the covariates included, the estimation procedure and the type of price instruments. Specification (1) reports the results of an ordinary least squares standard multinomial Logit model regression. This first specification includes price, demographic and competition variables as covariates. Furthermore, we consider a quadratic functional form for $\varphi (q_j)$ and introduce heterogeneity by interacting price with observable demographic characteristics. The coefficients on these different covariates are all of the expected sign but mostly statistically insignificant. The price coefficient is one example of the latter, suggesting that the average consumer is price insensitive. The interactions with household size and consumer age are also statistically insignificant suggesting that these observed demographics do not explain price sensitiveness. The interaction with household income is, however, highly significant suggesting that households with higher income are less price sensitive. The coefficients on package size are indicative that consumers value package size at a statistically significant decreasing rate. Finally, the coefficients on demographic and competition covariates are statistically insignificant. This suggests that the utility of purchasing (and not purchasing) is not explained by the observed demographics nor impacted by the number of nearby grocery, convenience stores and pharmacies.

The structural error term of specification (1) includes the full ξ_{jm} since it does not allow for any control of the unobserved characteristics. In specification (2), we include UPC fixed

effects in order to fully control for ξ_j.[9] This increases the absolute value of the price coefficient, which suggests that prices may be positively correlated with the mean valuation of the unobserved UPC characteristics, which will underestimate consumer price sensitivity if not accounted for. We interpret the effects on the price coefficient as evidence that controlling for ξ_j matters. The price coefficient suggests that the average consumer is in fact price sensitive. The interactions with household size and consumer age remain statistically insignificant suggesting that these observed demographics do not explain price sensitiveness. The interaction with household income remains, however, highly significant suggesting that households with higher income are less price sensitive. While most demographic covariates remain statistically insignificant, the coefficient on age becomes statistically significant suggesting that the utility of purchasing lowers with age. Finally, the coefficients on the competition covariates seem to suggest that the utility of not purchasing is higher with more nearby pharmacies in the area, while the number of nearby grocery and convenience stores remain not to have a statistically significant impact.

Specification (2) controls for UPC fixed effects that capture the mean valuation of the unobserved UPC. However, it does not fully control for ξ_{jm}. The error term includes UPC-invariant and UPC-specific market deviations from that mean: ξ_m and $\Delta\xi_{jm}$, respectively, both of which, as argued above, are taken into account in the pricing decision of firms, introducing correlation with the price covariate. Specifications (3), (5) and (7) report the results of a generalized method of moments standard multinomial Logit model regression that replicate specification (2) using each of the types of instruments described above to account for the correlation between prices and unobserved characteristics: ξ_m and $\Delta\xi_{jm}$. The effect on the price coefficient seems sensitive to the choice of instruments. Although the first stage F-test of the joint significance of the excluded instruments are statistically significant for all types of instruments, the tests of over-identification are rejected, suggesting that the identifying assumptions are not valid.

In order to reduce the requirements on the instruments, we estimate specifications (4), (6) and (8) that include store- and quarter-fixed effects. Because each market is defined as a store-quarter combination, the fixed effects control for ξ_m, UPC-invariant market deviations from the valuation means. ξ_m may be a function of unobserved demographics, and if those unobserved demographics are correlated with prices, ξ_m will be correlated with prices. The inclusion of these fixed effects increases the absolute value of the price coefficient, which suggests that prices may be positively correlated with ξ_m, which will underestimate consumer price sensitivity if not accounted for. We interpret the effects on the price coefficient as

[9] Moreover, this captures non-linearities in $\varphi(q_j)$.

TABLE 5

*Demand Estimation Results**

	Logit OLS		Logit HLZ		Logit BLP		Logit BST		RC Logit BLP
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Standard Price Parameters									
Price	-0.074	-0.837	-0.921	-1.054	-0.442	-2.442	-0.627	-2.301	-2.516
	(0.364)	(0.216)	(0.188)	(0.124)	(0.487)	(0.239)	(0.510)	(0.232)	(0.352)
Price × HH Size	-0.021	-0.053	-0.074	-0.074	-0.256	-0.187	-0.216	-0.189	
	(0.160)	(0.100)	(0.083)	(0.055)	(0.220)	(0.083)	(0.233)	(0.088)	
Price × Age	0.016	0.007	0.009	-0.016	-0.083	-0.250	-0.020	-0.135	
	(0.261)	(0.135)	(0.115)	(0.076)	(0.292)	(0.135)	(0.314)	(0.140)	
Price × HH Income	0.113	0.123	0.159	0.144	0.154	0.181	0.082	0.161	
	(0.072)	(0.043)	(0.038)	(0.021)	(0.085)	(0.036)	(0.094)	(0.041)	
Standard Product Characteristics Parameters									
Package Size	0.029								
	(0.025)								
Package Size^2	-0.005								
	(0.001)								
Standard Demographic Parameters									
HH Size	-0.213	-0.141	-0.020		0.482		0.253		
	(0.591)	(0.290)	(0.240)		(0.633)		(0.665)		
Age	-0.460	-0.620	-0.557		-0.299		-0.576		
	(0.892)	(0.355)	(0.325)		(0.829)		(0.881)		
HH Income	-0.082	-0.112	-0.171		-0.274		-0.065		
	(0.268)	(0.125)	(0.106)		(0.256)		(0.283)		

TABLE 5
Extended

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Standard Competition Parameters									
Nearby Grocery Str.	0.704	0.646	0.383		0.429		0.731		
	(0.844)	(0.571)	(0.406)		(0.493)		(0.482)		
Nearby Conven. Str.	1.403	0.733	2.017		0.886		0.151		
	(1.479)	(0.953)	(0.737)		(0.849)		(0.849)		
Nearby Pharmacies	-1.313	-1.343	-1.556		-1.452		-1.568		
	(1.359)	(0.696)	(0.635)		(0.671)		(0.661)		
Random Coefficients: Standard Deviations									
Constant									0.030
									(2.501)
Price									0.047
									(0.330)
Random Coefficients: Demographic Interactions									
Price × HH Size									-0.189
									(0.190)
Price × Age									-0.223
									(0.222)
Price × HH Income									0.131
									(0.068)
Control Parameters	—	U–	U–	UST	U–	UST	U–	UST	UST
No. End. Var./Instr.	4/0	4/0	4/28	4/28	4/16	4/16	4/16	4/16	6/16
R^2/Hansen J Statistic	0.03	0.55	146.39	159.15	150.59	18.044^{+}	154.82	105.54	17.398^{+}

* Based on 17,745 observations. Standard errors clustered by supermarket-brand in parentheses. HH denotes household. Nearby Grocery Str. and Nearby Conven. Str. denote the number of nearby grocery and convenience stores, respectively. No. End. Var./Instr. denote the number of endogenous variables and the number of instruments, respectively. Specification (1) includes a constant term. U, S and T denote UPC, supermarket and time (quarter) dummy variables. + denotes that the J statistic of Hansen is statistically significant at the 5 percent level.

evidence that controlling for ξ_m matters. The first stage F-test of the joint significance of the excluded instruments are, again, statistically significant for all types of instruments. Controlling for the unobserved demographics via ξ_m eliminates the omitted-variable bias and improves the over-identification test statistic. In the case of the BLP type instruments, the improvement is such that the instruments are no longer rejected, suggesting that the BLP identifying assumption is valid. We explored the sensitivity of our results to the inclusion of market fixed effects and all the main coefficients were found to be robust. In order to avoid increasing unnecessarily the dimensionality of our problem, we controlled for ξ_m using store- and quarter-fixed effects.

Finally, specification (9) reports the results for the full multinomial random-coefficients Logit model with BLP type instruments. The results suggest that the average consumer is price sensitive. The interaction with household income is, once again, statistically significant confirming that households with higher income are less price sensitive. The remaining interactions with household size and consumer age are statistically insignificant suggesting that these observed demographics do not explain price sensitiveness. The standard deviations coefficients are also statistically insignificant, which suggests that most of the heterogeneity is due to demographics.

Table 6 reports a sample of the estimated median (across the 643 store-quarter markets) own- and cross-price elasticities computed according to the estimates from specification (9) in Table 5. The average (across the 56 UPCs) of the median of the estimates of the own-price elasticity is -8.9. While such elasticities may seem relatively high, when one takes into account the fact that there is a large number of UPCs typically produced by large multiproduct firms, the elasticities seem quite reasonable. If we were to look at own-price elasticities across products or brands, considering the cross-price elasticities of all the other UPCs that the company owns, the magnitudes would be lower. The average of the median of the estimates of the cross-price elasticity is 0.1. By a similar argument as above, while such elasticities may seem relatively low, if we were to look at cross-price elasticities across products or brands, the magnitudes would be higher.

Predicted Marginal Costs

We now move on to predict and recover the (unobserved) marginal costs using the Bertrand-Nash behaviour described in Assumption 5 jointly with the estimated demand side substitution patterns. Following equation (13), the procedure makes use of the current ownership structure established in matrix $\mathbf{L}^{pre}$, with typical element l_{fg}^{pre} and relies on the ability to

TABLE 6

*Median Own- and Cross-Price Elasticities**

UPC	4	7	9	10	12	13	14	15	16
1. B Lady Shaver 10r	0.045	0.275	0.009	0.031	0.105	0.045	0.059	0.004	0.006
2. B Metal Shaver 5r	0.036	0.327	0.009	0.033	0.105	0.050	0.149	0.004	0.006
3. B Pastel Lady Shaver 5r	0.031	0.301	0.011	0.032	0.105	0.051	0.156	0.004	0.006
4. B Shaver 10r	-6.439	0.256	0.010	0.028	0.106	0.046	0.145	0.004	0.006
5. G Daisy Slim 5r	0.024	0.294	0.011	0.051	0.111	0.072	0.228	0.004	0.006
6. G Good News 3r	0.036	0.325	0.009	0.033	0.114	0.051	0.146	0.004	0.006
7. G Good News 10r	0.032	-12.877	0.010	0.032	0.109	0.051	0.165	0.004	0.006
8. G Good News Microtrac 5r	0.031	0.346	0.009	0.035	0.117	0.052	0.181	0.004	0.006
9. G Good News Pivot Plus 10r	0.022	0.387	-12.761	0.038	0.111	0.054	0.205	0.004	0.006
10. ASR Personna Flicker 5r	0.032	0.313	0.009	-10.221	0.113	0.053	0.187	0.004	0.006
11. PL Single Blade 5r	0.030	0.246	0.008	0.028	0.107	0.047	0.135	0.004	0.006
12. PL Twin Blade 5r	0.030	0.258	0.008	0.029	-4.538	0.047	0.140	0.004	0.006
13. WL Schick Slim Twin 5r	0.027	0.323	0.009	0.034	0.111	-7.277	0.157	0.004	0.006
14. WL Schick Slim Twin 10r	0.031	0.305	0.010	0.031	0.110	0.050	-10.901	0.004	0.006
15. WS Colors 5r	0.026	0.324	0.011	0.036	0.108	0.056	0.202	-3.650	0.007
16. WS Ultra Glide Twin 5r	0.023	0.336	0.011	0.033	0.110	0.058	0.205	0.004	-4.769

* Figures denote the median price elastiticities over the 643 markets. The elasticity in row i and column j represents the percentage change in market share of product i with a 1% change in price of product j. B: BIC, G: Gillette, ASR: American Safety Razor, PL: Private Label, WL: Warner-Lambert, WS: Wilkinson Sword. 3r, 5r and 10r denote package sizes of 3, 5 and 10 razors, respectively.

TABLE 7
*Principal Shareholders and Subsidiaries**

	Shareholders		Subsidiaries	
	Total Stock	Voting Stock	Total Stock	Voting Stock
American Safety Razor Company				
Allsop Venture Partners III, LP	12.40	12.40		
Goldman Sachs Group, LP	7.80	7.80		
Scudder Stevens and Clarck	7.00	7.00		
Equitable*	14.40	14.40		
Grantham Mayo Van Otter	5.10	5.10		
Leucadia Investors, Inc.	4.10	4.10		
Mezzanine Capital and Income Trust 2001 PLC	2.00	2.00		
BIC Corporation				
Bruno Bich	77.70	77.70		
Warner-Lambert Company				
The Capital Group, Inc.	5.16	5.16		
Wilkinson Sword, Inc.			100.00	100.00
The Gillette Company				
Berkshire Hathaway, Inc.	10.90	10.70		

* 1994's Schedule 14A (proxy statement) information. Equitable denotes the cumulative ownership of Equitable Capital Partners, LP, Equitable Deal Flow Fund, LP, Equitable Capital Partners (Retirement Fund), LP, and The Equitable Life Assurance Society of the United States.

consistently estimate the own- and cross-price elasticities required to compute the elements of matrix Ω^{pre}:

$$\widehat{\mathbf{mc}} = \mathbf{p}^{pre} - \boldsymbol{\Omega}^{pre} \left(\mathbf{p}^{pre}\right)^{-1} \mathbf{G}^{pre} \mathbf{s} \left(\mathbf{p}^{pre}\right).$$

The vectors $\mathbf{p}^{pre}$ and $\mathbf{s}\left(\mathbf{p}^{pre}\right)$ are observed in the data. The own- and cross-price elasticities required to compute the elements of matrix Ω^{pre} are estimated within the demand model (Table 6 provides a sample of those estimates). Matrix $\mathbf{L}^{pre}$ is computed, under Assumptions 1-4 and 6, using each firm's distribution of total and voting stock. Table 7 presents this distribution for the ownership structure of the different firms from March 22, 1993 onwards according to 1994's Schedule 14A (proxy statement) information reported by each firm.

In the context of our illustrative application, the marginal cost includes any incremental costs required for the manufacturer firm to produce, distribute and make available one additional pack of disposable razors to the final consumer. In the lines of Nevo (2001) and consistently with a wide variety of models of manufacturer-retailer interaction, this cost can be expressed as follows:

$$mc_{jm} = mc^{M}_{jm} + mc^{R}_{jm} + margin^{R}_{jm},$$

where mc_{jm}^{M} denotes the manufacturer's marginal cost of producing the additional pack and transporting it from the plant to the retailer store, mc_{jm}^{R} denotes the retailer's marginal cost of getting the additional pack to the store shelves and selling it, and $margin_{jm}^{R}$ denotes the retailer markup over the acquisition cost.

The first two columns of Table 8 present price and recovered marginal costs for a sample of UPCs. Given that those variables vary by UPC and market, we present the median for each selected UPC across the 643 (store-quarter) markets. The average of the median price and recovered marginal cost is \$3.02 and \$2.59, respectively. The third column of Table 8 presents the recovered marginal costs as a percentage of price. The average of the median marginal cost corresponds to 85.8% of the sale price .

In order to evaluate the reasonability of our results, we decompose the recovered (predicted) marginal cost using the gross retail margin (to capture $margin_{jm}^{R}$), a variable not used in the demand side estimation for exactly this purpose. This decomposition is presented, with the obvious exception of private labels, in columns four and five of Table 8. The average of the median store markup corresponds to 36.6% of price, yielding that the manufacturer's marginal cost of producing the additional pack, transporting it from the plant to the retailer store, getting it to the store shelves and finally selling it correspond to the remaining 51.6% of price. According to the Department of Commerce's Annual Retail Trade Survey, which provides national estimates of (among others) total annual sales and total operating expenses for retail businesses located in the United States, grocery stores's marginal cost of getting the additional pack to the shelves and selling it account for around 4.2% of price.[10] This includes costs (some of which can be argued not to be marginal costs) with temporary labour, packaging materials, containers and other materials, electricity, transportation, shipping and warehousing services, and advertising and promotional services. This implies an average manufacturer's marginal cost of producing an additional pack and transporting it from the plant to the retailer store of 47.4% of price. We compare this marginal cost estimate with the accounting estimates supported by 1994's Annual Report of the two biggest-selling brands (excluding private labels). Gillette and Warner-Lambert's production and distribution costs account for 62.7% (blades & razors business segment) and 72% (consumer health care industry segment) of the corresponding manufacturer price, respectively. If we were to use the ratio between the sale price and the manufacturer price (DFF's average acquisition cost computed using the gross retail margin) to re-scale the percentages in terms of the sale price, we would conclude that Gillette and Warner-Lambert's production and distribution

[10] We use data for detailed operating expenses as a percentage of sales referent to 2009 as a crude measure. We argue that this ratio may have had a similar path to the annual gross margin as a percentage of sales, that data shows to have been relatively stable ratio from 1993-2010.

TABLE 8
*Median Recovered Marginal Costs**

UPC	p_{jm}	mc_{jm}	mc_{jm}	mc_{jm} Decomposition	
				$margin^R_{jm}$	mc^M_{jm}+mc^R_{jm}
				(% p_{jm})	
1. B Lady Shaver 10r	2.16	1.79	83.1	27.6	55.3
2. B Metal Shaver 5r	2.09	1.73	82.3	48.3	34.1
3. B Pastel Lady Shaver 5r	2.01	1.64	82.0	45.7	35.2
4. B Shaver 10r	2.39	2.00	84.0	34.5	49.6
5. G Daisy Slim 5r	1.89	1.48	77.9	4.20	68.2
6. G Good News 3r	2.19	1.71	78.6	37.9	40.9
7. G Good News 10r	4.83	4.38	90.6	35.6	54.8
8. G Good News Microtrac 5r	2.89	2.41	83.6	34.5	48.2
9. G Good News Pivot Plus 10r	4.66	4.15	89.3	36.1	55.0
10. ASR Personna Flicker 5r	3.74	3.39	90.2	61.0	28.7
11. PL Single Blade 5r	1.01	0.62	61.8	–	–
12. PL Twin Blade 5r	1.67	1.28	76.7	–	–
13. WL Schick Slim Twin 5r	2.69	2.30	85.6	35.6	49.4
14. WL Schick Slim Twin 10r	4.03	3.65	90.7	35.1	55.7
15. WS Colors 5r	1.29	0.93	71.7	61.9	10.3
16. WS Ultra Glide Twin 5r	1.69	1.32	78.4	43.8	34.6

* Figures denote the median price, average acquisition cost and inferred marginal cost over the 643 markets. B: BIC, G: Gillette, ASR: American Safety Razor, PL: Private Label, WL: Warner-Lambert, WS: Wilkinson Sword. 3r, 5r and 10r denote package sizes of 3, 5 and 10 razors, respectively.

costs account for 40.3% and 44.8% of the sale price, a value reasonably close to our results. This conclusion is reinforced by the fact that disposable razor products typically sell at a lower margin than the remaining razor products, making the accounting estimates above a conservative one.

Counterfactual Equilibrium Results

After recovering the implied marginal costs, $\widehat{\mathbf{mc}}$, we consider different shareholder and cross-ownership structures and simulate counterfactual equilibria. The procedure involves re-computing matrix $\mathbf{L}$ and consequently, the corresponding elements of matrices $\mathbf{\Omega}$ and $\mathbf{G}$, for each shareholder and cross-ownership structure considered and finally use equation (15) to simulate the counterfactual equilibrium prices, $\mathbf{p}^{post}$:

$$\mathbf{p}^{post} = \widehat{\mathbf{mc}} + \mathbf{\Omega}^{post}\left(\mathbf{p}^{post}\right)^{-1}\mathbf{G}^{post}\mathbf{s}\left(\mathbf{p}^{post}\right).$$

We consider the recovered marginal costs of each UPC in a given market to remain

constant (before and after the shareholder and cross-ownership structure change), although the analysis is not constrained to this assumption. Because our dataset ranges from July 1994 to June 1996 and we aim to perform counterfactuals about facts that occurred prior to 1994, the counterfactual equilibrium is computed for each UPC and store in the third quarter of 1994. We consider the following shareholder and cross-ownership structures:

a) Baseline Case (counterfactual): The shareholder structure of Wilkinson Sword is independent of the remaining firms in the industry. This mimics the industry ownership structure before December 20, 1989.

b) Case 1 (counterfactual): The Gillette Company acquires a 100% voting equity interest in Wilkinson Sword. This constitutes an hypothetical ownership structure and it is presented to illustrate the counterfactual market outcomes if Gillette did not voluntarily rescinded the acquisition of Eemland's wet shaving razor blade business in the United States.

c) Case 2 (counterfactual): The Gillette Company acquires a 22.9% nonvoting equity interest in Wilkinson Sword. This mimics the industry ownership structure from December 20, 1989 to March 22, 1993.

d) Case 3 (counterfactual): The Gillette Company acquires a 22.9% voting equity interest in Wilkinson Sword. This constitutes an hypothetical ownership structure and it is presented here to illustrate the differential impact of acquiring a voting and nonvoting equity interest.

e) Case 4 (1994 actual situation): Warner-Lambert Company acquires a 100% voting equity interest in Wilkinson Sword. This constitutes a full merger and mimics the industry ownership structure from March 22, 1993 onwards.

Table 9 reports the median simulated percentage variation in equilibrium prices and market shares relative to the baseline case for a sample of UPCs across all DFF stores. Case 1's counterfactual, presented in the first two columns, examines the impact (when compared with the baseline case) of the 100% voting equity interest acquisition in Wilkinson Sword initially proposed by Gillette. This acquisition was voluntarily rescinded due to antitrust concerns. The Department of Justice (DoJ) instituted a civil proceeding against Gillette. The complaint alleged that the effect of the acquisition by Gillette may have been substantially to lessen competition in the sale of wet shaving razor blades in the United

States and shortly after the case was filed, Gillette voluntarily rescinded the acquisition of Eemland's wet shaving razor blade business in the United States. The simulated price increases are, however, low: 3.6% and 2.7% for WS Colors and WS Ultra Glide, respectively.

Case 2's counterfactual, presented in the next two columns, examines the impact (when compared with the baseline case) of the 22.9% nonvoting equity interest acquisition in Wilkinson Sword by Gillette. The DoJ allowed this acquisition after being assured that this stake would be passive. However, even when the acquiring firm cannot influence the conduct of the target firm, the partial acquisition of a financial interest in a rival may still reduce the incentive of the acquiring firm to compete aggressively because it shares in the losses thereby inflicted on that rival. We examine this question. The results confirm the reasonability of the DoJ decision. The simulated price increases are extremely low: smaller than 0.001% for both WS Colors and WS Ultra Glide.

Case 3's counterfactual, presented in the next two columns, examines the impact (when compared with the baseline case) of a 22.9% voting equity interest acquisition in Wilkinson Sword by the Gillette Company. When a firm acquires a voting interest in a rival, it acquires the ability to influence the competitive conduct of the target firm. Such influence can lessen competition because it may be used to induce the rival to compete less aggressively against the acquiring firm. We expect the impact of, in addition to a financial interest, acquiring a voting interest to lessen competition to a greater extent when compared with the sole acquisition of a financial interest. The simulated price increases confirm this expectation: 1.0% and 0.8% for WS Colors and WS Ultra Glide, respectively.

Finally, case 4's counterfactual, presented in the last two columns, examines the impact (when compared with the baseline case) of a 100% voting equity interest acquisition in Wilkinson Sword by the Warner-Lambert Company. The acquisition was prompted after the European Commission ordered the Gillette Company to sell its stake in Eemland because of antitrust concerns. The concern was focused particularly on Europe where Wilkinson Sword was a stronger player than in the US. Consistently with traditional merger analysis, a merger between firms selling differentiated products may diminish competition by enabling the merged firm to profit by unilaterally raising price. The simulated price increases are however relatively low: 1.1% and 0.9% for WS Colors and WS Ultra Glide, respectively. Interestingly, the quantitative impact of a full merger with a smaller player (the Warner-Lambert Company) on WS's prices is similar to a 22.9% partial voting acquisition by a larger player (the Gillette Company).

The main contribution of the paper is to provide a structural model that can be empir-

TABLE 9

*Simulated Median Percentage Change in Prices and Shares**

	WS acquired by							
	G 100% voting		G 22.9% nonvoting		G 22.9% voting		WL 100% voting	
UPC	price	share	price	share	price	share	price	share
1. B Lady Shaver 10r	†0.001	0.051	†0.001	0.006	†0.001	0.014	0.042	-0.207
2. B Metal Shaver 5r	0.001	0.070	†0.001	0.008	†0.001	0.019	0.051	-0.272
3. B Pastel Lady Shaver 5r	†0.001	0.037	†0.001	0.004	†0.001	0.010	0.026	-0.133
4. B Shaver 10r	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5. G Daisy Slim 5r	0.002	0.038	†0.001	0.004	†0.001	0.010	0.001	0.015
6. G Good News 3r	0.003	0.046	†0.001	0.005	0.001	0.012	0.002	0.019
7. G Good News 10r	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8. G Good News Microtrac 5r	0.002	0.044	†0.001	0.005	0.001	0.012	0.001	0.019
9. G Good News Pivot Plus 10r	0.002	0.050	†0.001	0.006	†0.001	0.013	0.001	0.018
10. ASR Personna Flicker 5r	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11. PL Single Blade 5r	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12. PL Twin Blade 5r	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13. WL Schick Slim Twin 5r	0.001	0.065	†0.001	0.007	†0.001	0.018	†0.001	0.027
14. WL Schick Slim Twin 10r	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15. WS Colors 5r	3.570	-11.854	†0.001	0.008	1.037	-3.599	1.149	-3.979
16. WS Ultra Glide Twin 5r	2.719	-11.829	†0.001	0.008	0.789	-3.591	0.889	-4.003

* Figures are the median percentage change for each product over 81 stores in the third quarter of 1994. †0.001 denotes percentage changes smaller than 0.001. B: BIC, G: Gillette, ASR: American Safety Razor, PL: Private Label, WL: Warner-Lambert, WS: Wilkinson Sword. 3r, 5r and 10r denote package sizes of 3, 5 and 10 razors, respectively.

TABLE 10

*Changes in Consumer Welfare, Brand Revenues and Profits, and Total Welfare**

	WS acquired by							
	G 100% voting		G 22.9% nonvoting		G 22.9% voting		WL 100% voting	
Consumer welfare	-10.586		-1.164		-2.866		-3.552	
Profits/Revenues	4.737	1.679	0.477	0.773	1.379	0.350	1.839	-4.293
B BIC	0.459	2.765	0.050	0.303	0.124	0.750	0.086	-7.691
G Gillette	3.061	17.007	0.334	1.864	0.829	4.606	1.056	5.756
ASR Personna	0.049	0.530	0.005	0.058	0.013	0.144	0.017	0.186
PL Private Label	0.881	-6.198	0.013	-1.927	0.269	-1.272	0.492	1.273
WL Schick	0.632	4.130	0.069	0.451	0.171	1.120	0.214	1.381
WS Wilkinson Sword	-0.344	-16.555	0.005	0.023	-0.027	-4.996	-0.027	-5.197
Total Welfare	-5.849		-0.687		-1.487		-1.713	

* Figures are in thousands of US dollars.

ically estimated and used not just to simulate the price equilibrium that would result from several partial acquisition counterfactuals, but also to analyze the corresponding change in consumer welfare. Table 10 presents changes in consumer welfare, brand revenues and profits, and total welfare for each of the shareholder and cross-ownership structures considered.

The consumer welfare results were calculated as follows. The first step consisted in computing the average compensating variation across the 2,000 simulated consumers for each market m (given that we focus our analysis on the third quarter of 1994, a market is defined here as a store). We then computed the aggregate compensating variation, for each store m, multiplying the corresponding average by the potential size of the store. Finally, we added the aggregated compensating variation across all stores. In order to extrapolate the results for the US economy as a whole, we computed the average compensating variation across the different markets and multiplied by the US economy yearly potential market. The results suggest that the 100% voting equity interest acquisition in Wilkinson Sword initially proposed by Gillette, and voluntarily rescinded due to antitrust concerns, would have had the highest negative impact on consumer welfare: approximately $10.6 thousand a year. BVC show that a participation that induces control is more damaging to consumer welfare than a passive participation, though both decrease consumer surplus. Our empirical results are consistent with this theoretical result. The 22.9% nonvoting equity interest acquisition in Wilkinson Sword by Gillette, which was not challenged by the DoJ after being assured that this stake would be passive, has a negative impact on consumer welfare: approximately $1.2 thousand a year, which is indeed smaller than the negative impact of approximately

$2.9 thousand a year resulting from the (hypothetical) control-inducing 22.9% acquisition.

The profits and revenues results were calculated using a procedure similar to the above. The first step consisted in computing the profits and revenues variation for each store m. We then aggregated the results across all stores. And, finally, in order to extrapolate the results for the US economy as a whole, we computed the average profits and revenues variation across the different markets and multiplied by the US economy yearly potential market. The results mirror the ones for consumer welfare. The 100% voting equity interest acquisition in Wilkinson Sword initially proposed by Gillette would have had the highest (now) positive impact on profits: approximately $4.7 thousand a year, while the 22.9% nonvoting equity interest acquisition in Wilkinson Sword by Gillette has the smallest impact: approximately $0.5 thousand a year. The results also seem to confirm Gillette version in saying that its reason for participating in Eemland was solely its wish to acquire various Wilkinson Sword trade marks and wet-shaving activities in certain countries outside the 12-nation European Community. After the acquisition, the aggregate profits of Gillette would include a share in Wilkinson Sword's profits, but the incremental positive impact (in addition to that) for Gillette seems relatively low and ranges from approximately $0.3 (case 2) to $3.1 (case 1) thousand a year.

Finally, the total welfare results aggregate the consumer welfare changes with the total profit changes. The 100% voting equity interest acquisition in Wilkinson Sword initially proposed by Gillette would have had an approximate total welfare reduction of -$5.8 thousand a year, which indeed exceeds the impact of the 22.9% nonvoting equity interest approved acquisition: -$0.7 thousand a year. The Warner-Lambert Company acquisition of Wilkinson Sword, prompted after the European Commission ordered the Gillette Company to sell its stake in Eemland because of antitrust concerns, was, however, detrimental for both consumer and total welfare: the reduction (comparison between case 4 and case 2) was approximately of $2.4 and $1.0 thousand a year, respectively.

4 Conclusions

This paper considers an empirical structural methodology to examine quantitatively the unilateral effects of partial acquisitions involving pure financial interests and/or effective corporate control on prices, market shares, firm profits and consumer welfare. The proposed methodology can deal with differentiated products industries, with both direct and indirect partial ownership interests and nests full mergers (100% financial and control acquisitions)

as a special case.

The general strategy models supply competition in a setting where partial ownership may or may not correspond to control and uses a Nash-Bertrand equilibrium assumption, jointly with demand side estimates, to recover marginal costs, which are then used to simulate the unilateral effects of actual and hypothetical partial acquisitions. This structural approach to partial acquisitions may be a preferable method for competition policy issues to the current indirect methods in the literature of using summary measures like modified HHIs or PPIs suitable or relevant only in certain particular economic conditions.

We provide an empirical application of the methodology to several acquisitions in the wet shaving industry. A DoJ challenged's proposed full acquisition of Wilkinson Sword by Gillette in 1989, voluntarily rescinded due to antitrust concerns in favor of a (not-challenged) partial acquisition of 22.9% nonvoting equity interest in 1990, and finally the full merger between Warner-Lambert and Wilkinson Sword in 1993, prompted after the European Commission ordered Gillette Company to sell its stake in Wilkinson Sword. The results seem to confirm the DoJ challenge of the initial proposal in the sense it would have induced more damage to consumer welfare than the 22.9% passive final participation. The results seem also to confirm Gillette version in saying that its reason for participating in Wilkinson Sword was non-financial in the sense that the estimated incremental impact of the acquisition for Gillette profits seems relatively low. And finally, the results seem also to suggest that the Warner-Lambert and Wilkinson Sword merger prompted for antitrust concerns, was, in fact, detrimental for both consumer and total welfare.

This paper leaves many issues yet to be explored. Extensions of this methodology to measure (*i*) the coordinated effects of partial acquisitions, and (*ii*) the unilateral and coordinated effects of partial acquisitions that involve firms in the vertical chain are provided in two companion papers (Brito *et al.*, 2013a,b).

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