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Abstract

This paper makes inferences about wholesale price discrimination and uniform wholesale pricing policy in a national grocery retail market where wholesale price discrimination occurs. I estimate demand and a supply model of multiple retailers' and manufacturers' oligopoly-pricing behavior where manufacturers may engage in wholesale price discrimination, which allows me to recover brand level marginal costs in this market. Then I simulate the welfare effects of no wholesale price discrimination via uniform price regulation given observed data on retail and input prices and retail quantities sold and not available data on wholesale prices. This approach uses retail level scanner data on coffee produced by multiple manufacturers sold at the largest retail outlets in Germany. The estimates of uniform wholesale pricing in this market suggest there to be positive welfare effects from preventing wholesale price discrimination, originating from positive effects on consumer surplus of the same magnitude as on joint vertical producer surplus. I show through simulations that estimated welfare decreases, due to higher retail prices under no wholesale price discrimination, for more collusive retail and manufacturer counterfactual scenarios. Finally, and in terms of counterfactual demand simulations, I find that banning wholesale price discrimination may be actually welfare improving the less heterogeneous and the more elastic demand is.

Wholesale Price Discrimination: Inference and Simulation*

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ABSTRACT

This paper makes inferences about wholesale price discrimination and uniform wholesale pricing policy in a national grocery retail market where wholesale price discrimination occurs. I estimate demand and a supply model of multiple retailers' and manufacturers' oligopoly-pricing behavior where manufacturers may engage in wholesale price discrimination, which allows me to recover brand level marginal costs in this market. Then I simulate the welfare effects of no wholesale price discrimination via uniform price regulation given observed data on retail and input prices and retail quantities sold and not available data on wholesale prices. This approach uses retail level scanner data on coffee produced by multiple manufacturers sold at the largest retail outlets in Germany. The estimates of uniform wholesale pricing in this market suggest there to be positive welfare effects from preventing wholesale price discrimination, originating from positive effects on consumer surplus of the same magnitude as on joint vertical producer surplus. I show through simulations that estimated welfare decreases, due to higher retail prices under no wholesale price discrimination, for more collusive retail and manufacturer counterfactual scenarios. Finally, and in terms of counterfactual demand simulations, I find that banning wholesale price discrimination may be actually welfare improving the less heterogeneous and the more elastic demand is.

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1. Introduction

"(...) Fünf Prozent höher lagen nach seinen Worten die Einkaufspreise (...)"

"(...) Five percent higher were, according to his words, the wholesale prices (...)"

Hamburger Abendblatt, March 26, 2006.

So it read in a statement by the CEO of one of the largest German retail chains, after merging with another retailer chain, and learning that the manufacturers were charging (pre-merger) five percent higher wholesale prices to his chain than to the merging partner. The main goal of this paper is to access the welfare effects of eliminating the possibility of wholesale price discrimination in the market, in the empirical context of unavailable data on wholesale prices.

When wholesale price discrimination is performed in the markets, wholesalers set different prices for the same product if sold to different downstream markets. In particular, a lower wholesale price is set in more price sensitive downstream markets and a higher wholesale price is charged in low price sensitive downstream markets. Borrowing from economic theory from final goods markets' third degree price discrimination,[1] Bork (1978) posits that if new markets are served overall due to wholesale price discrimination welfare effects are likely to be positive, that the price effects on final good market are ambiguous and under certain circumstances, retail prices to consumers under no wholesale price discrimination may actually increase relative to the average retail price under wholesale price discrimination. Some theoretical literature showed opposite results, where banning wholesale price discrimination may be actually welfare improving, emphasized in Katz (1987) and also in De-Graba (1990), O'Brien and Shaffer (1994) and Yoshida (2000). The reason being that input markets (or also called intermediate goods markets) exhibit fundamental differences from final goods markets, as the buyers have interdependent demands, can integrate upstream and supply the intermediate goods themselves, and wholesale price discrimination may in fact lead to higher wholesale prices charged to all buyers. Extending the previous theoretical work from linear wholesale pricing to non-linear wholesale pricing models, Rey and Tirole (2005) showed yet again that banning wholesale price discrimination may be welfare reducing, while Caprice (2006) finds that by adding upstream potential competition rather than having an upstream monopolist (as in Rey and Tirole, 2005), banning price discrimination at the wholesale level may actually cause prices to fall and thus be welfare improving. In general for multiple oligopolistic retailers and multiple oligopolistic

[1] See Schmalensee (1981), Varian (1985) and Ireland (1992).

manufacturers, whether uniform wholesale pricing (that is banning wholesale price discrimination) leads to higher or lower final goods retail prices and to lower or higher welfare is ambiguous and remains an empirical question whether in the presence of linear wholesale pricing as well as with non-linear wholesale pricing. This question is of policy relevance in a variety of markets, in particular where there are policy goals to enforce uniform wholesale price legislation and generally given that antitrust authorities have been significantly concerned with price discrimination in intermediate goods markets.[2]

This paper addresses this question by simulating the effects of such uniform wholesale price legislation, in the context of linear wholesale prices, in a German grocery retail market where manufacturer do wholesale price discriminate when selling to different retailers. Moreover, this paper makes inferences on wholesale price discrimination under limited data availability, in particular, of wholesale prices. In terms of methodology, the first step is to start with the demand side of the market and incorporate multiple manufacturers and retail oligopoly behavior into supply side econometric models of sequential vertical-pricing games, where manufacturers choose wholesale prices to maximize profits and then retailers choose retail prices given wholesale prices to maximize retail profits (as in Brenkers and Verboven, 2004, Goldberg and Verboven, 2001, Sudhir, 2001, Mortimer, 2002, Villas-Boas and Zhao, 2004, Villas-Boas, 2005, and Villas-Boas and Hellerstein, 2006). As a second step I illustrate how one would explicitly simulate uniform wholesale price implementation in the markets, and infer the welfare effects of such legislation given unobservable data on wholesale prices. Given the demand estimates I compute the price cost margins for the benchmark supply model (following Villas-Boas, 2006) where manufacturers may price discriminate. I recover retail and manufacturer level marginal costs for each product in the analysis by subtracting from the data on retail prices the price cost margins estimated from the benchmark model. I then solve for what would be the Nash equilibrium retail prices if instead manufacturers are subject to uniform wholesale pricing policies, and compute the resulting welfare changes. I demonstrate how these wholesale price legislation simulations may be performed given observed data on retail and input prices and retail quantities sold and not available data on wholesale prices.

In the empirical analysis I use data on coffee produced by multiple manufacturers and sold in several retail chain in Germany. There are two related studies that combine these same scanner data with additional data sources to empirically examine the determinants of retail and manufacturer margins in the German coffee market. In the first paper, Draganska and Klapper (2006)

[2]European Union Treaty's article 82 (c) prohibits practices where a dominant firm "would place trading partners at a competitive disadvantage". U.S. law, in the form of the Robinson Patman Act, forbids "discriminat[ing] in price between different purchasers" where the effect "may be to lessen competition" unless the price differences are based on costs or price differences were needed to meet competition (two statutory defenses).

relate estimated manufacturer conduct parameters, in a reduced form setting, to exogenous factors related to retail competitive environment. Draganska, Klapper and Villas-Boas (2006) consider a model of linear pricing of multiple Bertrand Nash competing manufacturers selling through multiple Bertrand Nash competing retailers, to obtain estimates of manufacturer and retail margins. Then they relate those estimated margins again in a reduced form setting to their potential demand side, cost side, and retail and manufacturer level determinants. The focus of this present paper is entirely different from these two papers, providing to my knowledge the first empirical investigation of policy simulations from upstream price discrimination. It further performs such policy simulations under different counterfactual scenarios of upstream and downstream competition in this market. The estimates suggest there to be significant positive welfare effects from preventing wholesale price discrimination, originating from positive effects both on consumer surplus and on joint vertical producer surplus, resulting from positive effects on manufacturer and on retailer surplus. Through simulations I also show how the estimated welfare effects change given counterfactual retail, manufacturer and demand scenarios.

The rest of the paper proceeds as follows. The next section describes the coffee market and the data and, section 3, presents the economic and econometric models of demand and supply to derive the equilibrium under the possibility of wholesale price discrimination. In section 4 the simulation of uniform wholesale pricing is outlined, where in section 5 the method of estimation, the demand and the benchmark supply model results are presented. In section 6 the simulation results are presented and evaluated along several counterfactual scenarios of departures from firm Bertrand Nash pricing and for counterfactual demand scenarios. Conclusions and extensions of this research are presented in section 7 where also suggestions are made as to how the proposed analysis can be adapted to different settings.

2. The Coffee Market and The Data

To make inferences on wholesale pricing practices the focus is on the coffee market in Germany, where there are a small number of manufacturers producing coffee and selling to a small number of retail chains, consisting therefore an interesting and empirically attractive market to study imperfectly competitive retailers and manufactures and restrictions on vertical pricing. Industry stated evidence by one of the largest retail chains suggests that there are differences in wholesale prices charged to different retailers in this industry, making this a particular interesting case to simulate what would be the effects of imposing single uniform pricing.[3]

The small number of key players in this industry is also attractive from a modeling and empirical perspective. In fact, there are slightly more than a handful of manufacturers producing coffee and selling it to consumers via a small set of national retailers. At the retail level there are four major retail chains that have several retail stores throughout Germany, and they are called Edeka, Markant, Metro, and Rewe. Aldi is another player in the retail distribution, as the largest German discounter but unfortunately Aldi does not make their data available. At the manufacturer level there are seven major national brands in the coffee market, and these are Jacobs, Onko, Melitta, Idee, Dallmayr, Tchibo, and Eduscho. These brands capture more than 95% of the market, while the rest consists of private label brands and a few minor brands. Jacobs and Onko are produced by Kraft, while Tchibo and Eduscho are two brands of the same main firm Tchibo.[4]

The empirical analysis is based on a weekly data set on retail prices, aggregate market shares and product characteristics for seven coffee products produced by five manufacturers sold at four retail chains. Note that there are seven brands at the manufacturer level that are sold through the different four retailers and thus creating the choice set equal to twenty eight products at the retail-consumer level. The price, advertising and market share data used in the empirical analysis were collected by MADAKOM, Germany, from a national sample of retail outlets belonging to the four major retailers Edeka, Markant, Metro, and Rewe, during the years of 2000 and 2001. These data contain weekly information on the sales, prices, and promotional activity for all brands in the ground coffee category. I focus on the 7 major national brands of 500 grams package size, which is the modal size in the data: the largest being Jacobs with 28% market share, Onko (20%), Melitta (16%), Idee (12%), Dallmayr (12%), Tchibo (9%), and Eduscho with 3 percent. Private label brands (1.71% market share) and a few minor brands (combined share of 2.57%) were dropped from the analysis.

Table 1 describes the data summary statistics broken up for each of the four retail chains, for the seven brands in the data. For the retail chains considered, the data obtained to perform this analysis were already aggregated across the different stores for each chain. Several aggregation methods were used and the results in this paper are robust to those. Combined market shares for the products sold in Metro represent over forty six percent of the market, Markant comes next with

[3]As quoted in the introduction, after a recent merger in the German retail industry, one of the retailers realized that the other one had 5 percent lower wholesale prices: "(...) Fünf Prozent höher lagen nach seinen Worten die Einkaufspreise. Das wollten und konnten wir so nicht akzeptieren (...)" http://www.abendblatt.de/daten/2006/03/17/544236.html

[4]An accompanying study assesses the welfare effects of the mergers that occurred in this market between Jacobs and Onko and between Tchibo and Eduscho, Villas-Boas (2007).

twenty nine percent, then Edeka with fourteen percent and finally Rewe with 11 percent. Among the retail chains not considered in the data there is the German version of Walmart, called Aldi, who in fact does not provide detailed scanner data to researchers, but estimates of the market share of this chain were obtained and are used to compute the outside option not modeled. Looking at brand presence per retail chain, Jacobs is the market leader, followed by Melitta and Tchibo. However, Tchibo is the top-selling brand at Rewe. In terms of descriptive statistics for prices, Markant seems to be offering the lowest overall prices. Melitta, Jacobs, Onko, and Eduscho are somewhat lower-priced at all retailers, whereas Idee, Dallmayr and Tchibo occupy the upper end of the market. Price data are expressed in Deutsch Marks per 500 grams. Most of the quantity time series variation may be attributed to temporary price discounts. This is particularly true for the leading brands in the market, Jacobs, Tchibo and Melitta.

In terms of promotions data, the dataset contains a dummy variable for the presence of store-front advertisements, display and feature advertising, and this variable varies by brand and by retailer. Auxiliary data on total advertising expenditures by brand (but not by brand by retailer) varies by year.

The quantity data consist of quantities sold for each brand of coffee at the different retailers. A unit in this data set corresponds to 500 grams of coffee, the modal package size of the products sold. To calculate the market share of each brand allowing for no purchase option (also called outside good option), one needs a measure of the size of the potential market. Market size per key account is calculated based on individual consumer panel data obtained from GfK Germany, which records panelists' shopping trips. Given that the panel is representative, for each chain, the number of shopping trips in a given week is defined as the total market potential. I then use this measure of market size to calculate the share of the outside good and the brand shares. Given the largest other retailer not included in the data, Aldi, I include the potential impact of Aldi by adjusting the weekly market size, i.e., the magnitude of the outside good, to account for the percentage of consumers who made their coffee purchases there (3% in 2000 and 4.5% in 2001).

3. The Model

The economic-econometric model for this study is a standard discrete choice demand formulation (see, e.g., McFadden 1984, Berry, 1994, Berry, Levinsohn and Pakes, 1995 and Nevo, 2001) and a supply model of vertical relationships between manufacturers and retailers, where multiple Bertrand-Nash competing manufacturers choose wholesale prices and then multiple Bertrand-Nash competing retailers choose retail prices given the wholesale prices. The price-cost margins for the retailers and manufacturers are expressed solely as functions of demand substitution patterns. Due to data-set limitations, I do not observe wholesale prices or separate data on wholesale and retail costs. This section derives expressions for the total sum of retail and manufacturer price-cost margins as functions of demand substitution patterns for the supply model of no uniform wholesale pricing, following Villas-Boas (2006) and I refer to this paper for more details on the supply side derivation.

3.1. Demand Side

Assume the consumer chooses in each period[5] t among N_t different products sold by several retailers. I define a certain product at the retail-manufacturer level. For example, if product A is sold at retailers 1 and 2 I consider there to be at the consumer level two products, $n = A1, A2$, to chose from. Using the typical notation for discrete choice models of demand, the indirect latent utility of consumer i from buying product j during week t is given by

$$u_{ijt} = d_j + \gamma d_t + x_{jt}\beta - \alpha_i p_{jt} + \xi_{jt} + \epsilon_{ijt} \tag{1}$$

where d_j represents product (brand-store) fixed effects capturing time invariant product characteristics, d_t is a time trend capturing time varying unobserved determinants of demand, x_{jt} contain promotions and advertising expenditures by brand by retailer, p_{jt} is the price of product j, ξ_{jt} identifies the mean across consumers of unobserved (by the econometrician) changes in product characteristics[6] and ϵ_{ijt} represents the distribution of consumer preferences about this mean. The coefficients β are unknown consumer taste parameters for the different promotional variables, and the random coefficients α_i represent the marginal disutility of price. These taste parameters for price are allowed to vary across consumers according to $\alpha_i = \alpha + \Upsilon\ v_i$ where unobserved consumer characteristics are contained in v_i. The parameter α represents the mean of the random coefficient described above. The non-linear demand parameter Υ captures the unobservable heterogeneity due to random shocks v_i. In the econometric model, unobserved random consumer characteristics v_i are assumed to be normally distributed.

[5]The demand model is static and consumers choose every period among alternatives. The consequences of assuming the static demand model in this context are important (as found in Che, Seetharaman and Sudhir, 2003). I acknowledge that ignoring state dependence is a simplification in this paper and, as shown in Hendel and Nevo (2006), ignoring dynamic demand results in biased demand elasticities and thus in estimated price cost margins that are too low for single and multi-product firms.

[6]In particular, ξ_{jt} includes the (not-trending) changes in unobserved product characteristics such as unobserved promotions, changes in shelf display and changes in unobserved consumer preferences.

Additionally, an outside good is included in the model, allowing for the possibility of consumer i not buying one of the N_t marketed goods. Its price is not set in response to the prices of the other N_t products. The outside good includes the possibility of not buying as well as products sold by grocery stores not considered in the analysis. The mean utility of the outside good, δ_{0t}, is normalized to be constant over time and equal to zero. The measure M_t of the market size has been described above, and is calculated based on an individual consumer panel data-set. The observed market share of product j during week t is then given by $s_{jt} = q_{jt}/M_t$, where q_j are the units sold.

Assuming that consumers purchase one unit of that product[7] among all the possible products available at a certain time t that maximizes their indirect utility then the market share of product j during week t is given by the probability that good j is chosen, that is,

$$s_{jt} = \int_{[(v_i,\epsilon_{it})|u_{ijt} \geq u_{iht} \ \forall \ h=0,\ldots N_t]} dF(\epsilon)\, dF(v). \tag{2}$$

If v is fixed and consumer heterogeneity enters only through the random shock where ϵ_{ijt} is distributed i.i.d. with an extreme value type I density, then (2) becomes the Multinomial Logit model. Assuming that ϵ_{ijt} is distributed i.i.d. extreme value and allowing consumer heterogeneity to affect the taste parameters for the different product characteristics, this corresponds to the full random coefficients model or mixed Logit model.[8]

3.2. Supply Side Model of No Uniform Wholesale Pricing

The supply side assumes the standard linear pricing model in which M manufacturers set wholesale prices p^w and R retailers follow setting retail prices p, and this price setting behavior occurs every time period (in this case every week).[9] Let retailers' marginal costs be constant and given by c^r and let manufacturers' marginal cost be constant and given by c^w. I consider the following benchmark model of no uniform wholesale pricing where, following the example from above, manufacturer A

[7] Dubin and McFadden (1984), Hanemann (1984), Hausman, Leonard and McFadden (1995) and Hendel (1999) explicitly model multiple discrete choices but do need individual level data for estimation. Since this paper uses only market-level data, these techniques could not be directly applied here. Failure to account for multiple discreteness significantly affects cross-product substitution patterns and matters less for aggregate demand predictions (Dubé, 2004).

[8] This is a very general model. As shown in McFadden and Train (2000), any discrete choice model derived from random utility maximization can be approximated, with any degree of accuracy, to a Mixed Logit. If there are systematic changes in preferences over time then these are not captured in the random coefficients on observed product characteristics. The effect on the direction of the parameter bias of this possibility may not be entirely clear.

[9] It would be interesting to investigate cases when retail prices do not change every week solely due to manufacturer-retailer relationships, but change due to other (possibly dynamic) reasons.

is allowed to set, if he wishes to do so, two different wholesale prices for the same product sold through the two different retailers (that is p^w_{A1} may be chosen to be different from p^w_{A2}).

Assume each retailer maximizes his profit function:

$$\pi_r = \sum_{j \epsilon S_r} \left[p_j - p^w_j - c^r_j \right] q_j(p) \quad \text{for} \quad r = 1, ...R. \tag{3}$$

where S_r is the set of products sold by retailer r. The first-order conditions, assuming a pure-strategy Nash equilibrium in retail prices, are:

$$q_j + \sum_{m \epsilon S_r} T_r(m, j) \left[p_m - p^w_m - c^r_m \right] \frac{\partial q_m}{\partial p_j} = 0 \quad \text{for} \quad j = 1, ...N \tag{4}$$

where matrix T_r has the general element $T_r(i, j) = 1$, if the retailer sells both products i and j and equal to zero otherwise. Switching to matrix notation, let us define $[A * B]$ as the element-by-element multiplication of two matrices of the same dimensions A and B. Let Δ_r be a matrix with general element $\Delta_r(i, j) = \frac{\partial q_j}{\partial p_i}$, containing retail level demand substitution patterns with respect to changes in the retail prices of all products. Solving (4) for the price-cost margins for all products in vector notation gives the price-cost margins m_r for the retailers under Nash-Bertrand pricing:

$$\underbrace{p - p^w - c^r}_{m^r} = -[T_r * \Delta_r]^{-1} q(p), \tag{5}$$

which is a system of N implicit functions that expresses the N retail prices as functions of the wholesale prices. If retailers behave as Nash-Bertrand players then equation (5) describes their supply relation.

Manufacturers choose wholesale prices p^w to maximize their profits given by

$$\pi_{wt} = \sum_{j \epsilon S_{wt}} \left[p^w_{jt} - c^w_{jt} \right] s_{jt}(p(p^w)), \tag{6}$$

where S_{wt} is the set of products sold by manufacturer w during week t and c^w_{jt} is the marginal cost of the manufacturer that produces product j, and knowing that retailers behave according to (5). Solving for the first-order conditions from the manufacturers' profit-maximization problem, assuming again a pure-strategy Nash equilibrium in wholesale prices and using matrix notation, yields:

$$\underbrace{(p^w - c^w)}_{m^w} = -[T_w * \Delta_w]^{-1} q(p), \tag{7}$$

where T_w is a matrix with general element $T_w(i,j) = 1$, if the manufacturer sells both products i and j and equal to zero otherwise, Δ_w is a matrix with general element $\Delta_w(i,j) = \frac{\partial q_j}{\partial p_i^w}$ containing changes in demand for all products when wholesale prices change subject to retail mark-up pricing behavior assumed in (5), and $*$ represents the element-by-element multiplication of both matrices.[10]

4. Simulation of Uniform Wholesale Pricing

This section outlines how to perform the policy simulations of the uniform wholesale pricing Nash equilibrium. In the uniform wholesale price model, and following the simple example from above, the manufacturer is constrained to set the same wholesale price for product A sold at any retailer (that is p^w_{A1}=p^w_{A2}).

Given demand and assuming the model of no uniform pricing (derived in 3.2) as starting point, where retail and manufacturer mark-ups are given by (5) and (7), respectively, I recover the marginal costs under such model by

$$\underbrace{c^w + c^r}_{\hat{c}_{3.2}} \;=\; p \;-\Big[\;-[T_r * \Delta_r]^{-1} q(p) - [T_w * \Delta_w]^{-1} q(p)\Big]\,. \tag{8}$$

Note that I recover the sum or retail and manufacturer marginal costs in (8) without the need to observe wholesale prices, once I have estimated demand.

Then the simulation analysis consists in numerically computing the new Nash equilibrium after imposing constraints on uniform wholesale pricing based on the estimates obtained for the demand and marginal cost recovered under no uniform wholesale pricing. The equilibrium (N by 1) vector of retail prices under uniform wholesale pricing restrictions are the prices that solve

$$p^* = \hat{c_{3.2}} + \underbrace{\text{Retail Margins } (p^*) + \text{Manufacturer Margins } (p^*)}_{\text{Under Uniform Pricing}}, \tag{9}$$

again without the need to observe wholesale prices. Details on how to compute the manufacturer and retail margins under uniform wholesale pricing are provided in the appendix.

[10]For the derivation of Δ_w see Villas-Boas (2006).

I access the changes in the welfare components (consumers', manufacturers' and retailers' surplus) resulting from the changes of the simulated counterfactual equilibrium prices p^* after uniform wholesale pricing from the observed equilibrium prices p with no uniform wholesale pricing. Given the demand model utility maximization primitives, expected consumer i's surplus (following Small and Rosen, 1981) is defined as $E\left[CS_i\right] = \frac{1}{|\alpha_i|}E\left[max_j(u_{ij}(p)\forall j)\right]$, where α_i denotes the marginal utility of income in (1) that is assumed to remain constant for each household. Given the extreme value distributional assumptions and linear utility formulation, the change in consumer surplus for individual i is computed as

$$\Delta E\left[CS_i\right] = \frac{1}{|\alpha_i|}\left[ln\left(\sum_{j=1}^{N} e^{d_j + x_j\beta_i - \alpha_i p_j^*}\right) - ln\left(\sum_{j=1}^{N} e^{d_j + x_j\beta_i - \alpha_i p_j}\right)\right]. \tag{10}$$

This measure of consumer valuation is computed using the estimated demand model parameters and the simulated counterfactual retail equilibrium prices. Total change in consumer surplus is obtained by adding this over all the individuals. The change in the sum (given that I do not observe wholesale prices) of manufacturers' and retailers' producer surplus is given by

$$\Delta E\left[PS\right] = \left[\sum_{j=1}^{N}\left(\pi_j^r\left(p^*\right) + \pi_j^w\left(p^*\right)\right) - \sum_{j=1}^{N}\left(\pi_j^r\left(p\right) + \pi_j^w\left(p\right)\right)\right]. \tag{11}$$

where I assume that manufacturer and retailer marginal costs remain unchanged. The change in total welfare is the sum of total change in consumer surplus, manufacturers' producer surplus and retailers' producer surplus.

5. Estimation and Results

With the data sample discussed in section 2, demand is estimated and the estimates are used to compute price-cost margins for retailers and manufacturers assuming the benchmark model of no uniform pricing (derived in 3.2) as starting point, to then finally simulate the resulting equilibrium from imposing uniform wholesale pricing practices, and derive expressions to compute estimates of welfare, consumer surplus and producer surplus changes.

5.1. Demand Estimation

When estimating demand, the goal is to derive parameter estimates that produce product market shares close to the observed ones. This procedure is non-linear in the demand parameters, and prices enter as endogenous variables. The key step is to construct a demand side equation that is linear in the parameters associated with the endogenous variables so that instrumental variables estimation, GMM, can be directly applied. This follows from equating the estimated product market shares[11] to the observed shares and solving for the mean utility across all consumers, defined as

$$\delta_{jt}(\Upsilon) = d_j + \gamma d_t + x_{jt}\beta - \alpha p_{jt} + \xi_{jt}. \tag{13}$$

For the mixed Logit model, solving for the mean utility (as in Berry, 1994) has to be done numerically (see Berry, Levinsohn and Pakes, 1995). Finally, once this inversion has been made, one obtains equation (13) which is linear in the parameter associated with price. Let θ be the demand side parameters to be estimated, then $\theta = (\theta_L, \Upsilon)$ where Υ are the non-linear parameters. In the mixed Logit model, θ is obtained by feasible Method of Simulated Moments following Nevo's (2000) estimation algorithm, where equation (13) enters in one of the steps.

5.2. Instruments and Identification of Demand

The remainder of the paper relies heavily on having consistently estimated demand parameters or, alternatively, demand substitution patterns. In this paper, the experiment asks consumers to choose between different products over time, where a product is perceived as a bundle of attributes (among which are prices). Since prices are not randomly assigned, I use input price changes over time that are significant and exogenous to unobserved changes in product characteristics to instrument for prices. These cost instruments separate cross-brand variation in prices as well as cross-store/brand variation in prices due to exogenous factors from endogenous variation in prices from unobserved product characteristics changes. It is reasonable to assume that the prices of inputs are uncorrelated with changes in unobserved product characteristics, ξ_{jt}. For example, changes in shelf display in Markant are most likely not correlated with manufacturer input prices such as the prices of coffee price in New York Stock Exchange. The exact cost measure used in the analysis is the trade-volume weighted average of the five most traded contracts at the New York Stock Exchange, where the dollar prices were adjusted for the exchange rate and taxes.

[11]For the random coefficient model the product market share in equation (2) is approximated by the Logit smoothed accept-reject simulator given by

$$s_{jt} = \frac{1}{R}\sum_{i=1}^{R} \frac{e^{\delta_{jt}+[p_{jt}](\Upsilon\ v_i)}}{1+\sum_{k=1}^{N_t} e^{\delta_{kt}+[p_{kt}](\Upsilon\ v_i)}}, \tag{12}$$

where R are the random draws from the distribution of v. This simulator is continuously differentiable in the data and in the parameters to be estimated, so gradient-based methods are applied to estimate Υ.

5.3. Demand Estimation Results

The demand model estimates are presented in Table 2. The first set of columns present the OLS estimates without instrumenting for price, the second set of columns present the Logit model estimates. In the last set of columns consumer heterogeneity is considered by allowing the coefficient on price to vary across consumers as a function of unobserved consumer characteristics, and the Generalized Method of Moments estimates of the random coefficient specification are presented, where the individual choice probabilities are given by (2).

The first stage R-squared and F-Statistic are high suggesting that the instruments used are important in order to consistently estimate demand parameters. Also when comparing the first two set of columns corresponding to no instrumentation (OLS) with the other columns to the right, when price is instrumented for, one notices that the estimates of the other variables affecting utility are robust to instrumentation, and the price parameter increases slightly when instrumenting, in absolute value.

On average price has a significant and negative impact on utility and, moreover, when comparing the Logit with the random coefficient specification, it appears that unobservable characteristics in the population seem to affect the price coefficient significantly. Promotion and advertising coefficients are significant and positive, and are thus estimated demand expanding factors. There is a significant and negative time trend effect, which is in line with the evidence in the market that the overall attractiveness of the category has been diminishing over time in the German coffee market.[12]

5.4. Supply Estimation Results

The demand estimates from the random coefficient specification are used to compute the implied estimated substitution patterns, which in turn are combined with the model of retail and manufacturer behavior to estimate the retail and wholesale margins. In Table 3 the summary statistics for the estimated margins are presented under the benchmark model of no uniform wholesale pricing. Subtracting the estimated margins from retail prices I also recover the sum of retail and manufacturer marginal costs of all products for both models, and summary statistics for those are provided in the bottom of the table.

The average estimated recovered cost of 4.3 Deutsch Marks per unit is very plausible, according to industry research, and also within the ball-park when comparing with the average raw coffee

[12]Industry evidence from Germany shows that yearly consumption, measured as kilograms per capita per year, has fallen by ten percent from over 7.4 in the twelve year period of 1990-2002.

price after adjusting for the expected loss in volume when produced. Starting with an average raw coffee price of slightly over 4 Deutsch Marks per 500 grams, and given that there is a weight loss in the process of roasting the coffee, one obtains an estimate of 4.4 Deutsch Marks per 500 grams, which is not significantly different from the average recovered cost estimate. If considering an alternative model where wholesalers margins are zero, as found in Villas-Boas (2006), the recovered cost estimates are different from the raw cost estimate at the five percent significance level, whereas, for the benchmark model we cannot reject at any significance level that the recovered costs are equal to the raw coffee estimate.

Breaking up the supply estimates by manufacturers, and comparing the column of standard deviations (across brands and time), the largest brands, Jacobs and Tchibo exhibit larger variability of estimated margins, while Melitta has the lowest estimated variability. Looking at the retail level, Metro exhibits slightly larger variability in the estimated margins.

5.5. Analysis of Wholesale Price Differences Across Retailers

One nice thing about this approach is that, if I make one more assumption on costs of the N products in the choice set, I can look at estimated differences in wholesale prices for the same brand sold at different chains. The assumption one needs to make, in particular, is that the retailer costs c_i^r for the brand i are the same no mater at which retailer that brand is sold.[13] The way I have defined a product in the choice set, is as a brand sold at a certain retailer. Remember there are twenty eight products, consisting of seven brands sold at four retailers. Equation (8) recovers for all twenty eight products the sum of retailer and manufacturer marginal costs.

The first step is to compute differences among the costs obtained from equation (8) within brand, obtaining for example, for a certain week the recovered difference of the sum of retail and wholesale marginal costs of Jacobs sold at Edeka minus the wholesale and retail costs that same week of Jacobs sold at Markant. Given the assumption above, by performing this difference within brand across retailers, one obtains for Jacobs the difference in wholesale costs from distributing and producing Jacobs and selling it via Edeka versus Markant. The first step consists thus of performing for each of the seven brands the recovered differences in wholesale costs, and this consists in performing six differences per brand. Each difference I shall define for further reference as

$$\underbrace{c_j^w + c_j^r - (c_k^w + c_k^r) = c_j^w - c_k^w}_{\text{Under the assumption that } c_j^r = c_k^r} \tag{14}$$

[13] I thank Andrew Sweeting and Ariel Pakes for this suggestion.

given that both products j and k are the same brand but sold and distributed to different retailers.

In the second step, note that given that wholesale margins are defined as the wholesale price minus the wholesale cost, if one computes the difference between wholesale margins of j versus k one obtains

$$p_j^w - c_j^w - (p_k^w - c_k^w) = p_j^w - p_k^w - \underbrace{c_j^w - c_k^w}_{\text{equal to (14)}}. \tag{15}$$

If one adds to the differences in wholesale margins in (15) the difference in wholesale costs in (14), one obtains a data-set of the recovered difference in wholesale prices $p_j^w - p_k^w$ for all brands when comparing among all the retailers.

The recovered mean differences in wholesale prices (MDWP) by brand among the different retailers are given in Table 4, and are expressed in Deutsch Marks per unit of 500 grams. If the above assumption on retail costs is reasonable, then when looking at the mean differences in wholesale prices, in the three columns to the left, there are some interesting patterns that emerge. First, looking at the decomposition by brand, Idee, Tchibo and particularly Eduscho exhibit the smallest wholesale price differences, and these last two brands belong to the same manufacturer. If wholesale price uniformity is imposed in the next section, then one would expect Idee, Eduscho and Tchibo wholesale prices to have the smallest changes given such policy, given that they seem to be the least price discriminating brands. Second, Dallmayr, Onko and also Jacobs exhibit the largest wholesale price differences (except when comparing among the chain Metro and Rewe, but when comparing both these retailers, all brands exhibit the lowest or practically no wholesale price differences). This suggests that Dallmayr, Onko and also Jacobs' wholesale pricing should be the most (first order) affected by uniform pricing policy. Third, and following up in terms of the retail level comparisons, when comparing the retailer Metro with the others, it looks like Metro and Rewe have the highest wholesale prices overall.

The three columns to the right have the average of the ratio of the MDWP and a cost estimate consisting of the average estimated raw coffee cost adjusted after roasting. That cost estimate is about 5 Deutsch Marks per unit. To get an idea on how large these wholesale price differences are, I divide them by this estimate of marginal cost. That estimate may be a lower bound on any wholesale price charged by any brand. So the ratio between the wholesale price differences and that estimate is somewhat an overestimate of the percent differences. As can be seen in the table, and looking at the retail level averages as percentage of costs, they are very consistent with the five percent quoted in the introduction, so they do seem quite reasonable as an approximation. Even if I divide the price differences by the average retail price, which is an upper bound on any wholesale price, that percentage is larger than 4 percent for the Metro and Markant and Edeka comparisons, which again looks reasonable given the industry evidence.

6. Uniform Wholesale Pricing Policy Simulations

Estimated effects from simulating uniform wholesale pricing in this market are presented in this section. Table 5 provides summary information on the general price level changes, price changes by brands and by retailers due to uniform wholesale pricing policy. Looking at simple average price changes or at weighted average price changes, where the weights are given by the product markets shares from the benchmark model of no uniform pricing, yields similar results. Although the average across all products price effect is very small, a decrease of about 0.04 Deutsch Marks or four Pfennig, the average retail price changes by retailers and manufacturers are negative and significant. Comparing average price changes by manufacturers and by retailers yield no significant differences. In the next table the results for changes in producer and in consumer surplus are presented.

In intermediate goods market price discrimination literature there are no general theoretical predictions of price, profits, consumer surplus and welfare effects resulting from uniform wholesale pricing.[14] In Table 7 I present the estimated effects on producer surplus and consumer surplus, and particularly distinguishing the estimated effects on manufacturers and retailers' producer surplus from imposing uniform wholesale pricing. I emphasize that I not only are able to estimate the joint effects on retailers and manufacturers surplus but also on the retail-level and manufacturer-level components of the surplus, even though I do not observe data on wholesale prices.

In the bottom of the table joint vertical producer surplus is estimated to increase at the ten percent significance level. The implications of the small and (barely) significant increase in total surplus are interesting, namely that the possibility to wholesale price discriminate under the starting model did by itself not contribute to the vertical profits in the benchmark case, since preventing it via uniform wholesale pricing has small positive effects on vertical profits.

From the breaking down by manufacturers and retailers I find that the retailers and the manufacturers on average benefit from this policy simulation. In terms of the heterogenous effects on the different retailers and on the different manufacturers, there are significant differences to note.

[14] Theoretical predictions in the context of final goods markets' resulting from third degree price discrimination are also ambiguous (see Stole, 2001 for a survey and also Thisse and Vives, 1988 and Corts, 1998). Profits may increase (Holmes, 1989) or decrease if competition becomes more intense ex-post (Armstrong and Vickers, 2001) in the theoretical third degree price discrimination literature models.

From pairwise comparisons of average surplus changes between retailers, consisting of the differences in estimated means, Metro benefits the most and significantly from the uniform wholesale pricing simulation. In terms of manufacturer specific effects, Dallmayr benefits significantly while the other manufacturers' surpluses exhibit positive but not significant changes at the five percent significance level. The estimated average effects from uniform wholesale pricing on all individual manufacturers' and individual retailers' surplus are positive. These effects are significant for Metro at the five percent significance level and for Markant at the ten percent significance level, while for the other two retailers the effects are positive but not significant. It is interesting to note that the retailer Metro, that according to Table 4 faces the pre-simulation largest wholesale price differences and has overall estimated larger wholesale prices, does exhibit post-simulation indeed the largest change in its surplus compared to the other retailers.

I note that the estimated changes in surplus represent small percentages of channel revenues. The implications of the very small and not significant increases in manufacturer surplus are interesting, namely that the possibility to wholesale price discriminate under the starting model did by itself not contribute to the profits of most manufacturers in the benchmark case, since preventing it via uniform wholesale pricing has small positive or not significant effects on average on their profits.

Finally, looking at estimated changes in consumer surplus measured as the difference in compensating variation identified from the demand model, consumers in the market do have a positive and significant estimated impact on their surplus of one hundred and sixty Deutsch Marks a week, which represents about one percent of weekly revenues in this market. Consumer level effects are estimated to be of the same magnitude and sign than those estimated effects on overall producer surplus at any significance level. Thus the welfare effects are overall small, positive and significant.

6.1. Welfare Estimates from Simulation of Uniform Wholesale Pricing under Counterfactual Demand and Supply Scenarios

Here I consider counterfactual scenarios when performing the uniform pricing simulations. These what-if simulations aim at taking the results one step further. While the estimated results for the benchmark scenario discussed in the previous subsection are interesting, by investigating how estimated welfare changes would be like under counterfactual demand and supply scenarios takes the empirical exercise beyond the market at hand. In particular I consider departures from Bertrand Nash pricing assumptions, by assessing the implications of other oligopolistic models of retail or manufacturer competition, and of alternative demand models on the empirical estimates of average welfare changes.

The approach to perform these what if simulations is as follows. For example, for alternative supply scenarios, the counterfactual Nash equilibrium retail prices of no uniform pricing under collusive retail or manufacturer markets are first simulated. And then those prices are compared to the Nash equilibrium simulated retail prices resulting from a uniform wholesale pricing policy under those same collusive retail or manufacturer markets. Changes in producer and consumer surplus are finally computed. I also perform simulations of uniform wholesale pricing under counterfactual demand parameters, more precisely changing the mean price sensitivity and heterogenity demand parameters significantly using the same methodology. The final simulations use both changes in demand and supply primitives and the resulting simulated welfare changes due to uniform wholesale pricing are computed.

All the above counterfactual simulated price changes and estimated welfare changes are presented in Table 7. From the benchmark case in the first row and first column of this table the conclusion is that on average retail prices decrease, retail and manufacturer profits increase as does consumer surplus. Going down along the first column, for the benchmark demand estimates I simulate the resulting Nash equilibria under more collusive retail and manufacturer models and compute the welfare changes resulting from imposing uniform wholesale pricing. The results show that under those counterfactual scenarios welfare decreases due to both drop in producer and consumer surplus, and average retail prices do increase, and this happens for both manufacturer collusive as well as for retailers' collusive scenarios. This result in terms of manufacturer collusion is consistent with Caprice (2006)'s findings that having more competitive upstream manufacturers leads to welfare increases when banning wholesale price discrimination, and we show that this would happen for retailers changes in competition as well. In fact, for this market, the estimated changes in welfare resulting from uniform wholesale pricing under manufacturer and under retailer collusive models are of the same magnitude and not significantly different from each other.

Going now along the first row to the second and third columns, the results correspond to changes in welfare from banning wholesale price discrimination under alternative demand scenarios. Column (A) corresponds to changing the mean price marginal utility significantly and thus having larger elasticity estimated in absolute value. Column (B) corresponds to changing significantly the random coefficient on price, creating more heterogeneity in the demand. Comparing the first column with the second, having a more elastic demand leads to a significant increase in the welfare estimates, average retail price resulting from simulating uniform wholesale pricing drops much more than in the benchmark case, and given that demand is more elastic, the producer surplus increases significantly relative to the benchmark case as does the estimated change in consumer surplus. Finally, more heterogeneity in the underlying demand model leads to a larger increase in simulated retail prices due to uniform wholesale pricing, and producer and consumer surplus decreases significantly.

In rows two and three and columns two and three of Table 7 I present the estimated changes in welfare for counterfactual retail and demand joint scenarios (in the second row of results) and for the counterfactual manufacturer model at the same time as changing the demand (in the third row of results). Changes in welfare due to changes in demand elasticity seem to dominate the changes in welfare due to retail and or manufacturer collusion. On the contrary, changes in the amount of heterogeneity in the demand model lead to changes in welfare in the same (negative) direction as those due to retail and manufacturer collusion and thus welfare decreases even more. Interestingly, and going down along the third column, wholesale collusion and high demand heterogenity lead to the largest decrease in surplus, mostly due to the largest drop in producer surplus. The drop in surplus in this case is larger than the drop in producer surplus when retail collusion is paired with high demand heterogeneity.

7. Conclusions and Extensions

In this paper the goal is to make inferences about wholesale price discrimination and uniform wholesale pricing policy, by simulating the effects of such uniform wholesale price legislation in a grocery retail market. Given a demand and supply model of three competing retailers' and a handful of manufacturers' oligopoly-pricing behavior in the German coffee market I estimate the demand model and recover the underlying marginal costs of each firm in this market under a no uniform wholesale pricing starting scenario. The objective of the empirical analysis is to simulate the counterfactual equilibrium prices if uniform wholesale price restrictions would be implemented in this market. In doing so, I estimate there to be positive overall welfare effects from preventing wholesale price discrimination. These welfare gains are driven by both gains in consumer surplus and gains in total vertical producer surplus. In terms of resulting estimated changes in producer surplus the effects are in the same order of magnitude and not significantly different from the gains in consumer surplus. The pattern of heterogeneous effects among different retailers and different manufacturers is also reasonable. All exhibit gains, although of different economic magnitudes and significance, where the retailer that according to our analysis has the pre-simulation largest wholesale prices, does exhibit post-simulation indeed the largest gain in its surplus.

Through simulations I also show how the estimated welfare effects change given counterfactual retail, manufacturer and demand scenarios. For more collusive retail and manufacturer counterfactual scenarios, the main take away is that estimated welfare decreases when there is no wholesale price discrimination, due to higher simulated retail prices. Furthermore, I find that estimated welfare changes also depend on the elasticity and heterogeneity of demand in the market, where banning wholesale price discrimination may be actually welfare improving the less heterogenous and the more elastic demand is.

This paper develops and analyzes an economic model of wholesale pricing in the markets that only requires data at the retail level and at the upstream input price level and that does not require observed data on wholesale prices. It also outlines the policy simulation procedure for uniform wholesale price legislation subject to the lack of observable wholesale price data. Given that this is the typical data situation researchers and policy makers face, the main contribution is to derive simple tools to shed light into welfare effects of and as a basis for inference on the existence of uniform wholesale pricing practices in the markets. General theoretical predictions regarding the price, profits, consumer surplus and welfare effects of eliminating price discrimination (via uniform wholesale pricing) in a multiple retailer and manufacturer setting are ambiguous, and remain an empirical question of policy relevance in the markets. This paper sheds some light into this, by investigating how estimated welfare changes under counterfactual demand and supply scenarios.

A possible extension to this current empirical approach is to model, estimate and simulate non discriminating wholesale pricing in the presence of non-linear wholesale pricing, as in Rey and Tirole (2005) and Caprice (2006), and following the methodological and empirical methods first implemented in Bonnet, Dubois and Simioni (2004). Building on the results of this present paper, future research considers the fact that looking at just one category may be restrictive since manufacturers, retailers and consumers make their pricing and consumption decisions in the context of multiple categories. Finally, this approach can be also easily extended to other settings where uniform wholesale price is being considered or enforced. Not only can policy makers access the overall welfare effect of such interventions, without observing wholesale prices, but they may also estimate the effects separately on the retailers and manufacturers involved. Let me, for illustrative purposes, consider the gasoline markets where "fair/uniform wholesale price legislation" is being considered.[15]. In North California, a debate centers on the "Wholesale Motor Fuel Fairness and Competition Restoration Act" which "seeks to reduce the exorbitant price of gasoline". The legislation addresses two major factors that have been identified by industry experts as contributing to high gasoline prices: discriminatory pricing and price zones. It would effectively "outlaw price discrimination and price zoning by requiring oil companies to charge the same wholesale price regardless of service station ownership or location()." Proponents of the legislation claim that it will decrease retail gasoline prices. Gasoline refineries (upstream firms) use wholesale price discrimination to price discriminate

[15]See for example in the state of New York, the New York State Motor Fuel Marketing Practices Act (MFMPA) that went into effect last April 2004.

between retail gasoline markets by setting a lower price in more price-sensitive markets (typically in lower income markets) and a higher price in less price-sensitive markets. The policy contribution of a study along the lines of the present one applied to a gasoline local market, would consist in simulating the effect on retail prices from not allowing retail price discrimination across wholesalers. The results should add to the policy debate over wholesale price regulation in resource markets, in general, and the effects of the above mentioned gasoline wholesale price legislation of gasoline prices, in particular.

8. References

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	Prices	std p	Shares	Promotion	Advertising
Retailer Edeka					
Jacobs	6.815	0.325	30.359	1.277	2.335
Onko	5.980	0.564	8.547	1.057	0.224
Melitta	6.241	0.320	12.706	1.018	1.776
Idee	8.008	0.638	4.989	0.726	0.302
Dallmayr	7.314	0.421	15.820	1.166	1.618
Tchibo	7.893	0.422	17.951	0.661	1.640
Eduscho	6.960	0.499	9.628	0.932	1.465
Retailer Markant					
Jacobs	6.537	0.523	30.619	1.024	2.335
Onko	5.978	0.541	7.306	1.033	0.224
Melitta	5.965	0.440	19.581	1.290	1.776
Idee	7.779	0.697	3.709	0.783	0.302
Dallmayr	7.304	0.491	12.248	0.939	1.618
Tchibo	7.826	0.446	15.845	0.684	1.640
Eduscho	6.916	0.553	10.692	0.904	1.465
Retailer Metro					
Jacobs	7.093	0.724	27.485	0.921	2.335
Onko	6.557	0.808	10.172	0.577	0.224
Melitta	6.669	0.808	23.375	0.857	1.776
Idee	8.093	0.930	3.735	0.536	0.302
Dallmayr	7.818	0.666	11.091	0.710	1.618
Tchibo	7.738	0.512	11.841	0.694	1.640
Eduscho	6.958	0.603	12.301	0.910	1.465
Retailer Rewe					
Jacobs	7.039	0.537	23.350	0.688	2.335
Onko	6.296	0.397	7.157	0.578	0.224
Melitta	6.565	0.392	15.892	0.863	1.776
Idee	8.279	0.480	2.812	0.410	0.302
Dallmayr	8.109	0.817	7.806	0.448	1.618
Tchibo	7.912	0.444	28.434	1.025	1.640
Eduscho	6.919	0.528	14.549	1.134	1.465
By Retailers					
Edeka	7.017	0.721	13.528	0.866	9.360
Markant	6.769	0.829	29.072	0.991	9.360
Metro	7.117	0.864	46.697	0.805	9.360
Rewe	7.260	0.829	10.703	0.842	9.360

Table 1: Summary Statistics for the 28 Products in the Sample.
The mean of the variables in the data is reported. Prices are in Deutsch Marks per 500 grams, Quantity in units sold of 500 grams, and Advertising in Million Euros. Source: MAKADOM, Germany.

	$OLS(1)$		$Logit(2)$		$GMM(3)$	
Parameter	Estimate	Std	Estimate	Std	Estimate	Std
Price	−0.678	(0.016)	−0.753	(0.035)	−0.772	(0.065)
Constant	−2.137	(0.137)	−1.534	(0.284)	−1.619	(0.411)
Promotion	0.482	(0.015)	0.435	(0.025)	0.466	(0.033)
Trend	−0.002	(0.000)	−0.002	(0.000)	−0.002	(0.000)
Advertising	0.032	(0.008)	0.032	(0.008)	0.027	(0.007)
Onko in Edeka	−1.849	(0.052)	−1.922	(0.061)	−1.897	(0.064)
Melitta in Edeka	−1.172	(0.049)	−1.227	(0.054)	−1.202	(0.051)
Idee in Edeka	−0.678	(0.052)	−0.615	(0.058)	−0.663	(0.055)
Dallmayr in Edeka	−0.373	(0.048)	−0.340	(0.050)	−0.362	(0.047)
Tchibo in Edeka	0.612	(0.049)	0.664	(0.053)	0.632	(0.048)
Eduscho in Edeka	−0.858	(0.047)	−0.863	(0.048)	−0.862	(0.038)
Jacobs in Markant	0.620	(0.047)	0.587	(0.050)	0.604	(0.047)
Onko in Markant	−1.266	(0.052)	−1.340	(0.061)	−1.315	(0.065)
Melitta in Markant	−0.351	(0.049)	−0.414	(0.056)	−0.388	(0.058)
Idee in Markant	−0.454	(0.051)	−0.405	(0.055)	−0.444	(0.058)
Dallmayr in Markant	0.260	(0.047)	0.280	(0.048)	0.266	(0.043)
Tchibo in Markant	1.184	(0.049)	1.232	(0.053)	1.202	(0.046)
Eduscho in Markant	−0.034	(0.048)	−0.044	(0.048)	−0.041	(0.037)
Jacobs in Metro	1.086	(0.047)	1.090	(0.047)	1.085	(0.051)
Onko in Metro	−0.931	(0.052)	−0.984	(0.056)	−0.966	(0.089)
Melitta in Metro	0.301	(0.048)	0.270	(0.050)	0.283	(0.064)
Idee in Metro	0.001	(0.052)	0.061	(0.058)	0.015	(0.056)
Dallmayr in Metro	0.442	(0.049)	0.491	(0.053)	0.459	(0.069)
Tchibo in Metro	1.289	(0.048)	1.331	(0.051)	1.305	(0.045)
Eduscho in Metro	0.554	(0.047)	0.547	(0.048)	0.549	(0.040)
Jacobs in Rewe	−0.122	(0.047)	−0.134	(0.048)	−0.125	(0.044)
Onko in Rewe	−1.845	(0.053)	−1.917	(0.061)	−1.887	(0.075)
Melitta in Rewe	−0.960	(0.048)	−0.998	(0.051)	−0.980	(0.052)
Idee in Rewe	−1.161	(0.052)	−1.093	(0.060)	−1.142	(0.062)
Dallmayr in Rewe	−0.720	(0.050)	−0.663	(0.055)	−0.700	(0.057)
Tchibo in Rewe	0.666	(0.050)	0.736	(0.058)	0.692	(0.057)
Eduscho in Rewe	−0.833	(0.047)	−0.832	(0.048)	−0.836	(0.043)
Std. Deviation Price (Υ)					0.098	(0.035)
First Stage						
F(28,2766) (p-value)			50.78	(0.000)	50.78	(0.000)
R Squared			0.842		0.842	

Table 2: Results from Demand.

OLS (in columns (1)), Logit (in columns (2) and Random Coefficients (in columns (3)) GMM estimates and White standard errors are in parenthesis. Source: Author's calculations.

	Linear Pricing Model		
	mean	std	Percent of Price
Manufacturer Margins			
Jacobs	1.411	(0.078)	20.7%
Onko	1.399	(0.074)	22.9%
Melitta	1.383	(0.067)	22.0%
Idee	1.397	(0.077)	17.5%
Dallmayr	1.397	(0.076)	18.5%
Tchibo	1.422	(0.088)	18.2%
Eduscho	1.405	(0.077)	20.4%
Retailer Margins			
Markant	1.415	(0.087)	20.4%
Edeka	1.429	(0.092)	21.1%
Metro	1.445	(0.096)	20.2%
Rewe	1.417	(0.088)	19.7%
Total Margins	2.829	(0.167)	40.4%
Recovered Costs	4.299	(0.921)	
t-statistic(recovered costs=raw Coffee Estimate Costs)	0.705		

Table 3: Price-Cost Margins and Recovered Costs for Benchmark Linear Pricing Model. PCM=$(p-c)/p$ where p is price and c is marginal cost and all data are expressed in Deutsch Marks per 500 grams. Recovered Costs=$p-PCM$ where p is retail price and PCM are the estimated margins, also in Deutsch Marks per 500 grams. Std: Standard deviation. Source: Author's calculations.

	Mean Differences in Wholesale Prices (MDWP)			MDWP/ Average Coffee Cost in Percent		
Edeka	Markant	Metro	Rewe	Markant	Metro	Rewe
Jacobs	0.29	−0.25	−0.22	5.77%	−4.92%	−4.45%
Onko	0.02	−0.54	−0.31	0.34%	−10.84%	−6.27%
Melitta	0.29	−0.40	−0.32	5.73%	−7.92%	−6.43%
Idee	0.24	−0.06	−0.27	4.84%	−1.14%	−5.40%
Dallmayr	0.03	−0.47	−0.79	0.51%	−9.37%	−15.70%
Tchibo	0.08	0.18	−0.02	1.64%	3.54%	−0.45%
Eduscho	0.06	0.03	0.04	1.19%	0.53%	0.76%
Average in Edeka	0.10	−0.33	−0.29	2.09%	−6.68%	−5.81%
Std	(0.02)	(0.03)	(0.02)			
Markant						
Jacobs		−0.53	−0.51		−10.69%	−10.22%
Onko		−0.56	−0.33		−11.18%	−6.61%
Melitta		−0.68	−0.61		−13.65%	−12.16%
Idee		−0.30	−0.51		−5.98%	−10.24%
Dallmayr		−0.49	−0.81		−9.87%	−16.21%
Tchibo		0.10	−0.10		1.91%	−2.09%
Eduscho		−0.03	−0.02		−0.66%	−0.42%
Average in Markant		−0.44	−0.41		−8.88%	−8.26%
Std		(0.03)	(0.02)			
Metro						
Jacobs			0.01			0.21%
Onko			0.01			0.19%
Melitta			0.00			0.08%
Idee			0.00			0.01%
Dallmayr			0.00			0.03%
Tchibo			0.00			0.08%
Eduscho			0.01			0.10%
Average in Metro			0.00			0.06%
Std			(0.00)			

Table 4: Estimated Wholesale Price Differences.

Mean Differences in Wholesale Price Differences (MDWP) are expressed in Deutsch Marks per unit of 500 grams. Standard errors are in parentheses. The average estimated raw coffee cost adjusted after roasting is about 5 Deutsch Marks per unit, and is used as a reference for the wholesale price differences, as a lower bound on the wholesale prices. The three columns to the right have the average of the ratio of the MDWP and that cost estimate. Source: Author's calculations.

	Uniform Pricing Versus Baseline Model Scenario	
	Average Change	Std
Changes in Retail Price		
By Retailer		
Edeka	−0.035	(0.012)
Markant	−0.035	(0.012)
Metro	−0.044	(0.013)
Rewe	−0.039	(0.012)
By Manufacturer		
Jacobs	−0.039	(0.016)
Onko	−0.039	(0.015)
Melitta	−0.036	(0.014)
Idee	−0.043	(0.018)
Dallmayr	−0.040	(0.017)
Tchibo	−0.036	(0.017)
Eduscho	−0.036	(0.016)

Table 5: Estimated Price Effects from Simulation of Uniform Wholesale Pricing.
Prices are expressed in Deutsch Marks. The standard errors are reported in parentheses. The average product price before simulation is 7.13 Deutsch Marks per 500 grams. Source: Author's calculations.

	Average Estimate	Std	Percent of Correspondent Revenues
Change in Producer Surplus			
Retailers			
Edeka	9.51	(7.82)	0.05
Markant	28.68	(16.82)	0.14
Metro	47.49	(23.13)	0.23
Rewe	8.21	(6.38)	0.04
Manufacturers			
Jacobs	30.40	(20.06)	0.15
Onko	7.25	(3.93)	0.03
Melitta	15.61	(11.44)	0.08
Idee	4.89	(3.35)	0.02
Dallmayr	14.35	(6.82)	0.07
Tchibo	17.75	(14.86)	0.09
Eduscho	7.37	(9.39)	0.04
	Mean Estimate	Std	Percent Total Revenues
Change in Producer Surplus	191.50	(120.16)	0.92
Change in Consumer Surplus	162.05	(82.90)	0.78
Change Welfare	353.56	(145.98)	1.70

Table 6: Welfare Estimates from Simulation of Uniform Wholesale Pricing.
Effects are expressed in Deutsch Marks per week. The standard errors are reported in parentheses. Source: Author's calculations.

Counterfactual Scenarios

Underlying Retail and Wholesale Bertrand Nash BenchMark Model

	Underlying Demand		Change Demand (A)		Change Demand (B)	
Change in	Mean Estimate	Std	Mean Estimate	Std	Mean Estimate	Std
Price	−0.038	(0.006)	−0.409	(0.007)	0.346	(0.006)
Producer Surplus	191.5	(120.2)	1530.7	(117.3)	−905.8	(121.4)
Consumer Surplus	162.1	(82.9)	728.4	(52.8)	−1243.8	(143.2)
Welfare	353.6	(146.0)	2259.1	(128.7)	−2149.6	(187.7)

Retail Collusion and Wholesale Bertrand Nash

	Underlying Demand		Change Demand (A)		Change Demand (B)	
Change in	Mean Estimate	Std	Mean Estimate	Std	Mean Estimate	Std
Price	0.037	(0.006)	−0.452	(0.006)	0.320	(0.006)
Producer Surplus	−519.7	(250.0)	1662.8	(119.1)	−752.2	(100.4)
Consumer Surplus	−243.3	(119.9)	770.7	(53.6)	−1051.9	(120.0)
Welfare	−763.0	(277.3)	2433.5	(130.6)	−1804.1	(156.5)

Retail Bertrand Nash and Wholesale Collusion

	Underlying Demand		Change Demand (A)		Change Demand (B)	
Change in	Mean Estimate	Std	Mean Estimate	Std	Mean Estimate	Std
Price	0.041	(0.006)	−0.449	(0.006)	0.342	(0.007)
Producer Surplus	−512.0	(246.5)	1672.5	(119.6)	−13238.1	(678.9)
Consumer Surplus	−237.2	(119.9)	773.5	(51.9)	−1113.5	(129.3)
Welfare	−749.2	(274.1)	2446.0	(130.4)	−14351.6	(691.1)

Table 7: Welfare Estimates from Simulation of Uniform Wholesale Pricing in Counterfactual Demand and Supply Scenarios.
Change Demand (A) column has the estimates resulting from simulating two standard deviations shock in the mean price marginal utility (= parameter α), while the Change Demand (B) column has the estimates resulting from simulating two standard deviations shock in the standard deviation of the price marginal utility (= parameter Υ). Effects are expressed in Deutsch Marks per week. The standard errors are reported in parentheses. Source: Author's calculations.

APPENDIX

In this appendix I derive the uniform pricing margins to be used for policy simulations. Let me first define a N_U by N matrix U that has as many rows, as many different manufactured products (N_U) and has N columns equal to the retail level products, and which element $U(i,j) = 1$ if product i is the same manufactured product as product j and is equal to zero otherwise. For example, assume three products,$A1$, $A2$ and $B1$, at the consumer level where the first two are produced by manufacturer A and are the same product and product B is sold at retailer 1 and produced by manufacturer B. The matrix U that describes which manufactured products are in fact the same, for the three sets of products above, is a 2 by 3 matrix $U = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$. Following this simple example each of the two retailers, 1 and 2 maximizes the profit function $\pi_1 = [p_{A1} - p_A^w - c_{A1}^r]\, q_{A1}(p) + [p_{B1} - p_B^w - c_{B1}^r]\, q_{B1}(p)$ and $\pi_2 = [p_{A2} - p_A^w - c_{A2}^r]\, q_{A2}(p)$, respectively. Note that the wholesale price for A is the same for both retailers. Solving for optimal price cost margins yields a system that implicitly defines three retail prices as a function of two wholesale prices. Generally, retailers maximize their profits as given by equation (3) but now the same wholesale price is charged for the same manufactured products regardless of retail outlet. If retailers behave as Nash-Bertrand players then the price-cost margins for all products in vector notation m_r are as in (5) describing retail supply relation. Manufacturers choose wholesale prices p^w to maximize their profits in (6) knowing that retailers behave according to (5) and subject to U. Manufacturers now only get to choose wholesale prices for N_U products since some manufactured products sold through different retailers are the same and therefore need to be set the same wholesale price.

For example, in the simple example manufacturers maximize their profits with respect to only 2 wholesale prices, respectively, $\pi_A = [p_A^w - c_A^w]\, [q_{A1}(p(p_A^w, p_{B1}^w)) + q_{A2}(p(p_A^w, p_{B1}^w))]$ and $\pi_B = [p_{B1}^w - c_B^w]\, q_{B1}(p(p_A^w, p_{B1}^w))$.

Lets derive now, for the general case, the mark-ups keeping the notation as in the no uniform wholesale price model. Solving for the first-order conditions from the manufacturers' profit-maximization problem, assuming again a pure-strategy Nash equilibrium in wholesale prices and using matrix notation, yields:

$$\underbrace{(p^w - c^w)}_{m_U^w} = -\underbrace{\left[\left(\underbrace{T_w^{Up}}_{N_U \text{ by } N} * \underbrace{\Delta_w^{Up}}_{N_U \text{ by } N}\right) \underbrace{U'}_{N \text{ by } N_U}\right]^{-1}}_{(N_U \text{ by } N_U)} \underbrace{[U\ q(p)]}_{(N_U \text{ by } 1)}, \qquad \text{(i)}$$

where U is the (N_U by N) matrix defined above, T_w^{Up} and Δ_w^{Up} are (N_U by N) matrices to be derived next, and $*$ represents the element-by-element multiplication of both matrices. What gets to be inverted is the (N_U by N_U) full rank matrix due to uniform wholesale pricing. Note that the derived wholesale mark-ups are denoted by the (N_U by 1) vector m_U^w and that $N - N_U$ products share the same wholesale prices and mark-ups due to uniform wholesale pricing restrictions. If manufacturers behave as Nash-Bertrand players subject to uniform wholesale pricing restrictions then equation (i) describes their supply relation.

To obtain Δ_w^{Up}, first note that $\Delta_w^{Up} = \underbrace{(\Delta_p^{Up})'}_{(N_U \text{ by } N)} \Delta_r$, where Δ_p^{Up} is a matrix of derivatives of all retail prices with respect to all the N_U independent wholesale prices. To get the expression for $\Delta_p^{N_U}$, I start by totally differentiating for a given j equation (4) with respect to all retail prices ($dp_k, k = 1, \cdots, N$) and with respect to a single wholesale price p_f^w, with variation dp_f^w obtaining (**??**). Putting all $j = 1,...N$ products together, let G be the matrix with general element $g(j,k)$ and let H_f be an N-dimensional vector with general element $H(j,f)$, as defined in equation (**??**). Note now that $N - N_U$ wholesale price variations are not independent. In terms of matrix notation, when solving for the derivatives of all retail prices with respect to the wholesale price p_f^w, the f-th column of Δ_p^{Up} is obtained as:

$$\frac{dp}{dp_f^w} = G^{-1} \underbrace{[H_j + ... + H_k]}_{H_f^{Up}}, \text{ where } j, ..., k = f, \text{ are restricted to be the same in } U. \tag{ii}$$

Stacking all $N - N_U$ independent-wholesale-price-corresponding columns together, $\Delta_p^{Up} = G^{-1} H^{Up}$ reflects the derivatives of all N retail prices with respect to the N_U wholesale prices, where the general element of Δ_p^{Up} is $(i,j) = \frac{\partial p_i}{\partial p_j^w}$.

For the simple example, (i) corresponds to $\begin{bmatrix} m_A^w \\ m_{B1}^w \end{bmatrix} = - \begin{bmatrix} \frac{\partial(q_{A1}+q_{A2})}{\partial p_A^w} & 0 \\ 0 & \frac{\partial q_{B1}}{\partial p_{B1}^w} \end{bmatrix}^{-1} \begin{bmatrix} q_{A1} + q_{A2} \\ q_{B1} \end{bmatrix}$ where $\frac{\partial q_i}{\partial p_f^w} = \sum_k (\frac{\partial (q_i}{\partial p_k} \frac{\partial p_k}{\partial p_f^w})$, $k = A1, A2, B1$, and now Δ_p^{Up} is (3 by 2) and gives the responses of the three retail prices with respect to changes in the two upstream wholesale prices, which is constructed from totally differentiating the system of three first order conditions (for the three retail prices) of the two retailers, subject to common wholesale price for the products $A1$ and $A2$.