Duopoly Competition in Supermarket Industry: The Case of Seattle-Tacoma Milk Market

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1 Introduction

The Seattle-Tacoma consumers have been paying higher prices for fresh milk than consumers in other Western states of United States. For instance, the retail price for whole milk averaged \$3.27/gallon during the period of April 1999- April 2003 in Seattle-Tacoma, while it did not go beyond \$2.86/gallon in most of the large metropolitan areas in Western U.S, during the same period (Carman and Sexton, 2006). In addition, retail prices in Seattle-Tacoma do not respond similarly to farm price increases and decreases. Supermarkets are prompt to pass on to consumers any increase in farm price, while they do not pass or lag behind when farm price decreases.

Understanding the pricing conduct of the supermarket chains in Seattle-Tacoma is a key issue toward explaining the level of fluid milk retail prices as well as the relationship between these prices and the farm price. A practical question to answer is related to the level of power supermarket chains have to set fluid milk retail prices beyond the competitive level. More specifically, do supermarket chains in Seattle-Tacoma exercise market power when they set the fluid milk retails prices? The objective of this article is, therefore, to test for and measure the market power of supermarket chains in setting fluid milk prices in Seattle-Tacoma market area.

The present study attempts to analyze the pricing conduct of supermarket chains in a duopoly setting using a structural model of consumers and firms behavior. Several studies have examined the pricing conduct in a duopoly setting. These studies can be classified into two categories. In the first category, the focus is on providing a theoretical background for analyzing pricing conduct by using game theoretic techniques to characterize the equilibrium[1].

In the second category, the focus is on modeling the firms pricing conduct by fitting market data to the theoretical models. Often, the studies in this category use observed data on sales and prices to infer the firms pricing conduct, either through a conduct parameter approach (conjectural variation studies) or through a menu approach. In the conjectural variation approach, the focus is on estimating a conduct parameter that informs on the degree of competition of the market or industry analyzed, and that nests the perfect competition, the perfect collusion, and the Cournot/Bertrand models (e.g., Iwata, 1974; Gollop and Roberts, 1979, Appelbaum, 1982; Liang, 1989). In the menu approach, a number of models based on strategic games played by firms are estimated and compared to find which game fits the data more consistently (e.g. Chintagunta and Jain (1995); Kadiyali et *al.* (1996); and Dhar et *al* (2005)).

In this paper, we examine the pricing conduct of two supermarket chains using retail supermarket-level data on sales and prices from Seattle-Tacoma market area[2]. We follow the approach developed in Kadiyali et *al.* (1996)

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[1] See for instance, Amir and Stepanova (2006); Ogawa and Kato (2006), and Christou et al. (2007).

[2] We thank Ronald Cotterill, Director of Food Marketing Policy of the University of

by comparing Bertrand-Nash pricing strategy against Stackelberg pricing strategy, allowing for various leader-follower alternatives.

In Seattle-Tacoma, the supermarket industry is dominated by two supermarket chains: Albertsons' and Safeway. The two supermarkets control more than 61% of total grocery sales and more than 53% of the fluid milk sales. In addition, the private label represents more than 95% of the total fluid milk sold at these supermarket chains. This offers a good case study of a full vertically integrated duopolists.

In terms of pricing, the figure below indicates that the two supermarket chains follow each other in setting the retail prices. In fact, using the four-weekly data from Information Resources Incorporated-Infoscan (IRI) [3], the partial correlation coefficient between the retail prices in Albertsons' and the retail prices in Safeway was approximately 0.85, suggesting that the two retailers follow each other in setting fluid milk prices. On the other hand, the spread between the retail prices and the farm price was widening and the partial correlation coefficient between retail prices in Safeway, for instance, and farm price was only 0.29.

The rest of the paper is organized as follows. In the next section, we develop a structural model of demand and supply for fluid milk at the retail level. The fluid milk is assumed to be differentiated product. The differentiation is made through the fat content and the supermarket differentiation

Connecticut, for allowing us to use this data.

[3] The data cover the period March 1996 through July 2000

(supermarket chain, location,...). The alternative pricing games of Bertrand-Nash and leader-follower are also described. In the third section, we describe the data used and the empirical estimation issues. In section four, the results and findings are presented. Section five concludes and present directions for future research.

2 The Model

The two supermarket chains in our model, Albertsons (call it firm 1) and Safeway (call if firm 2), each carry mainly two categories of fluid milk: the whole milk and the skimmed/low fat milk. These two categories are dominated by the store brand, representing more than 95% of the fluid milk sales. Assuming a profit-maximizing behavior for the two firms, each firm sets the price to maximize the profit given by

$$\pi_1 = (p_1 - MC1) * M * s_1(p) + (p_2 - MC2) * M * s_2(p) \tag{1}$$

$$\pi_2 = (p_3 - MC3) * M * s_3(p) + (p_4 - MC4) * M * s_4(p) \tag{2}$$

where the subscripts 1 and 2 designate the whole milk and the skimmed/low fat milk sold at Albertsons supermarkets, respectively; and the subscripts 3 and 4 are reserved for the whole milk and the skimmed/low fat milk sold at Safeway supermarkets, respectively. p_1, p_2, p_3, and p_4 are the retail prices of the whole milk and the skimmed/low fat milk sold at Albertsons and Safeway stores, respectively. MC_1, MC_2, MC_3, and MC_4 are the corresponding marginal costs associated with the production and the distribution of each milk category at each supermarket chain. s_1, s_2, s_3, and s_4 are the market shares, as function of the vector of prices $p = (p_1\ p_2\ p_3\ p_4)'$. M is a measure of the market size.

The first-order conditions for profit maximization for firm 1, assuming a Bertrand-Nash game[4] are given by

$$\frac{\partial \pi_1}{\partial p_1} = s_1 + (p_1 - MC_1)\frac{\partial s_1(p)}{\partial p_1} + (p_2 - MC_2)\frac{\partial s_2(p)}{\partial p_1} = 0 \tag{3}$$

$$\frac{\partial \pi_1}{\partial p_2} = s_2 + (p_1 - MC_1)\frac{\partial s_1(p)}{\partial p_2} + (p_2 - MC_2)\frac{\partial s_2(p)}{\partial p_2} = 0 \tag{4}$$

Similar first order conditions can be obtained for firm 2.

$$\frac{\partial \pi_2}{\partial p_3} = s_3 + (p_3 - MC_3)\frac{\partial s_3(p)}{\partial p_3} + (p_4 - MC_4)\frac{\partial s_4(p)}{\partial p_3} = 0 \tag{5}$$

$$\frac{\partial \pi_2}{\partial p_4} = s_4 + (p_3 - MC_3)\frac{\partial s_3(p)}{\partial p_4} + (p_4 - MC_4)\frac{\partial s_4(p)}{\partial p_4} = 0 \tag{6}$$

Solving for the price-cost margins $(p_i - MC_i)$ and putting the results in a

[4]Assuming a Bertrand-Nash game implies that $\frac{\partial p_2}{\partial p_1} = \frac{\partial p_3}{\partial p_1} = \frac{\partial p_4}{\partial p_1} = 0$. Idem for the other first-order conditions.

matrix form, we get

$$\begin{pmatrix} p_1 - MC_1 \\ p_2 - MC_2 \\ p_3 - MC_3 \\ p_4 - MC_4 \end{pmatrix} = - \begin{pmatrix} \frac{\partial s_1}{\partial p_1} & \frac{\partial s_1}{\partial p_2} & 0 & 0 \\ \frac{\partial s_2}{\partial p_1} & \frac{\partial s_2}{\partial p_2} & 0 & 0 \\ 0 & 0 & \frac{\partial s_3}{\partial p_3} & \frac{\partial s_3}{\partial p_4} \\ 0 & 0 & \frac{\partial s_4}{\partial p_3} & \frac{\partial s_4}{\partial p_4} \end{pmatrix}^{-1} \begin{pmatrix} s_1(p) \\ s_2(p) \\ s_3(p) \\ s_4(p) \end{pmatrix} \tag{7}$$

Or

$$\begin{aligned} p_1 - MC_1 &= -\tfrac{\eta_{22}s_1 - \eta_{21}s_2}{-\eta_{12}\eta_{21} + \eta_{11}\eta_{22}} \\ p_2 - MC_2 &= -\tfrac{\eta_{12}s_1 - \eta_{11}s_2}{\eta_{12}\eta_{21} - \eta_{11}\eta_{22}} \\ p_3 - MC_3 &= -\tfrac{\eta_{44}s_3 - \eta_{43}s_4}{-\eta_{34}\eta_{43} + \eta_{33}\eta_{44}} \\ p_4 - MC_4 &= -\tfrac{\eta_{34}s_3 - \eta_{33}s_4}{\eta_{34}\eta_{43} - \eta_{33}\eta_{44}} \end{aligned} \tag{8}$$

where $\eta_{ij} = \frac{\partial s_i}{\partial p_j}$, with $i = 1, 2, 3, 4$ and $j = 1, 2, 3, 4$.

Therefore, to estimate the price-cost margins under the Bertrand-Nash game theoretical assumption, we only need to estimate the demand equations. Equation (7) gives the price-cost margins for each category of milk, at each supermarket chain, as a function of the demand parameters and the market shares. Notice that, the price-cost margins are estimated without prior knowledge of the marginal cost.

In the Stackelberg game, we have a leader and a follower in the market. In this game, the leader observes the best response of the follower and sets the price that maximizes its profit given the follower's best responses. The game is solved by backward induction to find the subgame perfect Nash equilibrium. Assume for example that firm 1 (Albertsons supermarkets) is the leader in both the whole milk and the skimmed/low fat milk, and firm 2 (Safeway supermarkets) is the follower in both. Given that the game is solved by backward induction, the first-order conditions for the follower are given by:

$$\frac{\partial \pi_2}{\partial p_3} = s_3 + (p_3 - MC_3)\frac{\partial s_3(p)}{\partial p_3} + (p_4 - MC_4)\frac{\partial s_4(p)}{\partial p_3} = 0 \tag{9}$$

$$\frac{\partial \pi_2}{\partial p_4} = s_4 + (p_3 - MC_3)\frac{\partial s_3(p)}{\partial p_4} + (p_4 - MC_4)\frac{\partial s_4(p)}{\partial p_4} = 0 \tag{10}$$

Solving for the price-cost margins we get

$$\begin{aligned} p_3 - MC_3 &= -\tfrac{\eta_{44}s_3 - \eta_{43}s_4}{-\eta_{34}\eta_{43} + \eta_{33}\eta_{44}} \\ p_4 - MC_4 &= -\tfrac{\eta_{34}s_3 - \eta_{33}s_4}{\eta_{34}\eta_{43} - \eta_{33}\eta_{44}} \end{aligned} \tag{11}$$

The leader sets the prices to maximize the profit, given the follower's best responses. The first-order conditions for the leader profit maximization are given by

$$\begin{aligned} \tfrac{\partial \pi_1}{\partial p_1} &= s_1 + (p_1 - MC_1)[\eta_{11} + \eta_{13}\epsilon_{31} + \eta_{14}\epsilon_{41}] + (p_2 - MC_2)[\eta_{21} + \eta_{23}\epsilon_{31} + \eta_{24}\epsilon_{41}] = 0 \\ \tfrac{\partial \pi_1}{\partial p_2} &= s_2 + (p_1 - MC_1)[\eta_{12} + \eta_{13}\epsilon_{32} + \eta_{14}\epsilon_{42}] + (p_2 - MC_2)[\eta_{22} + \eta_{23}\epsilon_{32} + \eta_{24}\epsilon_{42}] = 0 \end{aligned} \tag{12}$$

where $\epsilon_{ij} = \frac{\partial p_i}{\partial p_j}$.[5]

The ϵ_{ij}'s could be obtained from the first-order conditions of the follower by differentiating the price-cost margins obtained in equation (11) with re-

[5] Here we assume that $\frac{\partial p_1}{\partial p_2} = \frac{\partial p_2}{\partial p_1} = 0$. In other words, products produced by the same firm do not react to each other.

spect to p_1 and p_2. This results in

$$
\begin{aligned}
\frac{\partial p_3}{\partial p_1} &= -\frac{1}{d}[\eta_{44}\left(\frac{\partial s_3(p)}{\partial p_1}+\frac{\partial s_3(p)}{\partial p_3}\frac{\partial p_3}{\partial p_1}+\frac{\partial s_3(p)}{\partial p_4}\frac{\partial p_4}{\partial p_1}\right)-\eta_{43}\left(\frac{\partial s_4(p)}{\partial p_1}+\frac{\partial s_4(p)}{\partial p_3}\frac{\partial p_3}{\partial p_1}+\frac{\partial s_4(p)}{\partial p_4}\frac{\partial p_4}{\partial p_1}\right)] \\
\frac{\partial p_3}{\partial p_2} &= -\frac{1}{d}[\eta_{44}\left(\frac{\partial s_3(p)}{\partial p_2}+\frac{\partial s_3(p)}{\partial p_3}\frac{\partial p_3}{\partial p_2}+\frac{\partial s_3(p)}{\partial p_4}\frac{\partial p_4}{\partial p_2}\right)-\eta_{43}\left(\frac{\partial s_4(p)}{\partial p_2}+\frac{\partial s_4(p)}{\partial p_3}\frac{\partial p_3}{\partial p_2}+\frac{\partial s_4(p)}{\partial p_4}\frac{\partial p_4}{\partial p_2}\right)] \\
\frac{\partial p_4}{\partial p_1} &= \frac{1}{d}[\eta_{34}\left(\frac{\partial s_3(p)}{\partial p_1}+\frac{\partial s_3(p)}{\partial p_3}\frac{\partial p_3}{\partial p_1}+\frac{\partial s_3(p)}{\partial p_4}\frac{\partial p_4}{\partial p_1}\right)-\eta_{33}\left(\frac{\partial s_4(p)}{\partial p_1}+\frac{\partial s_4(p)}{\partial p_3}\frac{\partial p_3}{\partial p_1}+\frac{\partial s_4(p)}{\partial p_4}\frac{\partial p_4}{\partial p_1}\right)] \\
\frac{\partial p_4}{\partial p_2} &= \frac{1}{d}[\eta_{34}\left(\frac{\partial s_3(p)}{\partial p_2}+\frac{\partial s_3(p)}{\partial p_3}\frac{\partial p_3}{\partial p_2}+\frac{\partial s_3(p)}{\partial p_4}\frac{\partial p_4}{\partial p_2}\right)-\eta_{33}\left(\frac{\partial s_4(p)}{\partial p_2}+\frac{\partial s_4(p)}{\partial p_3}\frac{\partial p_3}{\partial p_2}+\frac{\partial s_4(p)}{\partial p_4}\frac{\partial p_4}{\partial p_2}\right)]
\end{aligned} \tag{13}
$$

Or equivalently

$$
\begin{aligned}
\frac{\partial p_3}{\partial p_1} &= \epsilon_{31} = -\frac{1}{d}[\eta_{44}(\eta_{31}+\eta_{33}\epsilon_{31}+\eta_{34}\epsilon_{41})-\eta_{43}(\eta_{41}+\eta_{43}\epsilon_{31}+\eta_{44}\epsilon_{41})] \\
\frac{\partial p_3}{\partial p_2} &= \epsilon_{32} = -\frac{1}{d}[\eta_{44}(\eta_{32}+\eta_{33}\epsilon_{32}+\eta_{34}\epsilon_{42})-\eta_{43}(\eta_{42}+\eta_{43}\epsilon_{32}+\eta_{44}\epsilon_{42})] \\
\frac{\partial p_4}{\partial p_1} &= \epsilon_{41} = \frac{1}{d}[\eta_{34}(\eta_{31}+\eta_{33}\epsilon_{31}+\eta_{34}\epsilon_{41})-\eta_{33}(\eta_{41}+\eta_{43}\epsilon_{31}+\eta_{44}\epsilon_{41})] \\
\frac{\partial p_4}{\partial p_2} &= \epsilon_{42} = \frac{1}{d}[\eta_{34}(\eta_{32}+\eta_{33}\epsilon_{32}+\eta_{34}\epsilon_{42})-\eta_{33}(\eta_{42}+\eta_{43}\epsilon_{32}+\eta_{44}\epsilon_{42})]
\end{aligned} \tag{14}
$$

where $d = \eta_{33}\eta_{44} - \eta_{34}\eta_{43}$

Regrouping the terms together, we can solve for the price reactions ϵ_{31}, ϵ_{32}, ϵ_{41}, and ϵ_{42}. Notice that these price reactions are functions of the demand parameters, and are therefore easy to compute once the demand is estimated[6]. These price reactions are used to solve for the price-cost margins for the leader. These price-cost margins are given by

$$
\begin{aligned}
(p_1 - MC_1) &= -\frac{b_2 s_1 - a_2 s_2}{-a_2 b_1 + a_1 b_2} \\
(p_2 - MC_2) &= -\frac{b_1 s_1 - a_1 s_2}{a_2 b_1 - a_1 b_2}
\end{aligned} \tag{15}
$$

[6]In the appendix we give the expression of these price reactions as function of the parameters of the demand. Though their expressions look tedious, their values are easy to compute.

where $a_1 = \eta_{11} + \eta_{13}\epsilon_{31} + \eta_{14}\epsilon_{41}$, $a_2 = \eta_{21} + \eta_{23}\epsilon_{31} + \eta_{24}\epsilon_{41}$, $b_1 = \eta_{12} + \eta_{13}\epsilon_{32} + \eta_{14}\epsilon_{42}$, and $b_2 = \eta_{22} + \eta_{23}\epsilon_{32} + \eta_{24}\epsilon_{42}$.

Equations (11) and (15) allow us to estimate the game where firm 1 leads in both the whole milk and skimmed/low fat milk and firm 2 follows in both. The price-cost margins of this game are obtained as a function of the demand parameters.

The estimation of the games described above (Bertrand-Nash and Stackelberg games) relies heavily on the estimation the demand parameters. In this study, we use a standard random coefficients multinomial logit model[7] to derive the demand for differentiated products[8].

We assume that fluid milk is differentiated across supermarkets. This differentiation is the result of the differences between supermarket chains in many dimensions: one-stop shopping convenience, promotional activities, location, and the quality of the service offered to shoppers. The consumer chooses a supermarket chain from competing supermarkets in order to maximize utility, driven by the product and the store characteristics. The consumer has also the possibility to shop from other store formats (the outside option)[9].

The indirect utility of consumer i from shopping for milk at supermarket

[7]For more on the random coefficients multinomial logit applications, see Berry, Levinsohn, and Pakes (1995); Nevo (2000); Villas-Boas (2007); and Chidmi and Lopez (2007).

[8]Though the number of brands considered here is just 4, the use of the random coefficients multinomial logit model is justified for the consumers' heterogeneity and the richer pattern of substitution.

[9]The inclusion of the outside option is necessary to cover all the alternatives of the discrete choice model. For a detailed discussion, see Train (2003).

j[10] is given by

$$U_{ij} = \alpha_i p_j + \beta_i x_j + \varepsilon_{ij} \quad i = 1, ..., N \quad j = 1, ..., J \tag{16}$$

where p_j is the price of the fluid milk sold at the supermarket j, x_j is a vector of observed product-supermarket chain characteristics, ε_{ij} represents the distribution of consumer preferences about the unobserved product-characteristics, with a density $f(\varepsilon)$[11].The parameters to be estimated are α_i and β_i. Note that these parameters are allowed to vary among consumers and therefore take into account consumers as well as product heterogeneity. These coefficients can be decomposed into a fixed component, that does not vary with the consumer characteristics; and a variable component that changes with consumer characteristics. That is,

$$\begin{aligned} \alpha_i &= \alpha + \lambda D_i + \gamma v_i \\ \beta_i &= \beta + \varphi D_i + \rho v_i \end{aligned} \tag{17}$$

where D_i denotes consumer observed characteristics (i.e., income, age, household size, number of kids and so on), and v_i denotes the unobserved consumer characteristics, assumed to follow a standard normal distribution.

[10]We consider here the supermarket because in the case of Seattle-Tacoma market area, more than 95% of the milk sold at the Albetsons and Safeway supermarkets is private label.

[11]The unobserved characteristics are observed by the consumer but unobserved by the econometrician).

Substituting (17) into (16) yields

$$U_{ij} = \alpha p_j + \beta x_j + \lambda D_i p_j + \gamma v_i p_j + \varphi D_i x_j + \rho v_i x_j + \varepsilon_{ij} \tag{18}$$

The consumer chooses the product-supermarket that gives the highest utility within his choice set. Aggregating over consumers in the market, the market share of the j^{th} product-supermarket corresponds to the probability that the j^{th} product-supermarket is chosen. That is,

$$s_j = \int I \left\{ (D_i, v_i, \varepsilon_{ij}) : U_{ij} \geq U_{ik} \quad \forall k = 0, 1, ..., J \right\} dH(D) dG(v) dF(\varepsilon) \tag{19}$$

where I is an indicator function that equals one when the expression between brackets is true and zero, otherwise. H, G, and F are the probability distributions for the variables D, v, and ε, respectively.

We proceed as in Nevo (2000) to solve the integral in equation (18). The partial derivatives of the market shares with respect to retail prices, used in estimating the games described above, are obtained from the following expression:

$$\eta_{jk} = \frac{\partial s_j}{\partial p_k} = \{ \begin{array}{ll} \int \alpha_i s_{ij}(1 - s_{ij}) dH(D) dG(v), & for j = k, \\ - \int \alpha_i s_{ij} s_{ik} dH(D) dG(v), & otherwise \end{array} \tag{20}$$

3 Data and Methods

The methodology consists in two steps. In the first step, we estimate a consumer demand for fluid milk at the product-supermarket level using a random coefficients multinomial logit model. In the second step, we use the demand estimates to assess the market power of the supermarket chains using a duopoly framework, and assuming a Nash Bertrand pricing conduct and alternative Stackelberg pricing conducts.

For the demand estimation, we follow the algorithm developed by Berry, Levinsohn and Pakes (1995) and Nevo (2000). The demand estimation described above implies the need to use instrumental variables to account for the potential endogeneity of the prices. This study follows Villas-Boas (2007) and Chidmi and Lopez (2007) using instrumental variables constructed from the interaction between product-supermarket dummies and input prices. Hence, the farm milk price, the wages in Seattle-Tacoma retail industry, the electricity prices and a packaging index were interacted with the product-supermarket dummies.

The data used consist of two types of information: sales variables for each product and demographic variables that provide information on consumer heterogeneity. The sales data consist of scanner data from Information Resource Inc., (IRI) at the brand supermarket level for Seattle-Tacoma, provided by the food Policy Marketing Center of the University of Connecticut. The data is a four-week periods between March 1996 and July 2000. It provides information, for each product-supermarket, on dollar sales, volume sales, the percent of volume sold with any merchandising (promotion) and the percent of price reduction. Using these data, we obtain the product-supermarket market shares and the retail prices.

Data on product-supermarket characteristics include the product category (whole milk versus skimmed/low fat milk), the store brand (private label) dummy and the supermarket dummy. The demographic data were obtained as random draw from the Current Population Survey for Seattle-Tacoma. It consisted of two variables: the number of person under 16 years and the household income.

Once the demand is estimated, the results are used to estimate the alternative games presented in the previous section. The results of this exercise are presented in the following section.

4 Results

Demand Side

The parameter estimates of the random coefficients multinomial logit given by equation(19) are presented in Table 1. All the parameters in the mean valuation utility are significant. The parameter of the price, the price reduction variable, the private label dummy and the milk category dummy are of expected sign. The negative sign of the promotion variable could be explained by the fact that promotion may have an effect on the future sales but not the current sales. However, as the model takes into account consumers' heterogeneity, the interpretation of the parameter estimates does not provide full information as does the distribution of these parameter estimates across consumers[12].

Using equation (20), the matrix of price elasticities is computed and the results are summarized in Table 2. As it can be see, all the elasticities are of the expected sign. The own-price elasticities shows that the demand for fresh milk at the product-supermarket level is elastic. These elasticities are higher in Albertsons' supermarket chain than in Safeway.

In terms of cross-price elasticities, first note that within each supermarket chain the cross price elasticities are low when compared to the own-price elasticities. This attests that although consumers are sensitive to the prices of their products-supermarket, they have developed a degree of brand loyalty.

Supply Side

Table 3 presents the Lerner index[13] implied by each of the alternative game. In this paper we present a Bertrand-Nash game, a Stackelberg game, where Albertsons' leads both in whole milk and skimmed/low fat milk and Safeway follows in both; and a Stackelberg game where Safeway leads in both and Albertsons' follows in both.

The results shed light on the degree of market power the supermarket chains in Seattle-Tacoma have to set the retail prices for milk. The results

[12] We will not present and discuss the distribution of the parameter estimates in this draft.

[13] The Lerner index is given by $L = \frac{p_i - MC_i}{p_i}$.

in Table 3 shows that all the alternative games estimated in this paper imply some degree of market power exercised by the supermarket chains in Seattle-Tacoma. The results are consistent with the theory as the Lerner index implied by the Stackelberg game is higher than the one implied by the Nash-Bertrand game[14]. Notice also that the margins are greater for Safeway supermarket chain than for Albertsons for both products and for all the games. Also, supermarket chains make more money form the skimmed/low fat milk than from the whole milk.

5 Conclusion

[Insert conclusion here]

6 References

[Insert references here]

[14]In this draft we do not test which model fits the data better. This will be done in future version.

Table 1: Demand parameter estimates

Variable	Estimate	t-statistic
Mean Utility Valuation		
Price	-1.4306	-21.2598
Promotion	-0.9816	-1.9373
Price reduction	1.1083	2.6967
Private label dummy (PLD)	2.0256	10.9739
Store dummy (SD)	1.7862	9.3496
Milk category dummy (MCD)	-0.8249	-5.0494
Interactions		
Income	0.1336	0.0832
Income x Price	-0.8192	-2.3049
Income x PLD	0.7395	1.8098
Income x SD	1.4039	4.2999
Income x MCD	0.7836	2.5460
# of Kids	-0.1934	-0.0017
# of Kids x Price	-2.7055	-0.4676
# of Kids x PLD	0.0316	0.9259
# of Kids x SD	0.0306	3.5410
# of Kids x MCD	0.4997	0.3379
Unobserved	0.5858	1.2820
Unobserved. x Price	-0.1581	-1.3488
Unobserved. x PLD	1.4369	2.5686
Unobserved. x SD	0.7627	1.0084
Unobserved. x MCD	0.2396	0.6785

Table 2: Own- and cross-price elasticities

Product-supermarket	Albertsons' whole milk	Alberstons skimmed milk	Safeway whole milk	Safeway skimmed milk
Albertsons' whole milk	-3.9824	0.0629	1.6671	0.1251
Alberstons skimmed milk	0.3400	-3.5027	0.9916	0.2778
Safeway whole milk	0.6435	0.0704	-2.5113	0.1682
Safeway skimmed milk	0.2451	0.1011	0.8595	-2.6875

Table 3: Lerner index (in %) for alternative games

Product-supermarket	Bertrand-Nash	Albertsons leads	Safeway leads
Albertsons' whole milk	18.95	21.22	18.95
Alberstons skimmed milk	41.72	44.92	41.72
Safeway whole milk	35.25	35.25	37.356
Safeway skimmed milk	63.89	63.89	66.57

Figure 1: Retail and Farm Prices in Seattle-Tacoma, March 1996- July 2000