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Abstract

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An Empirical Investigation of the Welfare Effects of Banning Wholesale Price Discrimination*

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ABSTRACT

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1. Introduction

Wholesale price discrimination means that an upstream firm sets different prices for the same product for various downstream retailers. Wholesale price discrimination is commonly practiced in many markets. Examples include markets such as petroleum distribution, steel, heavy trucking, tobacco, and pharmaceuticals. In several countries, milk and other dairy products are sold using government administered or sanctioned discriminatory pricing schemes. Wholesale price discrimination practices are also used for services such as loans, insurance, and advertising.[1] Competition authorities have been concerned with wholesale price discrimination. The European Union Treaty's article 82 (c) prohibits practices where a dominant firm "would place trading partners at a competitive disadvantage." The U.S. 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.[2] As I discuss below, theory does not provide clear prediction about the welfare effects of wholesale price discrimination. The goal of this paper is to empirically assess the welfare effects of eliminating the possibility of wholesale price discrimination.

Wholesalers price discriminate for several reasons - such as to take advantage of differences in downstream demands and differences in downstream costs, - forces which have opposing welfare effects. To exploit differences in retail demands, it is optimal for the upstream firm to discriminate by setting a lower wholesale price in the more price-sensitive downstream markets and a higher price in the less price-sensitive ones (Schmalensee, 1981; Varian, 1985; Ireland, 1992). Bork (1978) posits that, as a result of such discrimination, total welfare will increase if new markets are served due to wholesale price discrimination. This effect is similar to the welfare test of a total increase in quantity in the case of third degree price discrimination in final goods markets.

If downstream firms' costs differ, the upstream firm sets a higher wholesale price to the more efficient, lower cost, retailer (Katz, 1987; De-Graba, 1990; Yoshida, 2000) and price discrimination will lower total welfare. By wholesale price discriminating the manufacturer shifts quantity from the more efficient retailer to the less efficient retailer. Moreover, in this context, the usual result that an increase in quantity sold increases welfare is no longer true. In the presence of downstream cost differences an increase in quantity sold may actually be a symptom of a welfare decrease due to wholesale price discrimination because the "wrong retailer is selling more" (Yoshida, 2000).[3]

Since the welfare effects of price discrimination cannot be determined theoretically, I estimate the effect empirically. In particular, I estimate the effects of uniform wholesale price legislation, which bans wholesale price discrimination, in a German grocery retail market where manufacturers wholesale price discriminate among retailers. As a first step I estimate a flexible demand system using detailed price and quantity data.

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[1] See, for gasoline markets, Texaco v. Hasbrouck, 496 US 543, No. 87-2048 (1990), and the New York State Motor Fuel Marketing Practices Act; for steel, Chan et. al. (2003); for heavy trucking, Volvo Trucks North America, Inc. v. Reeder-Simco GMC, Inc., Docket No. 04-905; for tobacco, Brooke Group Ltd. v. Brown and Williamson Tobacco Corp., 509 US 209, No. 92-466 (1993); for wholesale pharmaceutics see http://www.datcp.state.wi.us/trade/business/unfair-comp/drug_price.jsp; for dairy markets, see e.g., Gardner (1984); and for services see Givens (1983).

[2] Robinson-Patman enforcement has occurred mostly (56% of cases) in the food sector (Elzinga and Hogarty, 1978).

[3] Related literature extends the analysis to non linear wholesale pricing (O'Brien and Shaffer, 1992; McAffee and Schwartz, 1994; Rey and Tirole, 2005, Caprice, 2006). In this context, banning wholesale price discrimination has ambiguous welfare effects depending on upstream competition.

Using the demand estimates I am able to investigate whether differences exist in demand for a brand sold at different retailers in this market. Given the demand estimates, and a supply model of linear pricing of manufacturers and retailers, I compute price-cost margins for retailers and manufacturers.[4] By subtracting the estimated retail and manufacturer margins from observed prices I am able to recover the sum of retail and manufacturer costs for each brand sold at each retailer as a residual. To recover retail cost differences in this market I assume that a brand sold at two different retailers has the same manufacturer costs. Subtracting the differences in estimated retail and manufacturer margins from price differences of the same brand sold at two different retailers I estimate there to be retail cost differences, i.e. a force toward welfare to improve with the ban on wholesale price discrimination. Next, I estimate the welfare effects of a ban on wholesale price discrimination by computing the counterfactual Nash equilibrium when the manufacturers are not allowed to wholesale price discriminate and the estimates suggest that banning price discrimination has positive welfare effects in the market. Finally, I show through counterfactual simulations that the estimated positive welfare effects are smaller if downstream cost differences are smaller, or if there is less competition in the market.

This paper is related to the literature cited above that studies the welfare consequences of banning price discrimination in intermediate goods markets. In terms of the empirical strategy, I follow the recent literature by modeling vertical relationships (see, e.g., Bonnet, et.al., 2006, Brenkers and Verboven, 2006, Goldberg and Verboven, 2001, Hellerstein, 2008, Sudhir, 2001, Mortimer, 2008, Villas-Boas and Zhao, 2005, Villas-Boas, 2007a, and Villas-Boas and Hellerstein, 2006). Two related studies combine the same scanner data with additional data sources to empirically examine the determinants of retail and manufacturer margins in the German coffee market. Draganska and Klapper (2007) relate estimated manufacturer conduct parameters, in a reduced form setting, to exogenous factors related to retail competitive environment. Draganska, Klapper and Villas-Boas (2008) estimate margins in a structural model of multiple Bertrand- Nash competing retailers. Assuming a certain retail model as given, they estimate a simultaneous bargaining model between each manufacturer and each retailer for each product. In doing so, their goal is to relate bargaining power parameters in the model, in a reduced form setting, to potential determinants. Although the present paper uses the same data as Draganska et al. (2008), the contribution of this paper is to provide the first empirical investigation of the economic forces at play behind wholesale price discrimination.

The paper is organized as follows. The next section summarizes the economic forces at play behind the welfare effects of upstream price discrimination, while section 3 presents the economic and econometric models of demand and supply to derive the equilibrium under the possibility of wholesale price discrimination; an outline of the simulation of uniform wholesale pricing is provided as well. Section 4 describes the coffee market, the data used and the method of estimation. Section 5 presents the demand and the benchmark supply model results. Simulation results are presented and welfare effects along several counterfactual scenarios are investigated in section 6 . Conclusions and extensions of this research are presented in section 7.

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[4] I test the model used for this computation following the method in Villas-Boas (2007a) against an alternative model without wholesale margins, and reject the alternative model.

2. The economic forces at play

In this section I examine in a simple setting the main forces behind the welfare effects from banning upstream price discrimination. This section has two goals: The first is to understand the economics behind the welfare estimates I obtain in the empirical application. The second is to motivate economically meaningful counterfactual simulations. This enables me to generalize some of the findings and derive policy implications of banning wholesale price discriminations more generally.

While the reason behind a final goods' monopolist to price discriminate is to take advantage of differences in demands to increase its profits, a manufacturer monopolist may improve his profits by wholesale price discriminating toward different retailers by taking advantage of (i) differences in demands and (ii) differences in retail costs. In particular, I show in this section that an upstream monopolist will set a higher wholesale price for the retailer serving a "better" demand (less elastic and/or higher willingness to pay), and he will set a higher wholesale price for the "better" retailer (the one who has lower marginal costs and is more efficient). These two actions result in two opposing forces at work, in terms of implied welfare effects.

I illustrate these forces at play, using a simple model where an upstream manufacturer A, with zero marginal costs, sells to two downstream differentiated retailers, $r = 0, 1$, that have downstream marginal costs $c_1 \geq c_0 = 0$. The upstream manufacturer chooses wholesale prices, given retailers' retail pricing decisions, which are a function of wholesale prices. To start with, suppose that there is no substitution across retailers. Two products exist for the consumers and are defined as a brand-retail combination $\{A0, A1\}$. Consumers may differ in their preferences with respect to retailers. Let demands be given by

$$\begin{aligned} p_{A1} &= b - q_{A1} \\ p_{A0} &= 1 - q_{A0}^{s0} \end{aligned} \tag{1}$$

where retail level demand intercepts may differ by the parameter $b \geq 1$ and curvature of demand may differ by parameters s_0, where if $s_0 = 1$ both retailers face a linear demand.

Under the possibility of wholesale price discrimination, for general s_0, optimal wholesale prices are given by

$$\begin{aligned} w_{A1} &= \tfrac{(b-c_1)}{2} \\ w_{A0} &= w_{A0}(s_0). \end{aligned} \tag{2}$$

Downstream differences in demand, captured by b and s_0, and downstream differences in costs c_1 determine whether upstream firms want to wholesale price discriminate. In particular, note that $\frac{\partial w_{A1}}{\partial b} > 0$ and $\frac{\partial w_{A1}}{\partial c_1} < 0$.

If $c_1 = 0$ there are no downstream cost differences, whereas if $s_0 = 1$ and $b = 1$ there are no demand differences. I solve the model under these two extreme cases to investigate the resulting welfare changes due to wholesale price discrimination.

No cost differences. Assume that there are no cost differences, that is, $c_1 = 0$. To have an explicit solution, let $s_0 = \frac{1}{2}$. Under the possibility of wholesale price discrimination the optimal wholesale prices are given by

$$\begin{aligned} w_{A1} &= \tfrac{b}{2} \\ w_{A0} &= \tfrac{1}{3}. \end{aligned} \tag{3}$$

If $b \neq \frac{2}{3}$ the upstream firm wants to wholesale price discriminate. In particular, if $b > \frac{2}{3}$, then $w_{A1} > w_{A0}$. Let W_D denote the sum of consumer and producer surplus when prices are given by (3), and q_D be total quantity sold in this case.

If the manufacturer has to charge the same wholesale price to both retailers, then he maximizes upstream profits subject to $w_{A0} = w_{A1} = w_A$, yielding

$$w_A = \tfrac{25-\sqrt{433-216b}}{24}. \tag{4}$$

Let W_{ND} denote the sum of consumer and producer surplus with no discrimination and q_{ND} be total quantity sold under non-discrimination.

I compare the difference $D(b) = W_{ND} - W_D$ along comparative statics in downstream demand differences due to b and relate it to changes in quantity sold, in the following proposition.

Proposition 1: *Let there be no upstream and downstream competition, no downstream costs differences ($c_1 = 0$), and $s_0 = \frac{1}{2}$. Define $b^* : w_{A1}(b^*, c_1 = 0) = w_{A0}$. Banning wholesale price discrimination leads to a decrease in welfare, $D(s_0 = \frac{1}{2}, b, c_1 = 0) < 0$, for $b > b^*$, when both retailers sell post ban, as total quantity drops with the ban, that is $q_{ND} - q_D < 0$ for $b > b^*$.*

Proof: In the Appendix.

The intuition behind this result is as follows. As in third degree final goods price discrimination, wholesale price discrimination may be welfare improving if, by doing so, more market is served. As wholesale price discrimination results in consumers facing different retail prices, marginal utilities are not equal among consumers. A necessary condition to offset this inefficiency is that more consumers are reached with price discrimination. When there are no downstream retail cost differences, and demand differences are such that by wholesale price discriminating total output sold increases, then welfare may increase. In this case, banning price discrimination lowers welfare, and this is the usual result in final goods markets (as in (Schmalensee, 1981; Varian, 1985; Ireland, 1992). If discrimination, on the other hand, does not result in more quantity being sold, then a ban results in welfare increase.

No demand differences. Let me consider the other extreme case now, where there are no demand differences, $s_0 = 1$ and $b = 1$. The reason why consumers are charged different prices relates to the fact that they are served by retailers that have different costs. Under the possibility of wholesale price discrimination, optimal wholesale prices are given by

$$\begin{aligned} w_{A1} &= \tfrac{1-c_1}{2} \\ w_{A0} &= \tfrac{1}{2}. \end{aligned} \tag{5}$$

Wholesale price discrimination results in higher prices to the more efficient retailer $A0$ who in turn passes higher prices to his consumers. Let W_D denote the sum of consumer and producer surplus when prices are given by (5) and q_D is the total quantity sold in this discrimination case.

If the manufacturer has to charge the same wholesale price to both retailers then he maximizes upstream profits subject to $w_{A0} = w_{A1} = w_A$, yielding

$$w_A = \tfrac{2-c_1}{4}. \tag{6}$$

Let W_{ND} denote the sum of consumer and producer surplus with no discrimination. I compare the difference $D(b = 1, s_0 = 1, s_1 = 1, c_1) = W_{ND} - W_D$ along comparative statics in downstream cost differences c_1 in the following proposition.

Proposition 2: *With no upstream competition, when downstream markets are separated, when there are no demand differences ($b = 1$, $s_0 = 1$), banning wholesale price discrimination leads to a welfare increase $D(s_0 = 1, b = 1, c_1) > 0$ if both retailers are used.*

Proof: In the Appendix.

The intuition behind Proposition 2 is as follows. Welfare increases for moderate downstream cost differences (such that both retailers sell), given that by banning price discrimination the wholesale price of the more efficient retailer decreases and the wholesale price of the less efficient retailer increases (see Katz, 1987; De-Graba, 1990; Yoshida, 2000). Thus, by banning cost-only-based wholesale price discrimination, quantity is shifted from the less efficient to the more efficient retailer, and this is a force towards welfare to improve. I also note that, given that both retailers face linear demands, total output is unchanged with the ban.[5] The conclusion is that in the presence of retail cost differences banning wholesale price discrimination involves a force toward welfare improvement, as it results in the more efficient retailer selling more and the less efficient retailer selling less.

Cost and demand differences. The interplay of downstream cost differences and downstream demand differences, that imply opposing forces in Propositions 1 and 2, make welfare effects of a ban ambiguous in the general case. Welfare can only improve with discrimination if the resulting increase in quantity sold is enough to offset two inefficiencies: (i) the usual demand inefficiencies resulting from consumers facing different prices; (ii) the fact that the wrong retailer produces more. The presence of cost differences makes discrimination more likely to result in a drop in welfare, and thus a ban is more likely to improve welfare.

Consider Figure 1 as an illustration of the welfare changes due to a ban on price discrimination (top panel), and the corresponding changes in quantity sold due to a ban on price discrimination (bottom panel). Lets define the cost difference $c_1^*(s_0 = \frac{1}{2}, b)$ for given demand differences $(s_0 = \frac{1}{2}, b)$, such that $D(s_0 = \frac{1}{2}, b, c_1^*(s_0, b)) = 0$. In other words, if $c_1 = c^*$ we have $w_{A0} = w_{A1}$, and thus a ban has no welfare effects. Figure 1 illustrates the welfare effects given $s_0 = \frac{1}{2}$ and $b = 2$, for comparative statics in c_1.[6]

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[5] As shown in Robinson (1933), if a final goods' monopolist can price discriminate between two markets with linear demands, total output sold remains unchanged relative to no discrimination situation. When both demands are linear, wholesale price discrimination results in the same quantity being sold as no discrimination, regardless of demand and cost differences, and thus welfare drops unambiguously, as shown in the appendix. This means that a ban improves welfare for linear demands when both retailers sell.

[6] Note that the comparative statics in c_1 apply only to cases when both retailers are used pre and post ban, which occurs if cost differences are not too high. For very large c_1, retailer 1 stops being used. At that level of c_1, there is a discontinuity,

Lets assume that we are in the range where both retailers sell post price discrimination ban. As can be seen in the Figure 1, for low cost differences $c_1 < c_1^*$ welfare drops, whereas for higher cost differences ($c_1 > c_1^*$) welfare increases post ban. For low cost differences the demand force dominates and a ban drops welfare, as quantity sold drops. Whereas, for $c_1 > c^*$ the cost side force dominates and welfare improves with the ban. Welfare improves, even though total quantity drops with the ban, given that the more efficient retailer is producing more post ban. This result is consistent with Yoshida (2000), in that a drop in quantity sold post ban may be a symptom of welfare improvement in the presence of cost differences downstream.

Adding Competition. Having identified these two opposing forces in the absence of competition, adding both downstream and upstream competition makes the analysis more complex (see e.g., Holmes, 1989, Armstrong and Vickers, 2001, Stole, 2007), even in this simple model. For multiple oligopolistic retailers and manufacturers, whether banning wholesale price discrimination leads to lower or higher welfare is ambiguous and remains an empirical question. There is an extreme case and a special case each worth noting. First, in the extreme case, if there is perfect upstream competition, there is no welfare effect of the ban. Second, in the special case, in the presence of upstream competition, manufacturers may benefit from a ban. This effect is analogous to the effect previously identified in Corts (1998). Under imperfect upstream competition, a ban on wholesale price discrimination could lead to an increase in manufacturer profits. This effect could arise when manufacturers do not agree about which downstream retailer is their "best" retailer (due to better demand and/or lower costs).

3. Model

The model derived in this section is used to recover brand level demand and marginal costs. In particular, I separate costs differences and demand differences across retailers and indicate how I simulate the welfare effects of banning wholesale price discrimination. I model demand using a discrete choice demand formulation (see, e.g., McFadden, 1973, McFadden, 1984, Berry, 1994, Berry, Levinsohn and Pakes, 1995 and Nevo, 2001). The vertical relationship between manufacturers and retailers is modeled as multiple Bertrand-Nash competing manufacturers choosing wholesale prices and then multiple Bertrand-Nash competing retailers choosing retail prices given the wholesale prices. This section derives expressions for the total sum of retail and manufacturer price-cost margins solely as functions of demand substitution patterns for the supply model of wholesale price discrimination.[7]

Demand Model. Assume the consumer chooses in each period t among N_t different products sold by several retailers.[8] I define a product as a retail-brand combination. For example, if brand A is sold at retailers 1 and 2, I consider there to be two products, $n = A1, A2$, from which the consumer can choose.

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and the change in welfare for higher cost differences consists in the change in welfare for just using the low cost retailer post ban. Unambiguously, a welfare loss post ban results in that case.

[7] See Villas-Boas (2007a) for more details on the supply side derivation.

[8] The demand model is static. The consequences of assuming the static demand model are important but I do not have access to household level data for this market to formally address this issue. The implications of assuming a static framework are shown in Hendel and Nevo (2006): ignoring dynamic demand stockpiling behavior results in upward biased own price elasticities and thus, in estimated price cost margins that are too low.

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

$$u_{ijt} = d_j + \gamma d_t + x_{jt}\beta - \alpha_i p_{jt} + \xi_{jt} + \epsilon_{ijt} \tag{7}$$

where d_j represents product (brand-retailer) 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 per brand by retailer; p_{jt} is the price of product j, ξ_{jt} identifies the mean across consumers of unobserved changes in product characteristics,[9] and ϵ_{ijt} represents the distribution of consumer preferences about this mean. The coefficients β are 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. I also investigate the possibility of having more random coefficients in the demand specification.[10]

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 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[11] 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,

$$s_{jt} = \int_{[(v_i,\epsilon_{it})|u_{ijt}\geq u_{iht}\ \forall\ h=0,\ldots N_t]} dF(\epsilon)\ dF(v). \tag{8}$$

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 (8) becomes the Multinomial Logit model (McFadden and Train, 2000). 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 random coefficients Logit model.

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[9] In particular, ξ_{jt} includes the non trending changes in unobserved product characteristics, such as unobserved promotions, changes in shelf display and changes in unobserved consumer preferences.

[10] I investigate demand specifications that allow for a random coefficient on retail, on brand fixed effects, and on the promotional variable.

[11] 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 (Dubé, 2004).

Supply Model of Wholesale Price Discrimination. I assume a 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. I drop the time subscript to simplify notation.[12] Let retailers' marginal costs be constant with quantity and given by c^r, and let manufacturers' marginal cost be constant with quantity and given by c^w. I consider the benchmark model of price discrimination where a manufacturer is allowed to set, if he wishes to do so, two different wholesale prices for the same brand sold through different retailers.

Assume each retailer maximizes his profit function:

$$\pi_r = \sum_{j \epsilon S_r} \left[p_j - p_j^w - c_j^r \right] q_j(p) \quad \text{for} \quad r = 1, ...R, \tag{9}$$

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:

$$q_j + \sum_{m \epsilon S_r} T_r(m,j) \left[p_m - p_m^w - c_m^r \right] \frac{\partial q_m}{\partial p_j} = 0 \quad \text{for} \quad j = 1, ...N, \tag{10}$$

where matrix T_r has the general element $T_r(i,j) = 1$ if the retailer sells both products i and j, and is 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 (10) for the price-cost margins for all products in vector notation gives the price-cost margins m_r for the retailers under Bertrand-Nash pricing:

$$\underbrace{p - p^w - c^r}_{m^r} = -[T_r * \Delta_r]^{-1} q(p), \tag{11}$$

which is a system of N implicit functions that expresses the N retail prices as functions of the wholesale prices. If retailers behave as Bertrand-Nash players, then equation (11) describes their supply relation.

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

$$\pi_{wt} = \sum_{j \epsilon S_{wt}} [p_{jt}^w - c_{jt}^w] \; q_{jt}(p(p^w)), \tag{12}$$

where S_{wt} is the set of products sold by manufacturer w during week t and c_{jt}^w is the marginal cost of the manufacturer that produces product j, and where manufacturers know that retailers behave according to equation (11). Solving for the first-order conditions from the manufacturers' profit-maximization problem,

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[12] I assume that firms optimize in a static model, using weekly time series to estimate supply side mark-ups and thus, I do not model dynamic pricing. 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 reasons, possibly dynamic. As a robustness test I obtain supply side estimates assuming that firms do not optimize every time period.

assuming again a pure-strategy Nash equilibrium in wholesale prices and using matrix notation, yields:

$$\underbrace{(p^w - c^w)}_{m^w} = -[T_w * \Delta_w]^{-1} q(p), \tag{13}$$

where T_w is a matrix with general element $T_w(i,j) = 1$ if the manufacturer sells both products i and j, and is 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 (11).[13]

Simulation of Banning Wholesale Price Discrimination. I outline here how to perform the policy simulations of banning wholesale price discrimination, where the manufacturer is constrained to set the same wholesale price for a brand sold at any retailer. Given demand estimates and assuming retail and manufacturer mark-ups are given by equations (11) and (13), respectively, I recover the marginal costs by

$$\underbrace{c^w + c^r}_{\hat{c}} \;=\; p \;-\left[\; - [T_r * \Delta_r]^{-1} q(p) - [T_w * \Delta_w]^{-1} q(p)\right]. \tag{14}$$

Note that once I have estimated demand I recover the sum of retail and manufacturer marginal costs without the need to observe wholesale prices.

Using the estimated costs, I numerically compute the new Nash equilibrium after banning wholesale price discrimination, by imposing constraints of uniform wholesale pricing. The equilibrium retail prices solve

$$p^* = \hat{c} + \underbrace{\text{Retail Margins } (p^*) + \text{Manufacturer Margins } (p^*)}_{\text{Under Uniform Pricing}}. \tag{15}$$

Details on how to compute the manufacturer and retail margins are provided in the appendix.

I assess the changes in the welfare components (consumers', manufacturers' and retailers' surplus) resulting from the simulated counterfactual equilibrium prices p^*. Expected consumer i's surplus (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. Given the extreme value distributional assumptions and linear utility formulation, the change in consumer surplus for individual i is computed as

$$\Delta E\left[CS_i\right] = \frac{1}{|\alpha_i|}\left[ln\left(\sum_{j=1}^{N} e^{d_j + x_j\beta_i - \alpha_i p_j^*}\right) - ln\left(\sum_{j=1}^{N} e^{d_j + x_j\beta_i - \alpha_i p_j}\right)\right]. \tag{16}$$

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 of manufacturers' and retailers' producer surplus is given by

$$\Delta E\left[PS\right] = \left[\sum_{j=1}^{N}\left(\pi_j^r\left(p^*\right) + \pi_j^w\left(p^*\right)\right) - \sum_{j=1}^{N}\left(\pi_j^r\left(p\right) + \pi_j^w\left(p\right)\right)\right], \tag{17}$$

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[13] For the derivation of Δ_w see Villas-Boas (2007a).

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

4. Data and estimation

The coffee market and the data. I focus on the coffee market in Germany. It is an interesting and empirically attractive market in which to study imperfectly competitive retailers, and manufacturers as well as restrictions on wholesale pricing, because the market consists of a small number of manufacturers producing and selling coffee to a small number of retail chains. Evidence provided by one of the largest retail chains suggests that there are differences in wholesale prices charged to different retailers in this industry, making this an interesting case to simulate the effects of imposing uniform wholesale pricing.[14]

The empirical analysis is based on a weekly scanner data set of retail prices, aggregate market shares and product characteristics for seven coffee brands, each in a 500 gram package and sold at four retail chains; Edeka, Markant, Metro, and Rewe. Thus, seven brands are sold through four retailers creating the choice set equal to twenty eight products at the retail-brand level.[15] The seven brands are Jacobs, Onko, Melitta, Idee, Dallmayr, Tchibo, and Eduscho, all together capturing more than 95% of the market. The remaining market consists of private label brands and a few minor brands. Jacobs and Onko are produced by Kraft, while Tchibo and Eduscho are two brands from the same main firm, Tchibo. This results in a total of five manufacturers.[16]

The data cover the years 2000 and 2001 and contain weekly information on sales, prices, and promotional activity for all brands in the ground coffee category. Table 1 summarizes market shares, price, standard deviation of price, promotion, and advertising for each of the four retail chains, and for the seven brands in the data. The data are aggregated across different stores for each chain.

Market shares are obtained by dividing quantity by the potential market. The quantity data consist of quantities sold for each brand of coffee at the different retailers. To calculate the market share of each brand and allowing for no purchase option (also called outside good option), one needs a measure of the size of the potential market. The market size is calculated based on individual consumer panel data obtained from GfK Germany, which records panelists' shopping trips. Assuming that the panel is representative of each chain, the number of shopping trips in a given week is defined as the total potential market. This measure of market size is used to calculate the share of the outside good. Metro has over 46% of the market for these products. Markant comes next with 29%, then Edeka with 14% and finally Rewe with 11%. Among the retail chains not considered in the data is Aldi, the German version of Walmart. It is excluded from the analysis due to lack of scanner data and is therefore considered in the outside option.

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[14] After a recent merger in the German retail industry, one of the merging retailers was quoted as saying that the other retailer had 5 percent lower wholesale prices. http://www.abendblatt.de/daten/2006/03/17/544236.html, Hamburger Abendblatt, March 26, 2006.

[15] In the model, consumers may choose a brand at any retailer, and I allow for retailer competition. I found there to be a correlation between quantity sold at a certain retailer and prices at other retailers, which makes retail level competition a reasonable working assumption.

[16] Villas-Boas (2007b) assesses the welfare effects of the mergers that occurred in this market.

Looking at brand level shares, Jacobs is the market leader, followed by Melitta and Tchibo. Within each retailer, the seven brands rank differently in terms of their market shares. For instance, while Jacobs is the top brand in Edeka, Markant and Metro, it comes second to Tchibo in Rewe. While Idee has the lowest market share across all retailers, the ranking of the other middle selling brands differs within each retailer. The data also show differences in market shares of different brands across different retailers. While Jacobs, Idee and Dallmayr have their largest market share in retailer Edeka, Onko and Melitta rank Metro the highest in terms of the market share, and Tchibo and Eduscho sell the highest share in retailer Rewe.

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 price 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. Prices are on promotions (5% or more price drop from the mode) 23% of the time; 13% of the observations exhibit promotions of 10% or more, and 2% of the observations have promotions larger than 20%. The most frequent length of promotions is two weeks, and the second most frequent is one week. The dataset contains dummy variables for the presence of store-front advertisements, display and feature advertising. These variables vary by brand and by retailer. Auxiliary data on total advertising expenditures by brand (but not by brand by retailer) varies by year.

Demand estimation. In principle, demand parameters can be estimated by choosing the value that implies predicted market shares as close as possible to observed shares. However, in this case the objective function will be non-linear in the structural error term, which is a problem since price enters as an endogenous variable. The key step is to construct a demand-side equation that is linear in the structural error so that instrumental variables estimation can be applied directly. Following Berry (1994) and Berry, Levinsohn and Pakes (1995), this is done by equating the estimated product market shares to the observed shares and solving for the mean utility across all consumers, defined as

$$\delta_{jt}(\Upsilon) = d_j + \gamma d_t + x_{jt}\beta - \alpha p_{jt} + \xi_{jt}. \tag{18}$$

For the random coefficient Logit model, solving for the mean utility has to be done numerically (see Berry, 1994 and Berry, Levinsohn and Pakes, 1995). Let θ be the demand side parameters to be estimated, then $\theta = (\theta_L, \Upsilon)$ where Υ are the non-linear parameters. In the random coefficient Logit model, θ is obtained by feasible Method of Simulated Moments following Nevo's (2000) estimation algorithm, where equation (18) enters in one of the steps.

Instruments and identification of demand. Since prices are not randomly assigned, I use input price changes over time to instrument for prices. First, the price decision takes into account cost side variables, such as raw commodity prices. Second, it is reasonable to assume that the prices of inputs, measured in this case as average raw coffee commodity prices, are uncorrelated with changes in unobserved product characteristics, ξ_{jt}, such as changes in shelf display. The exact input price measure used in the analysis is the trade-volume weighted average of the five most traded contracts at the New York Stock Exchange, where dollar prices were adjusted for the exchange rate and taxes. I interact the input price with product fixed effects as instruments. Ideally, one would like input prices paid by different brands.

Not having those detailed data, the intuition for interacting commodity price with product fixed effects as instruments is to allow average raw coffee price to enter the production of each product differently: due to different blends used or due to purchasing raw coffee from different regions of the world, for instance.

5. RESULTS

Demand estimation results. The demand model estimates are presented in Table 2. The first set of columns (1) present the Logit OLS estimates without instrumenting for price; the second set of columns (2) present the Logit model estimates instrumenting for price. Unfortunately, I do not have data on product characteristics for the different coffee products to be able to specify heterogeneity along observable product characteristics as in Berry et al. (1995). Therefore, I have estimated specifications with random coefficients on brand dummies. While those estimated random coefficients are not significant, it is worth noting that the remaining demand parameter estimates are very robust to the different random coefficient specifications investigated. In the results presented in the second set of columns in Table 2, consumer heterogeneity is considered by allowing the coefficient on price, in column (3), and on price and promotion, in column (4), to vary across consumers as a function of unobserved consumer characteristics. The Generalized Method of Moments estimates of the random coefficient specification are presented, where the individual choice probabilities are given by (8).

The first stage R-squared is high and, most importantly, the F-Statistic for the input price instruments interacted with the product fixed effects is large and significant, equal to 8.33 with a p-value of 0.00. The list of instruments are raw coffee interacted with product fixed effects; front store advertising, feature and display, trend, and promotion; product fixed effects are also included in the first stage regression. When comparing the first two sets of columns corresponding to no instrumentation (OLS) with the other columns to the right, and 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 in absolute value when instrumenting. This is to be expected if the endogeneity problem is that price is correlated with positive determinants of demand, leading to OLS estimates of the price coefficient that are biased downwards in absolute value.

For the specification in (3), price has, on average, a significant and negative impact on utility and there is significant heterogeneity in price sensitivity. The set of columns (4) allow a random coefficient on promotion, as well as on price, to estimate a more flexible specification of demand heterogeneity, and both random coefficients are significant.[17] Promotion and advertising coefficients are significant and positive, and are thus estimated as factors that expand demand. There is a significant and negative time trend, which is in line with evidence in the market that the overall attractiveness of the category has been diminishing over time in the German coffee market.[18]

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[17] I have used both demand specifications to estimate the supply side and results remain unchanged as I discuss in subsequent tables and subsections. I have also estimated specifications with random coefficients on dummies for retailers and manufacturers, and these estimates were not significant.

[18] Industry evidence from Germany shows that yearly consumption, measured as kilograms per capita per year, has fallen by 10% from 1990 to 2002.

The estimated brand fixed effects differ across retailers, suggesting that consumer brand preferences differ across retailers. The estimated retail-brand fixed effects also show a pattern that there is an "agreement" as to the ranking of retailers. The estimates suggest a ranking of retailers. Demand fixed effect for all brands appears to be the highest at Metro, while the lowest brand fixed effect estimates are at Rewe, for all brands. A close second highest demand appears to be for Markant.

The estimated elasticities are reported in Table 3 using the random coefficients specification with heterogeneity on the price parameter, as reported in column (3) of Table 2.[19] The purpose of this table is two-fold. First, I investigate whether the estimated patterns of elasticities are close to Logit patterns. Indeed, this seems to be the case, as estimated cross-price elasticities, which on average are 0.03, do not vary a lot by brand within retailer. While the within store cross-price elasticities are larger than the cross price elasticities across stores, within retailers elasticities are very similar, and thus are close to the Logit elasticities. Attempts to allow for heterogeneity in other determinants of demand were not successful, given the data at hand, and thus I carry forward demand estimates that are close to Logit. This has implications in terms of roughly constant within retailer mark-ups, an issue I will return to, and discuss, in the supply estimation section. The second purpose of this table is to investigate whether the demand estimates suggest there are differences across retailers in terms of own price elasticities. In case there are such differences, higher wholesale prices would occur in less elastic retailers and lower wholesale prices would be effective in higher elasticity retailers. I turn to investigating this next. I obtain own price elasticities that are consistent with other studies in the ground coffee category (Krishnamurthi and Raj, 1991), where the average own price elasticity is -7.6%. When averaging by manufacturer, as demonstrated in the top panel of Table 3, and averaging by retailer in the bottom panel of this same Table, several insights emerge. By looking by brand, in the top panel, along each row, there is an agreement that Markant has the lowest elasticity of demand, while Rewe generally appears to have the most elastic demand for the brands. Looking at the bottom panel of the table, Markant has the lowest estimated price elasticity, while Rewe has the most elastic demand.

If there were no retail cost differences, and given only these estimated demand differences (in fixed effects and in estimated elasticities), the price discriminating wholesale prices pre-ban would be highest at Markant, where demand is less elastic than the other retailers, and the wholesale prices would be lowest at Rewe, where demand is more elastic. The ban would thus result in a force towards lowering the wholesale prices in Markant and possibly Metro, and towards increasing wholesale prices in Rewe. Furthermore, assuming again that there are no retail cost differences, given that the estimates suggest there to be a general agreement over the best and the worse retailer, a ban would result in lower profits to manufacturers (Corts ,1998). In the following subsections, given the demand estimates and a model of supply behavior, I investigate whether there is empirical evidence on significant retail cost differences. Then, I will return to the above demand patterns, as well as to estimated retail cost differences, if any, to interpret the changes in profits due to the ban of price discrimination given imperfect competition in this market, as well as interpreting resulting welfare changes.

Supply estimation results. The demand estimates from the mixed Logit specification are combined

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[19] Using the estimates with random coefficients on price and on promotion, yields estimates of elasticities that are very similar to those in the present table, which are not very different from the Logit.

with the model of retail and manufacturer behavior to estimate the retail and wholesale margins. In Table 4, the summary statistics for the estimated margins are presented under the benchmark model of wholesale price discrimination for four specifications. In specifications (1) and (2) firms optimize profits and choose prices weekly. The specification in column (1) reports supply estimates using the demand specification with a random coefficient on price only, while in column (2) I present the supply results using a demand specification with a random coefficient on price and promotion. In specifications (3) and (4) I do not assume that the first order conditions hold every week, but rather that they do hold every month, where column (3) uses estimates of demand assuming only a random coefficient on price, and (4) on price and promotion. Summary statistics for all specifications are presented for the estimated retail and manufacturer margins. Subtracting the estimated margins from retail prices, I also recover the sum of retail and manufacturer marginal costs of all products for both specifications. Summary statistics for those are provided in the last row of Table 4, while brand level and retail level cost estimates are presented and discussed in the next subsection in more detail.

First of all, when comparing (1) with (2), allowing for a random coefficient on promotion, the estimated margins (2) versus (1) and (4) versus (1), do not change significantly. Weekly versus monthly based estimates do not significantly differ either, and I shall therefore use the weekly specification (1) for the remainder of the paper.

The estimated costs that I obtain by subtracting margins from retail prices look reasonable. Looking at the bottom of Table 4, the average estimated recovered cost of 5.3 Deutsch Marks per unit is very plausible, according to industry research, and after adjusting for expected loss in volume when produced, is also within the ballpark when compared with the average raw coffee price. Starting with an average raw coffee price of slightly over 4 Deutsch Marks per 500 grams, and given that there is a 75 % to 85 % weight loss in the process of roasting the coffee, one obtains an estimate in the range of $5.04 - 5.71$ Deutsch Marks per 500 grams. I cannot reject at any significance level that the recovered mean costs are equal to the raw coffee estimate. When I consider an alternative nested model where wholesaler margins are zero, following Villas-Boas (2007a), and compared to the linear pricing benchmark model in (1), I reject that alternative model of zero wholesale margins with an F-statistic of 4.66 (p-value 0.000).

Analysis of retail cost differences across retailers. I defined a product in the choice set as a brand sold at a certain retailer; remember there are twenty eight products, consisting of seven brands sold at four retailers. Equation (11) recovers for all twenty eight products the sum of retailer and manufacturer marginal costs. In order to recover estimated cost differences by brand across retailers, and differences in wholesale prices across retailers, I need to make one more assumption on costs of the N products in the choice set. The assumption is that the manufacturer costs c_i^w for the brand i are the same no matter at which retailer that brand is sold.[20]

To recover differences in downstream costs, I compute differences across retailers among the costs obtained from equation (14) within brand. For example, for a certain week I obtain the recovered difference of the sum of retail and wholesale marginal costs of Jacobs sold at Edeka minus the wholesale and retail costs of Jacobs sold that same week at Markant. Given the above assumption, by performing this difference

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[20] I thank Andrew Sweeting, Ariel Pakes, and an anonymous referee for this suggestion.

within brand across retailers, one obtains the difference in retail costs from distributing and selling Jacobs in retailer Edeka versus retailer Markant. For each brand, and for retail pairwise comparisons, the downstream retail cost difference is thereby given as

$$\underbrace{c_j^w + c_j^r - (c_k^w + c_k^r) = c_j^r - c_k^r,}_{\text{Under the assumption that } c_j^w = c_k^w} \tag{19}$$

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

To recover wholesale price differences within brand across retailers, I perform within brand differencing of wholesale margins. 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 the difference in wholesale prices given the above assumption,

$$p_j^w - c_j^w - (p_k^w - c_k^w) = p_j^w - p_k^w - \underbrace{c_j^w - c_k^w}_{=0}. \tag{20}$$

The recovered mean differences in wholesale prices and the recovered retail cost differences by brand among the different retailers are given in Table 5, and are expressed in Deutsch Marks per unit of 500 grams.

When looking at wholesale price differences in the three left columns first, they are small, overall. When disaggregating by brand, Eduscho exhibits the smallest wholesale price differences. If wholesale price uniformity is imposed, one would expect Eduscho's wholesale prices to have the smallest changes, given that it seems to be the least wholesale price discriminating of the brands. Across most comparisons Onko exhibits the largest wholesale price differences, except when comparing the chain Markant with the others. This suggests that Onko should be the most (first order) affected, in terms of price changes by uniform pricing policy. Finally, it appears that Metro and Rewe have the largest wholesale price differences.

The three columns to the right show the average differences in retail costs by brand, and average overall retail cost differences by pairwise retail chain comparisons. There are significant retail cost differences in this market. However, wholesale price differences are small. Furthermore, the highest cost retailer does not have the lowest wholesale prices. For example, Markant has the lowest overall retail costs on average, but does not have the highest wholesale prices. According to the economic forces which have been identified as determining wholesale price discrimination, Markant should exhibit the highest wholesale prices if there are no demand differences. Thus, I conclude that there are not only cost differences but also demand differences determining the incentives to wholesale price discrimination. Which of the forces (cost or demand differences) has a greater impact on the welfare results is investigated next by simulating a ban on wholesale price discrimination for this market.

I am interested in explaining what the main forces are behind the fact that I observe a certain brand sold in two different retailers at two different retail prices. Observed prices can be different due to differences in margins and in costs. I assume that wholesale costs are the same, regardless of where a brand is sold. So, if the demand model implies margins that are very similar, residual differences in retail prices will be attributed mostly as differences in retail costs. Table 6 presents averages by brand of estimated retail, manufacturer, and total margins using the demand estimates in Table 2 column (3) with a random coefficient on price column, and with a random coefficient on price and promotion in column (4) of the same table. As Table 6 illustrates, when looking by brand, i.e. along a row, the estimated margins differ very little when comparing across retailers. This is true for the manufacturer, retail and the total margins estimated. The total estimated margins by brand are ones I use to recover retail cost differences reported in Table 5. I do this by performing the differences across retailers for total margins of the same brand. Furthermore, when looking along a certain column for the retailer and total estimated margins, and while looking along a certain row for the estimated manufacturer margins, these show patterns that are close to the Logit, as derived in Nevo and Rossi (2008). Table 6 complements what I showed previously in Table 3, that the analysis could be driven by the Logit restrictions. It is important to be aware to what extent using a certain demand model affects the supply side analysis. As shown in Nevo and Rossi (2008), the problem arises when multiproduct firms are maximizing profits in a Bertrand-Nash game, and each firm will then choose the same margin for all the products in their own portfolio, given a Logit demand. The closer the demand model is to a Logit, the closer the within firm (in this case, retailer or brand) margins will be. This would be a problem especially when recovering wholesale price differences, since to recover wholesale price differences reported in Table 5, I use pairwise differences in estimated manufacturer margins by brand (along each row separately) across retailers, which would mean these differences having simple Logit implied restrictive patterns. Looking at retail margins along a column, the Logit would predict the same pattern, as shown in the retail estimated margins in Table 6.

I have estimated more flexible demand specifications but the estimates do not look different, and additional random coefficients were not significant. I have allowed one more random coefficient on promotion, the only specification that had significant estimates, but things do not change significantly. The bottom line is that, after having attempted unsuccessfully to estimate a more flexible demand given the data available, the question remains whether roughly constant margins is a real finding in this market, or whether it is an artifact given the demand model.

6. Banning wholesale price discrimination policy simulations

In this section I present estimated effects from simulating uniform wholesale pricing in this market. Table 7 provides summary information on the price and profit changes by brands and by retailers due to uniform wholesale pricing policy. The first column presents mean changes in price. The average price effect across all products is very small; a decrease of about 0.023 Deutsch Marks (or two Pfennig). The average retail price changes by retailers and manufacturers are all negative, but barely significant or not significant. For the retailers Metro and Rewe the average price decrease is significant; I note that both of these retailers had the average largest wholesale prices (see Table 5).

In the second column of Table 7, I present the estimated effects on producer surplus, distinguishing the estimated effects on manufacturers' and retailers' producer surplus from imposing uniform wholesale pricing. The third column reports the percent change in profits relative to the wholesale price discrimination profits. Not only can I estimate the joint effects on retailers and manufacturers surplus, but also on the retail-level and manufacturer-level components of the surplus. Overall profits increase slightly. At the bottom of the table, joint vertical producer surplus is estimated to increase significantly by one hundred and ninety Deutsch Marks, 12% of the price discrimination case, which corresponds to slightly less than 1% of total weekly revenues in this market.

The implications of this increase in total surplus are interesting. Specifically, the possibility to wholesale price discriminate under the starting model did not by itself contribute to the vertical profits in the benchmark case, since preventing it via uniform wholesale pricing has small positive effects on vertical profits.

Another interesting fact is that average manufacturer profits increase significantly with the ban. One interpretation of this empirical finding is that manufacturers are better off not price discriminating. However, without the ban, not discriminating cannot be a Nash equilibrium in the oligopoly game. When the other firms are not price discriminating, each firm wants to unilaterally deviate by discriminating. This "prisoner dilemma" is analogous to the Corts (1998) effect in third degree final goods price discrimination case under competition. The idea is that, with competition, a ban on discrimination allows firms to sustain a non-Nash equilibrium that can make all firms better off relative to wholesale price discrimination.

Breaking down by manufacturers and retailers, I find that both retailers and manufacturers on average benefit from this policy simulation. In terms of the heterogeneous effects on the different retailers and on the different manufacturers, there are significant differences to note. From pairwise comparisons of average surplus changes between retailers, consisting of the differences in estimated means, Metro benefits the most from the uniform wholesale pricing simulation, and the benefit to Metro is significant. In terms of manufacturer specific effects, Jacobs and Dallmayr benefit significantly, while the other manufacturers' surpluses exhibit positive, but not significant, changes.

Finally, the first column of results presented in Table 8 summarize the average welfare effects due to the ban. 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 small but positive and significant estimated impact on their surplus. The estimated change in consumer surplus is of one hundred and thirty Deutsch Marks a week, which represents slightly above half of 1% of weekly revenues in this market. Consumer level effects are estimated to be of the same magnitude and sign as those estimated effects on overall producer surplus at any significance level. Thus, the welfare effects are small, positive and significant, overall.

As discussed in section two, there are no general theoretical predictions of price, profits, consumer surplus and welfare effects resulting from uniform wholesale pricing. However, underlying differences in downstream demands and costs may explain the direction of welfare changes. Therefore, given the identified forces at play, the results are consistent with underlying downstream cost differences being the main drivers of the positive estimated welfare effects. To assess the validity of this interpretation, in the next subsection I perform "what-if" simulations in the presence of no downstream cost differences. I would expect welfare gains to decrease, relative to the benchmark simulation in Table 7. I also investigate what would happen if I were to vary product competition in the market.

The economic forces driving the welfare estimates. I consider counterfactual retail costs and demand scenarios when performing the uniform pricing simulations. These "what-if" simulations aim at taking the results one step further. The estimated results for the benchmark scenario discussed in the previous subsection and presented in column (1) of Table 8 are consistent with downstream cost differences being the likely determinant of wholesale price discrimination in this market. I evaluate whether this is indeed the case by investigating what estimated welfare changes would be like under no counterfactual retail cost differences.

The estimates presented in Column (2) of Table 8 consider a ban given the underlying demand model estimates but assuming that there are no downstream retail cost differences. The approach to perform this what-if simulation is as follows. I impose, for all time periods that the retail cost differences are all zero. Given that the wholesale cost differences are also assumed to be zero, I thus equate total recovered costs by brand across the different retailers. For example, during the first week I make Jacobs' cost at the retailer Edeka be equal to Jacobs' cost at the retailer Markant.[21] Given this assumption, I first compute the counterfactual Nash equilibrium retail prices of no uniform pricing under the new costs. The second simulation is to find the retail price Nash equilibrium prices given the new costs and imposing the ban. These two simulated price series are compared, and the changes in producer and consumer surplus are computed.

Considering an alternative demand scenario takes the empirical exercise one step further beyond the market at hand. In particular, I consider the effect of having more product differentiation (less competition) on the empirical estimates of welfare changes. Remember that manufacturers profits increased with the ban under competition, a result also found in Corts (1998). In this counterfactual simulation of less competition, the simulated profits should increase less, or even decrease with a ban. The counterfactual exercise to investigate the direction of a drop in competition on the welfare changes due to a ban is again a two step procedure. Given benchmark costs, but changing demand, I first compute the Nash equilibrium prices under no ban. Then I compute the Nash equilibrium under the ban, given the same costs and changed demand. The differences between retail prices, profits, consumer surplus, and welfare are presented in column (3) of Table 8.

Recall that the benchmark case is in the first column of this table, and serves as the baseline to compare columns (2) and (3). First of all, all simulations result in changes that are small, which is not surprising given the recovered wholesale price differences estimated in Table 5. In comparing columns (1) and (2) I conclude that the estimated welfare effects I found in (1) were mostly due to differences in downstream retail costs, given that, in column (2), when there are no downstream retail cost differences, welfare drops with the ban. Both consumer surplus and producer surplus drop in column (2) because prices increase on average and accordingly, less market is served on average, thus decreasing welfare. Breaking up the changes by retailers and manufacturers I also notice interesting findings from this simulation. Some retailers lose and some gain from the ban if there are no downstream retail cost differences. Manufacturers whose profits drop significantly with the ban are now interpreted to have been discriminating based on demand differences, and these are Onko, Melitta and Eduscho. Looking at the retailer break-up in column (2), Edeka and to a smaller extent Markant, exhibit a drop in surplus, while Metro's profits increase. Recall from the wholesale price differences in Table 5, that Metro had the higher wholesale prices for pairwise

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[21] I have also used another retailer, aside from Markant, as the reference for cost equalization, and the overall direction of welfare changes is the same as the estimates presented in column (2).

comparisons, and interestingly, both in column (1) and (2) it is Metro that benefits the most from the ban.

In comparing columns (1) and (3), I conclude that, on average, less competition leads to smaller positive welfare changes due to the ban. The average own demand elasticity changed from -7% to -3% in columns (1) and (3), respectively. Consumer surplus increases post ban, but much less when there is more competition in the markets. Another force towards a smaller welfare effect when comparing (1) and (3) is due to producer surplus changes. In particular, it is no longer the case that manufacturers benefit post ban, as in (1). With less competition, the ban ceases to have the "Corts (1998) like" effect on manufacturers' profits. Under imperfect upstream competition, a ban on wholesale price discrimination, as previously discussed in section 2, could lead to an increase in manufacturer profits. By decreasing competition I found that this effect disappears. I note that this effect arises when manufacturers do not agree about which downstream retailer is their "best" retailer - due to better demand and/or lower costs. It is therefore also interesting to compare what happens to changes in manufacturer profits due to a ban, when retail cost differences are removed, given that, by removing downstream cost differences, I also remove "disagreements" about cost differences. Maintaining the level of competition, and comparing manufacturer profits changes in column (1) with column (2), I conclude that it is no longer the case that manufacturers benefit from the ban in column (2). One conclusion is that cost side disagreements were most likely more responsible for the increase in manufacturers' profits, than demand side disagreements in this market.

7. Conclusions and extensions

The goal of this paper 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 four retailers' and seven manufacturers' oligopoly-pricing behavior in the German coffee market, I estimate the demand model and recover the underlying marginal costs of each firm. The objective of the empirical analysis is to simulate the counterfactual equilibrium prices if uniform wholesale price restrictions were implemented in this market. In doing so, I estimate that there are 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. Through simulations, I also show that the estimated welfare effects are mostly due to differences in downstream retail costs. Simulations without downstream retail cost differences lead to a welfare drop post ban. Less competition also affects the welfare effects of the ban by reducing the welfare gains.

The findings of this paper add to the policy debate over wholesale price regulation in a variety of markets, by shedding some light onto the economic forces at play. In doing so, I derive the following policy implications for banning wholesale price discrimination. If discrimination is mostly due to downstream demand differences, the findings of final markets third degree price discrimination welfare effects hold. If, for instance, total quantity served increases due to discrimination, the ban is likely to lead to a welfare drop. If, however, wholesale price discrimination in certain markets is mostly due to downstream cost differences, welfare may increase if wholesale price discrimination is banned.

One potential limitation is that, given the demand model used in this paper, I may be attributing most of the observed difference in retail prices to retail cost differences, and thus suggesting a larger force towards welfare to increase than in reality. To what extent the estimated constant margins is a real finding in this market, or an artifact of the estimated demand model remains a question that I cannot address given the data at hand, exploring alternative demand specifications in the context of predicting welfare changes from upstream price discrimination is an avenue for future research.

Incorporating a dynamic setting in this analysis is an avenue for future research. The underlying framework of the empirical analysis abstracts from dynamic issues, such as consumer stockpiling behavior and sales. The implications of assuming a static model are important (see Hendel and Nevo, 2006), as static elasticities are over estimated and the price-cost margins are under estimated. For instance, if banning price discrimination results in overall lower prices, then consumers would respond, not by purchasing more coffee, but by stockpiling less. Future work would incorporate a dynamic model to simulate uniform pricing policies.

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Appendix A. Economic Forces at Play: Model Derivations and Proofs

For the simple model, there is an upstream manufacturer A, with zero marginal costs (without loss of generality), who sells to two downstream differentiated retailers, $r = 0, 1$, that have downstream marginal costs $c_1 \geq c_0 = 0$. The upstream manufacturer chooses wholesale prices, given retailers' optimal retail pricing decisions as a function of wholesale prices. Suppose downstream markets are separated. For consumers, there exist two products, defined as a brand-retail combination $\{A0, A1\}$ and in respect to retailers, consumers may differ in their preferences. In this simple model, demands are given by

$$\begin{aligned} p_{A1} &= b - q_{A1} \\ p_{A0} &= 1 - q_{A0}^{s_0}, \end{aligned} \tag{21}$$

where retail level demand intercepts differ by the parameter $b \geq 1$ and demand curvature differ by s_0.

Under the possibility of wholesale price discrimination, if $s_0 = \frac{1}{2}$, optimal wholesale prices are given by

$$\begin{aligned} w_{A1} &= \tfrac{b - c_1}{2} \\ w_{A0} &= \tfrac{1}{3}. \end{aligned} \tag{22}$$

From (22) it becomes apparent that what determines whether upstream firms want to wholesale price discriminate are downstream differences in demands b and downstream differences in costs c_1, and that $\frac{\partial w_{A1}}{\partial b} > 0$ and $\frac{\partial w_{A1}}{\partial c_1} < 0$.

Appendix A.1. No Cost Differences

If $c_1 = 0$ and there are only demand differences, I now solve for the optimal retail prices given (22 and $c_1 = 0$). Then I obtain resulting welfare W_D by adding up consumer and producer surpluses, given by $W_D = \frac{560}{2187} + \frac{7b^2}{32}$, and total quantity sold with discrimination is given by $q_D = \frac{16}{81} + \frac{b}{4}$.

If the manufacturer has to charge the same wholesale price for his product to both retailers, then he maximizes upstream profits subject to $w_{A0} = w_{A1} = w_A$ yielding

$$w_A = \tfrac{1}{24}(25 - \sqrt{433 - 216b}). \tag{23}$$

I obtain welfare under no discrimination W_{ND} by adding up consumer and producer surpluses given by

$$\begin{aligned} W_{ND} = \tfrac{1}{559872} \quad & (-84419 + 5211\sqrt{433 - 216b} + 3472\ \sqrt{434 - 2\sqrt{433 - 216b} - 216b} - \\ & 16\sqrt{866 - 432b}\sqrt{217 - \sqrt{433 - 216b} - 108b} + \\ & 108(-1971 + 54\sqrt{433 - 216b} - 16\sqrt{434 - 2\sqrt{433 - 216b} - 216b})b + 87480b^2), \end{aligned} \tag{24}$$

and obtain the non-discriminatory quantity sold q_{ND} given by

$$q_{ND} = \tfrac{432b - 241 + 25\sqrt{433 - 216b}}{1296}. \tag{25}$$

I can finally define the difference $D = W_{ND} - W_D$ as the change in welfare with the ban, and the quantity difference $Dq = q_{ND} - q_D$ is given by

$$Dq = \frac{108b - 497 + 25\sqrt{433 - 216b}}{1296}. \tag{26}$$

Proof of Proposition 1:

By substitution, $Dq(b = b^*) = 0$. Taking the first derivative of Dq with respect to b and simplifying I get

$$\frac{\partial Dq}{\partial b} = \frac{1}{12} - \frac{25}{12\sqrt{433 - 216b}}, \tag{27}$$

and so, by substitution, $\frac{\partial Dq}{\partial b}|_{b=b*} < 0$, which proves the result that quantity drops with a ban for $b > b^*$. Note that both retailers are not used if $b > 433/216$ and, in this case, only retailer 1 would be used. By substitution, $D(b = b^*) = 0$ and $\frac{\partial D}{\partial b}|_{b=b*} < 0$, which proves the result.[22] **(Q.E.D.)**

Appendix A.2. No Demand Differences

For this simple model, consumers do not differ in their preferences with respect to retailers and so demands are given by

$$\begin{aligned} p_{A1} &= 1 - q_{A1} \\ p_{A0} &= 1 - q_{A0}. \end{aligned} \tag{28}$$

Under the possibility of wholesale price discrimination, optimal wholesale prices are given by

$$\begin{aligned} w_{A1} &= \frac{(1-c_1)}{2} \\ w_{A0} &= \frac{1}{2}. \end{aligned} \tag{29}$$

From (22) it becomes apparent that what determines whether upstream firms want to wholesale price discriminate are downstream differences in costs c_1. Solving for optimal retail prices given (29), I obtain resulting welfare W_D by adding up consumer and producer surpluses, given by $W_D = \frac{7}{32}(2 - 2c_1 + c_1^2)$.

If the manufacturer has to charge the same wholesale price for his product to both retailers, then he maximizes upstream profits subject to $w_{A0} = w_{A1} = w_A$ yielding

$$w_A = \frac{(2-c_1)}{4}. \tag{30}$$

I obtain welfare under no discrimination W_{ND} by adding up consumer and producer surpluses, given by $W_{ND} = \frac{1}{64}(28 - 12c_1 - 5c_1^2)$. I can finally define the difference $D(c_1) = W_{ND} - W_D$ as the change in welfare with the ban.

Proof of Proposition 2:

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[22] The Mathematica program code is available upon request.

Given no downstream demand differences ($b = 1$), the welfare difference is given by a quadratic in c_1 namely $D(b = 1, c_1) = \frac{1}{64}(16 - 19c_1)c_1$. By substitution, $D(b = 1, c_1 = 0) = 0$, and $D(c_1) > 0$ for $0 < c_1 < \frac{16}{19}$, and this proves the result. **(Q.E.D.)**

Appendix A.3 Linear demands case

A final note relates to the shape of the demands retailers face. With no upstream and downstream competition, given linear demands ($s_0 = s_1 = 1$), banning wholesale price discrimination leads to no change in total quantity sold. In this case, welfare increases with a ban, because it eliminates the demand side and cost side inefficiencies present when price discrimination is possible, for any $b > 1$ and $c_1 > 0$. Given that total quantity due to discrimination did not increase, and this is a result of linearity of both demands, a ban increases welfare (Schmalensee, 1981), as in final goods third degree price discrimination. Given linear demands, that is for $s_0 = 1$, for any b and c_1, we get that

$$q_D = q_{ND} = \tfrac{1}{4}(1 + b - c_1). \tag{31}$$

Efficiency requires that marginal valuation of consumers be the same across retail markets, thus by discriminating and selling at two markets at different wholesale prices that in turn results in different retail prices and has inefficiencies. Only if total quantity sold increases will it offset the distributional inefficiency that different markets consumers face different prices, and therefore have different marginal utilities. In linear demands this force is not present, as output is unchanged with and without discrimination being possible. Now, if demands are non-linear, and if demands in the two markets are different in their degree of concavity, output may increase due to price discrimination in final goods markets (Schmalensee, 1981). This increase in quantity sold is necessary to improve welfare, but is not sufficient. In particular, in the presence of cost differences downstream, we can have quantity increasing with price discrimination but welfare decreasing (Yoshida, 2000), as illustrated for a numerical example in Figure 1.

Appendix B. Deriving uniform wholesale price discrimination margins

In this second part of the 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 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 where 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 $\pi_1 = [p_{A1} - p^w_A - c^r_{A1}]\, q_{A1}(p) + [p_{B1} - p^w_B - c^r_{B1}]\, q_{B1}(p)$, and $\pi_2 = [p_{A2} - p^w_A - c^r_{A2}]\, q_{A2}(p)$, 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 (9), 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 the same as those in (11), which describes retail supply relation. Manufacturers choose wholesale prices p^w to maximize their profits in (12) knowing that retailers behave according to (11), and subject to U. Manufacturers now are only able 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 at the same wholesale price. For example, manufacturers maximize their profits with respect to only two wholesale prices, $\pi_A = [p_A^w - c_A^w]\,[q_{A1}(p(p_A^w, p_{B1}^w)) + q_{A2}(p(p_A^w, p_{B1}^w))]$ and $\pi_B = [p_{B1}^w - c_B^w]\, q_{B1}(p(p_A^w, p_{B1}^w))$, respectively.

Let us now derive the mark-ups for the general case, 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:

$$\underbrace{(p^w - c^w)}_{m_U^w} = -\underbrace{\left[\left(\underbrace{T_w^{Up}}_{N_U \text{ by } N} * \underbrace{\Delta_w^{Up}}_{N_U \text{ by } N}\right) \underbrace{U'}_{N \text{ by } N_U}\right]^{-1}}_{(N_U \text{ by } N_U)} \underbrace{[U\; q(p)]}_{(N_U \text{ by } 1)}, \tag{32}$$

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. The (N_U by N_U) full rank matrix is inverted. 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 (32) 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 (10) 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. 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 Villas-Boas (2007a). Note now that $N - N_U$ wholesale price variations are not independent.

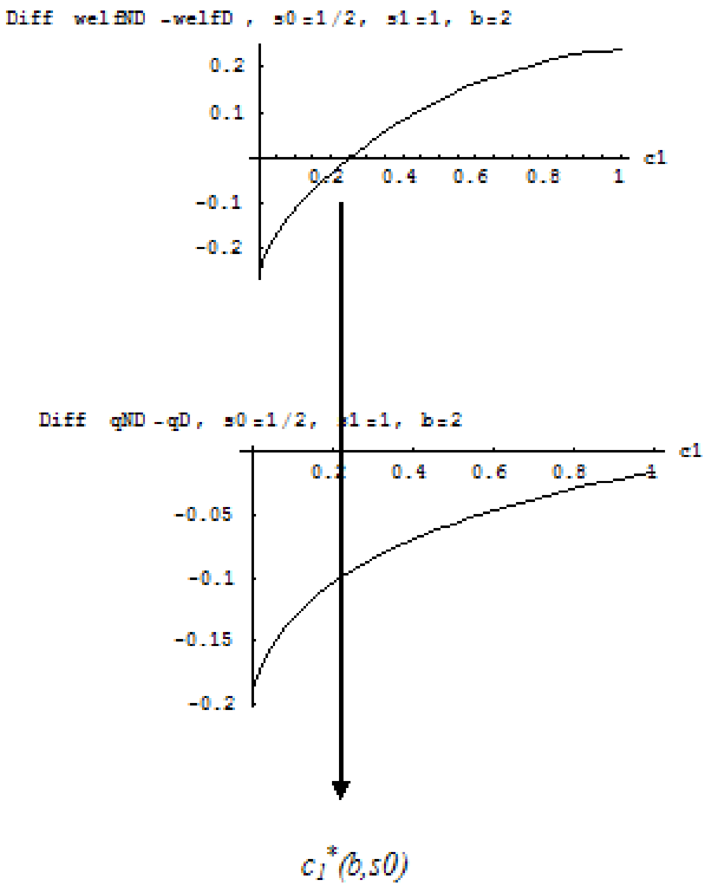
In terms of matrix notation, when solving for the derivatives of all retail prices, with respect to the wholesale price p_f^w, the f-th column of Δ_p^{Up} is obtained as:

$$\frac{dp}{dp_f^w} = G^{-1} \underbrace{[H_j + ... + H_k]}_{H_f^{Up}}, \text{ where } j, ..., k = f, \text{ are restricted to be the same in } U. \tag{33}$$

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 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, (32) 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. This matrix is constructed by 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 $A2$.



Above is the difference in welfare due to a ban (top panel) and the difference in total quantity sold due to a ban on wholesale price discrimination (bottom panel), for a given b=2, s_0=0.5, given that both retailers sell post ban. For c_1<c* welfare drops, and for c_1 above c* welfare increases with the ban.

Figure 1: Welfare and quantity changes for increasing cost differences c_1, given b and s_0.

	Shares	Prices	std	Promotion	Advertising
Retailer Edeka					
Jacobs	30.359	6.815	0.325	1.277	2.335
Onko	8.547	5.980	0.564	1.057	0.224
Melitta	12.706	6.241	0.320	1.018	1.776
Idee	4.989	8.008	0.638	0.726	0.302
Dallmayr	15.820	7.314	0.421	1.166	1.618
Tchibo	17.951	7.893	0.422	0.661	1.640
Eduscho	9.628	6.960	0.499	0.932	1.465
Retailer Markant					
Jacobs	30.619	6.537	0.523	1.024	2.335
Onko	7.306	5.978	0.541	1.033	0.224
Melitta	19.581	5.965	0.440	1.290	1.776
Idee	3.709	7.779	0.697	0.783	0.302
Dallmayr	12.248	7.304	0.491	0.939	1.618
Tchibo	15.845	7.826	0.446	0.684	1.640
Eduscho	10.692	6.916	0.553	0.904	1.465
Retailer Metro					
Jacobs	27.485	7.093	0.724	0.921	2.335
Onko	10.172	6.557	0.808	0.577	0.224
Melitta	23.375	6.669	0.808	0.857	1.776
Idee	3.735	8.093	0.930	0.536	0.302
Dallmayr	11.091	7.818	0.666	0.710	1.618
Tchibo	11.841	7.738	0.512	0.694	1.640
Eduscho	12.301	6.958	0.603	0.910	1.465
Retailer Rewe					
Jacobs	23.350	7.039	0.537	0.688	2.335
Onko	7.157	6.296	0.397	0.578	0.224
Melitta	15.892	6.565	0.392	0.863	1.776
Idee	2.812	8.279	0.480	0.410	0.302
Dallmayr	7.806	8.109	0.817	0.448	1.618
Tchibo	28.434	7.912	0.444	1.025	1.640
Eduscho	14.549	6.919	0.528	1.134	1.465
By Retailers					
Edeka	13.528	7.017	0.721	0.866	9.360
Markant	29.072	6.769	0.829	0.991	9.360
Metro	46.697	7.117	0.864	0.805	9.360
Rewe	10.703	7.260	0.829	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. Quantity, in units sold of 500 grams, divided by potential market yields market shares. Prices are in Deutsch Marks per 500 grams, and advertising in Million Euros. Source: MAKADOM, Germany.

	Logit OLS(1)		Logit IV(2)		RC Logit(3)		RC Logit(4)	
Parameter	Estimate	Std	Estimate	Std	Estimate	Std	Estimate	Std
Price	−0.68	(0.02)	−1.04	(0.05)	−1.25	(0.11)	−1.40	(0.13)
Constant	2.14	(0.14)	0.73	(0.40)	1.76	(0.66)	2.57	(0.73)
Promotion	0.48	(0.01)	0.25	(0.03)	0.23	(0.04)	0.69	(0.13)
Trend	0.00	(0.00)	0.00	(0.00)	−0.01	(0.00)	−0.01	(0.00)
Advertising	0.03	(0.01)	0.03	(0.01)	0.02	(0.01)	0.02	(0.01)
Onko in Edeka	−1.85	(0.05)	−2.20	(0.07)	−2.27	(0.09)	−2.47	(0.10)
Melitta in Edeka	−1.17	(0.05)	−1.44	(0.06)	−1.48	(0.07)	−1.61	(0.08)
Idee in Edeka	−0.68	(0.05)	−0.38	(0.07)	−0.37	(0.07)	−0.41	(0.08)
Dallmayr in Edeka	−0.37	(0.05)	−0.22	(0.06)	−0.21	(0.06)	−0.20	(0.06)
Tchibo in Edeka	0.61	(0.05)	0.86	(0.06)	0.87	(0.07)	0.91	(0.07)
Eduscho in Edeka	−0.86	(0.05)	−0.88	(0.05)	−0.89	(0.05)	−0.87	(0.05)
Jacobs in Markant	0.62	(0.05)	0.46	(0.06)	0.44	(0.06)	0.31	(0.07)
Onko in Markant	−1.27	(0.05)	−1.62	(0.07)	−1.70	(0.09)	−1.98	(0.11)
Melitta in Markant	−0.35	(0.05)	−0.65	(0.07)	−0.71	(0.08)	−0.93	(0.10)
Idee in Markant	−0.45	(0.05)	−0.22	(0.06)	−0.22	(0.08)	−0.34	(0.08)
Dallmayr in Markant	0.26	(0.05)	0.36	(0.05)	0.36	(0.05)	0.30	(0.05)
Tchibo in Markant	1.18	(0.05)	1.41	(0.06)	1.42	(0.06)	1.45	(0.07)
Eduscho in Markant	−0.03	(0.05)	−0.08	(0.05)	−0.10	(0.05)	−0.10	(0.05)
Jacobs in Metro	1.09	(0.05)	1.10	(0.05)	1.09	(0.06)	0.86	(0.08)
Onko in Metro	−0.93	(0.05)	−1.18	(0.06)	−1.24	(0.10)	−1.58	(0.12)
Melitta in Metro	0.30	(0.05)	0.15	(0.06)	0.12	(0.07)	−0.19	(0.09)
Idee in Metro	0.00	(0.05)	0.29	(0.07)	0.29	(0.07)	0.10	(0.08)
Dallmayr in Metro	0.44	(0.05)	0.67	(0.06)	0.68	(0.08)	0.48	(0.09)
Tchibo in Metro	1.29	(0.05)	1.49	(0.06)	1.50	(0.06)	1.52	(0.06)
Eduscho in Metro	0.55	(0.05)	0.52	(0.05)	0.51	(0.05)	0.51	(0.05)
Jacobs in Rewe	−0.12	(0.05)	−0.18	(0.05)	−0.18	(0.05)	−0.26	(0.05)
Onko in Rewe	−1.84	(0.05)	−2.19	(0.07)	−2.26	(0.09)	−2.44	(0.10)
Melitta in Rewe	−0.96	(0.05)	−1.14	(0.06)	−1.18	(0.06)	−1.32	(0.08)
Idee in Rewe	−1.16	(0.05)	−0.84	(0.07)	−0.83	(0.08)	−1.01	(0.08)
Dallmayr in Rewe	−0.72	(0.05)	−0.45	(0.06)	−0.44	(0.07)	−0.64	(0.08)
Tchibo in Rewe	0.67	(0.05)	1.00	(0.07)	1.03	(0.08)	1.18	(0.09)
Eduscho in Rewe	−0.83	(0.05)	−0.83	(0.05)	−0.84	(0.05)	−0.79	(0.05)
Std. Dev. Price (Υ)					0.17	(0.04)	0.24	(0.04)
Std. Dev. Promotion (Υ)							0.72	(0.07)
First Stage								
F(28,2740) (p-value)			8.33	(0.00)	8.33	(0.00)	8.33	(0.00)
R Squared			0.85		0.85		0.85	

Table 2: Results from Demand.

Logit OLS estimates in columns (1), Logit with IV in columns (2), Random Coefficient (RC) Logit estimates in columns (3) and (4), and White standard errors are in parentheses. The first stage regression has the 28 instruments, corresponding to raw coffee price interacted with 28 product dummies, and the regression also includes product dummies, promotion and advertising. Source: Author's calculations.

Elasticity Estimates

	Own Elasticity	Std	Mean Cross	Edeka	Markant	Metro	Rewe
Jacobs	−7.38	0.01	0.07	−7.36	−7.07	−7.53	−7.58
Onko	−6.80	0.00	0.01	−6.60	−6.59	−7.12	−6.90
Melitta	−6.93	0.01	0.04	−6.84	−6.56	−7.19	−7.14
Idee	−8.47	0.00	0.01	−8.45	−8.24	−8.51	−8.69
Dallmayr	−8.11	0.00	0.03	−7.83	−7.80	−8.26	−8.53
Tchibo	−8.26	0.01	0.06	−8.33	−8.24	−8.15	−8.34
Eduscho	−7.48	0.01	0.03	−7.51	−7.46	−7.47	−7.47
			Mean Cross Same Store				
			Yes	No			
Edeka	−7.56	0.02	0.02	0.02			
Markant	−7.42	0.04	0.04	0.03			
Metro	−7.75	0.05	0.05	0.05			
Rewe	−7.81	0.02	0.02	0.01			
Average	−7.63	0.03					

Table 3: Estimated Elasticities.

Elasticity estimates are based on column (3) of Table 2. The top panel of this table reports averages by manufacturer, while the bottom panel reports averages by retailer. Source: Author’s calculations.

	optimizing by week			optimizing by month			
	(1)	(2)	t-stat (1)-(2)	(3)	t-stat (1)-(3)	(4)	t-stat (1)-(4)
Manufacturer Margins							
Jacobs	0.93	0.83	0.63	1.02	−0.93	0.87	0.51
	(0.08)	(0.13)		(0.05)		(0.09)	
Onko	0.91	0.82	0.64	0.99	−0.93	0.84	0.59
	(0.07)	(0.12)		(0.05)		(0.10)	
Melitta	0.90	0.80	0.84	0.98	−0.99	0.79	1.09
	(0.06)	(0.11)		(0.05)		(0.08)	
Idee	0.92	0.86	0.37	1.01	−0.94	0.92	−0.01
	(0.08)	(0.13)		(0.06)		(0.11)	
Dallmayr	0.92	0.84	0.54	1.01	−0.97	0.87	0.34
	(0.08)	(0.13)		(0.06)		(0.11)	
Tchibo	0.94	0.87	0.43	1.05	−0.88	0.98	−0.28
	(0.10)	(0.12)		(0.06)		(0.08)	
Eduscho	0.92	0.82	0.93	1.02	−1.02	0.90	0.21
	(0.08)	(0.08)		(0.05)		(0.06)	
Retailer Margins							
Markant	0.93	0.84	0.64	0.81	1.22	0.71	1.60
	(0.09)	(0.12)		(0.04)		(0.10)	
Edeka	0.95	0.85	0.59	0.83	1.05	0.72	1.54
	(0.10)	(0.14)		(0.04)		(0.11)	
Metro	0.97	0.89	0.35	0.84	1.04	0.74	1.53
	(0.11)	(0.17)		(0.04)		(0.10)	
Rewe	0.93	0.87	0.42	0.81	1.22	0.72	1.60
	(0.09)	(0.13)		(0.04)		(0.10)	
Total Margins	1.87	1.70	0.54	1.84	0.15	1.61	1.21
	(0.17)	(0.26)		(0.07)		(0.13)	
Recovered Costs	5.26	5.43	−0.13	5.29	−0.02	5.52	−0.21
	(0.92)	(0.86)		(0.91)		(0.87)	

Table 4: Results from Supply - Price-Cost Margins and Recovered Costs for Several Specifications. The top rows of this table present estimates of absolute price cost margins, while the last row presents estimates of recovered costs obtained as the difference between retail price and estimated margins. Columns (1) and (2) present results assuming firms optimize every week when deciding prices. Column (1) reports the mean absolute and standard deviations of margins for Random Coefficient only on price, while Column (2) allows a random coefficient on price and promotion. The third column reports the t-statistic of the mean differences between estimates in (1) and (2). The right-most columns assume that firms optimize prices every month, where column (3) has only a random coefficient on price and column (4) has a random coefficient on price and promotion. Source: Author's calculations.

	Mean Differences in Wholesale Prices			Mean Differences in Retail Costs		
Edeka	Markant	Metro	Rewe	Markant	Metro	Rewe
Jacobs	0.002	−0.015	−0.001	0.287	−0.227	−0.221
Onko	−0.003	−0.018	−0.005	0.020	−0.520	−0.307
Melitta	0.004	−0.010	−0.006	0.282	−0.383	−0.316
Idee	0.004	0.000	−0.004	0.240	−0.052	−0.266
Dallmayr	0.001	−0.008	−0.011	0.025	−0.455	−0.775
Tchibo	−0.002	−0.004	−0.002	0.086	0.185	−0.021
Eduscho	−0.002	−0.006	−0.001	0.063	0.036	0.039
Average in Edeka	0.001	−0.009	−0.004	0.143	−0.202	−0.267
std	(0.000)	(0.001)	(0.000)	(0.019)	(0.029)	(0.020)
Markant						
Jacobs		−0.017	−0.004		−0.514	−0.508
Onko		−0.016	−0.002		−0.540	−0.327
Melitta		−0.014	−0.009		−0.665	−0.598
Idee		−0.004	−0.008		−0.292	−0.506
Dallmayr		−0.010	−0.012		−0.480	−0.800
Tchibo		−0.001	0.001		0.099	−0.107
Eduscho		−0.004	0.001		−0.026	−0.024
Average in Markant		−0.009	−0.005		−0.346	−0.410
std		(0.001)	(0.001)		(0.030)	(0.023)
Metro						
Jacobs			0.032			0.021
Onko			0.239			0.229
Melitta			0.082			0.078
Idee			−0.209			−0.210
Dallmayr			−0.313			−0.314
Tchibo			−0.196			−0.200
Eduscho			0.017			0.012
Average in Metro			−0.050			−0.055
std			(0.030)			(0.029)

Table 5: Estimated Wholesale Price Differences and Retail Cost Differences.
Assuming that the same brand sold at different retailers costs the same to manufacture, the mean differences in wholesale prices and the mean retail cost differences are reported. All are expressed in Deutsch Marks per unit of 500 grams. Standard errors are in parentheses. Source: Author's calculations.

	Using Demand Table 2 Specification (3)					Using Demand Table 2 Specification (4)				
		Average within retailer					Average within retailer			
	Mean	Edeka	Markant	Metro	Rewe	Mean	Edeka	Markant	Metro	Rewe
Retail										
Jacobs	0.94	0.93	0.94	0.96	0.93	0.85	0.81	0.83	0.89	0.87
Onko	0.93	0.91	0.93	0.95	0.92	0.84	0.80	0.81	0.90	0.85
Melitta	0.93	0.92	0.93	0.95	0.92	0.83	0.82	0.79	0.86	0.84
Idee	0.96	0.95	0.96	0.98	0.95	0.90	0.89	0.89	0.92	0.91
Dallmayr	0.95	0.94	0.95	0.98	0.95	0.87	0.83	0.84	0.91	0.91
Tchibo	0.96	0.95	0.96	0.97	0.94	0.90	0.90	0.91	0.91	0.87
Eduscho	0.94	0.93	0.95	0.96	0.93	0.85	0.84	0.86	0.86	0.82
Manufacturer										
Jacobs	0.93	0.92	0.92	0.94	0.93	0.83	0.80	0.81	0.87	0.85
Onko	0.91	0.91	0.91	0.92	0.91	0.82	0.79	0.79	0.87	0.84
Melitta	0.90	0.90	0.89	0.91	0.90	0.80	0.79	0.76	0.82	0.82
Idee	0.92	0.92	0.92	0.92	0.92	0.86	0.86	0.85	0.87	0.88
Dallmayr	0.92	0.91	0.91	0.92	0.93	0.84	0.80	0.81	0.86	0.88
Tchibo	0.94	0.94	0.94	0.93	0.92	0.87	0.88	0.89	0.83	0.80
Eduscho	0.92	0.92	0.92	0.94	0.94	0.82	0.82	0.83	0.88	0.85
Total										
Jacobs	1.87	1.85	1.86	1.90	1.86	1.68	1.60	1.65	1.76	1.72
Onko	1.84	1.82	1.84	1.88	1.83	1.67	1.59	1.60	1.77	1.70
Melitta	1.83	1.82	1.82	1.86	1.83	1.63	1.61	1.56	1.68	1.65
Idee	1.88	1.87	1.88	1.90	1.87	1.77	1.74	1.74	1.79	1.80
Dallmayr	1.87	1.85	1.87	1.90	1.87	1.71	1.63	1.65	1.77	1.79
Tchibo	1.90	1.89	1.91	1.92	1.89	1.77	1.78	1.80	1.79	1.72
Eduscho	1.87	1.85	1.87	1.89	1.85	1.67	1.66	1.68	1.69	1.63

Table 6: Estimated Margins by Manufacturer and by Retailer.

For each brand in each row, this table reports the mean across all retailers and the mean within each of the four retailers of estimated retail, manufacturer and total margins. The first set of five columns uses the demand estimates presented in Table 2 Specification (3), with a random coefficient on price only, while the next set of five columns uses specification (4) with a random coefficient on price and promotion. All are expressed in Deutsch Marks per unit of 500 grams. Source: Author's calculations.

	Changes in Retail Price	Changes in Profits	% Change Relative to Price Discr. Case
By Retailer			
Edeka	−0.019	7.80	3.40
Markant	−0.020	21.85	3.81
Metro	−0.031*	57.92*	5.49
Rewe	−0.022*	7.05	3.73
By Manufacturer			
Jacobs	−0.026	31.63	4.33
Onko	−0.026*	6.94*	3.66
Melitta	−0.022	19.92	3.32
Idee	−0.025	3.75	3.64
Dallmayr	−0.024	12.48*	3.59
Tchibo	−0.020	15.57	4.19
Eduscho	−0.021	4.73	4.08
Average Retailers		23.65* (9.21)	4.11
Average Manufacturers		13.58* (4.99)	3.83
Overall	−0.023* (0.007)	189.67* (50.80)	12.85

Table 7: Estimated Price and Profit Effects from Banning Wholesale Price Discrimination. Prices and Profits are expressed in Deutsch Marks. The third column reports the change as a percentage of profits in the price discrimination (benchmark) case. The standard errors are reported in parentheses, and * means statistical significance at 10 percent level. The average product price before simulation is 7.13 Deutsch Marks per 500 grams. Source: Author's calculations.

	Counterfactual Scenarios		
	(1)	(2)	(3)
Change in	Underlying Demand Retail Cost Diff.	Underlying Demand No Retail Cost Diff.	Less Competition Retail Cost Diff.
Overall Price	-0.023^{*}	0.001^{*}	-0.011^{*}
	(0.007)	(0.000)	(0.001)
Edeka's Profits	7.80	-1.60^{*}	-0.14
	(8.51)	(0.82)	(0.19)
Markant's Profits	21.85	-0.37^{*}	-1.65^{*}
	(17.78)	(0.17)	(0.68)
Metro's Profits	57.92^{*}	1.25^{*}	0.02
	(30.68)	(0.62)	(0.17)
Rewe's Profits	7.05	-1.41	0.34^{*}
	(7.07)	(0.92)	(0.13)
Jacobs' Profits	31.63	-0.70	-0.56^{*}
	(22.75)	(1.06)	(0.29)
Onko's Profits	6.94^{*}	-0.17^{*}	-0.14^{*}
	(4.11)	(0.04)	(0.04)
Melitta's Profits	19.92	-0.33^{*}	-0.26^{*}
	(15.50)	(0.11)	(0.04)
Idee's Profits	3.75	0.04^{*}	-0.26^{*}
	(3.56)	(0.02)	(0.06)
Dallmayr's Profits	12.48^{*}	0.05	-0.28^{*}
	(7.65)	(0.09)	(0.05)
Tchibo's Profits	15.57	-0.32^{*}	0.02
	(19.41)	(0.06)	(0.01)
Eduscho's Profits	4.73	-0.50^{*}	-0.03
	(10.81)	(0.17)	(0.02)
Overall Profits	189.67^{*}	-4.06^{*}	-2.82^{*}
	(50.80)	(1.85)	(0.78)
Consumer Surplus	134.83^{*}	-0.11^{*}	7.07^{*}
	(66.10)	(0.04)	(2.58)
Welfare	324.49^{*}	-4.16^{*}	4.25^{*}
	(83.36)	(1.85)	(2.70)

Table 8: Welfare Estimates from Counterfactual Scenarios.

Column (1) has the benchmark model simulation results as in Table 7. Column (2) has estimates resulting from simulations using the benchmark demand model estimates and assuming there are not any downstream retail cost differences. Column (3) uses the benchmark retail cost differences but assumes a demand model where there is less competition due to more product differentiation (by increasing the Logit standard deviation by 100 % (from 1 to 2); which results in dividing all demand estimates by 2. The average own demand elasticity changed from -7% to -3% in columns (1) and (3), respectively. Effects are expressed in Deutsch Marks per week. The standard errors are reported in parentheses. Source: Author's calculations.