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What are the factors affecting the consumers' milk choices?

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Abstract: There is an increasing interest in specialty milk products such as soymilk, cholesterol free/lactose free (CFLF) milk and organic milk. While the market shares of these milk types are still small, specialty milk consumption is one of the fastest growing consumer segments in the dairy industry. Therefore, it is of interest to producers, consumers as well as the policy-makers to identify the consumer profile of these products and to determine policies based on the consumer choices. In the article, there are utilised the actual consumer sales data to see whether the USDA's dairy policy follows the consumers' milk preferences. The results indicate that the household demographics significantly affect milk preferences. Race is by far the most striking factor in the consumers' decision process. Minority households have a much higher probability of purchasing specialty milk types than the white households. They are also loyal customers of the specialty milk types and are less responsive to the changes in factors that affect their purchase decision. Based on these findings, there is recommend an alternative policy to the USDA's one-size-fits-all type of dairy guidelines.

Keywords: consumer choice, demand analysis, lactose intolerance, milk, soymilk

Dairy products are among the most nutritious foods. The USDA Center for Nutrition Policy & Promotion (2015) suggests that dairy products provide essential nutrients such as Calcium, Potassium, Vitamin D, and Protein. These nutrients are vital for healthy living. It is also claimed by the USDA that dairy products may reduce the risk of osteoporosis and cardiovascular diseases and type 2 diabetes. Given these benefits, the USDA website claims dairy products as the best complement for a healthy meal. The USDA's MyPlate initiative suggests 3 cups of dairy products for adults and teenagers, and 2 cups of dairy products for infants under 3 years old. What the USDA does not mention is that the presence of lactose in milk might cause uncomfortable digestive issues in some individuals, causing diarrhoea and in some cases bloating, gas, and stomach cramping.

Digesting lactose requires special enzymes, which might not be available in sufficient amounts for especially the non-European people. When an individual does not have these enzymes, milk consumption can cause gas, cramps and/or diarrhoea. Asians are among the racial groups who do not have the lactose digesting enzymes. As a result, in many Asian countries, soymilk has been consumed as a substitute for dairy products for centuries. Research suggests that black consumers may also suffer from the lactose intolerance. As suggested by Steinman (2002) approximately 90–95% of black individuals are deficient in the enzymes that digest lactose. The USDA has included soymilk (soy beverage) in the same category as milk where 1 cup of the calcium-fortified soymilk is counted the same as 1 cup of cow's milk. However, it is not clear whether soymilk is recommended as a viable alternative to everyone or specifically to those who have the lactose intolerance or cholesterol issues.

With the rise of interest in functional foods, soymilk has become an increasingly popular alternative to the dairy-based milk in households (Menrad 2003). It is not only lactose free, but it is also cholesterol free which makes it a valuable alternative to those who have cholesterol concerns. There are also lactose free cholesterol free milk (CFLF) types where special procedures are applied to remove these ingredients from the milk. Organic labelled milk is another substitute

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for the health-concerned individuals, whether they are lactose intolerant or not (Moschini et al. 2005). While these milk types have different properties, they share one thing in common: they are priced with a hefty premium and yet have a loyal customer base.

Even though the market shares of these specialty milk products are low, the demand for them has been increasing rapidly over time. This change in the market provides not only key opportunities but also challenges to the dairy sector. It is of special interest to identify the factors that affect the demand for these specialty milk products. While a substantial research has been performed on the health benefits of these products, most of the empirical research is concerned with analysing the demand for the hormone-free food products or the CLA-enriched milk (Wang et al. 1997; Chakraborty 2005; Aizaki et al. 2012). Some research has been done on analysing the consumer's acceptance of soy products (Moon et al. 2005), organic food (Thompson 1998; Garretson and Burton 2000), rBST milk (Kolodinsky 2008) and lactose free milk (Scrimshaw and Murray 1988). However, none of this research has attempted to quantify the consumer profiles for the specialty milk products.

This research contributes to the literature by quantifying the demographic factors that affect the households' decision to purchase specialty milk products using the actual sales data. Our goal is to identify the type of households who are likely to purchase these products. By analysing the households' purchase motivations, the USDA can also better tailor its dairy recommendations instead of generalizing its advisory initiatives.

In order to identify the household's primary characteristics, we applied a probabilistic approach where each household chooses to buy or not to buy specialty milk at each shopping occasion. The theoretical framework follows that of McFadden's (1980) logistic model. Davis and Wohlgenant (1993) applied this model to natural and artificial Christmas tree choices to estimate demand elasticities. Cotterill and Dhar (2003) employ a similar approach on the Boston fluid milk market. Following Nimon and Beghin (1999), Steiner (2004), Boer and Bast (2015), in our model we assume that label is a valuable source of information for consumers and consumers use this information in their purchase decisions. We use this framework to explain the choice variation among households based on their demographic profiles.

We also estimate price, income, size and age sensitivities of demand for each specialty milk type using elasticities. Minority households are among the loyal consumers of specialty products. Income is not found to be significant, whereas age, education level, and employment status all have positive impacts on demand.

Our findings suggests that the USDA's 3 cups of dairy products along with the meal recommendations are based on unrealistic generalizations and ignore the genetic differences among the American households. For the non-white households, consumption of dairy products in the form of fluid milk while having a meal is not a viable option. Even for white households, having a burger with milk can cause serious issues. Moreover, the lactose-intolerant consumers are very likely to suffer from lactose in milk as digesting lactose is a serious issue for them. While suggesting soymilk is a step forward, the USDA also needs to support the lactose-free dairy alternatives or even better digestive alternatives such as the kefir or ayran to those with the lactose intolerance.

The next section in this paper explains the model used in the estimation. Here, we briefly explain how we used the discrete choice logistic model along with a hedonic regression for identifying the customer profile and estimating their purchase sensitivities to sociodemographic variables. The data section introduces the basics of our data. The results based on the logistic demand for the specialty milk types are discussed in the results section. Finally, the paper concludes with a discussion of findings and policy recommendations.

METHODS

In order to identify the customer profile of the specialty milk consumers, we apply a two-stage estimation technique. The theoretical framework for the first stage of our analysis follows that of the hedonic regression in a utility-maximizing consumption model. In this model, the consumer makes the consumption decision based on the unique properties of the product in concern. Thus, the total value of the final product is a sum of value of the individual components in this product. However, one does not observe the value of these individual components directly. For example, the consumer does not observe the price of being lactose free or cholesterol free. That is why the implicit prices are estimated through the hedonic regression method.

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Consumer willingness to pay for each attribute in milk

Hedonic estimation techniques can help us to measure the consumer's preferences (Nerlove 1995). These methods also enable us to estimate the consumer's willingness to pay for the implicit prices in a differentiated market (Rosen 1974). In the first stage, we perform a regression on each purchase occasion to explain the price of the final product in terms of its unique attributes such as being soy-based, organic, or CFLF. Following the work of Gulseven and Wohlgenant (2014), we estimate the following regression:

$$p_i = \sum_{j=1}^{k} \beta_j x_{ij} + \varepsilon_i = \beta_1 x_{1j} + \beta_2 x_{2j} + \cdots + \beta_k x_{kj} + \varepsilon_i \quad (1)$$

Equation (1) is similar to Wang et al. (2008), where the authors estimate the consumer demand for food safety. In Equation (1), the estimated Beta values indicate the customers' willingness to pay for special milk characteristics for each type of milk. Each x_{ij} value represents the amount or the presence of a specific content in each milk type. The above regression assumes that the consumer's choice is based on the benefit received from the specific ingredients within each milk type. In this additive form, the price of the final milk product is disaggregated into the sum of the individual components of milk. We define the discrete characteristics that affect consumers' preferences as soy-based, lactose free, cholesterol free, and organic.

Purchase probability estimation

In the second stage, we use the implicit content prices derived from the first regression along with the individual household characteristics to determine which type of household prefers what type of specialty milk product. For this step, we apply a probabilistic approach where the explained variable is the probability of choosing a specialty milk type instead of regular milk. Both probit and logistic models could have served well for our purpose. Gracia and Magistris (2008) used the probit approach to model the demand for organic foods. Following Tepper et al. (1997), we have chosen the logistic model in order to focus on how the household demographics affect purchase decisions. Groote and Kimenju (2008) used this approach to estimate consumer preferences for the differentiated maize. Pounis et al. (2011) also used this approach to estimate consumers' preferences regarding iron fortified foods.

The logistic model is based on the assumption that the consumer chooses the product which yields the highest utility among the feasible set of alternatives. Assuming that the unobserved factors are independent across time and they are independent and identically distributed, the model can be derived by defining the utility received from a product as a sum of deterministic and random components. Following Train (2003), the probability that the consumer n chooses product i is

$$P(U_{ni} > U_{nj}, \forall i \neq j) = P(\varepsilon_{nj} < \varepsilon_{ni} + V_{ni} - V_{nj}, \forall i \neq j) \quad (2)$$

Similar to Manser et al. (2007), a household has the option to buy or not buy a specific type of milk in a given week. If we define utility as linear in parameters such that $V_{nj} = \beta' x_{nj}$, the logistic probability with only two alternatives can be written as

$$P_n = \frac{e^{\beta' x_n}}{1 + e^{\beta' x_n}} \quad (3)$$

In our probabilistic model, x_n refers to the household specific demographic information such as the household income, size, age, composition, education level, employment status and racial background. The vector β refers to the corresponding coefficients that measure the effects of these variables on probabilities. For each specialty milk type, a separate regression equation was estimated. In total, three regression equations were estimated in the second stage.

Elasticities

While our primary aim is to identify the consumer profile of the specialty milk purchasers, we also want to estimate how consumers react to changes in prices. Therefore, we calculated elasticities to see how the consumers respond to the changes in income, household size, and the age of the head of household. Based on the consumer demand equations estimated above (based on log ratio form of equation (3) relative to the probability of not choosing the alternative – soymilk, CFLF milk, organic milk), the demand elasticity with respect to variable x_{nit} can be calculated as

$$E_{x_{nit}}^{nit} = \frac{\partial P_{nit}}{\partial x_{nit}} \frac{x_{ni}}{P_{ni}} = \beta_n P_{nit}(1 - P_{nit}) \frac{x_{nit}}{P_{nit}}$$

$$= \beta_n x_{nit}(1 - P_{nit}) \quad (4)$$

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DATA

We derived our consumer purchase data from the AC Nielsen Homescan Panel, which tracks purchases made by thousands of households across the United States. Once households purchase items, they record their purchase using scanners and subsequently the data are uploaded to the AC Nielsen database. The rich nature of our commercial data allowed us to conduct our research without limiting ourselves to a restricted small-size sample. We selected a core set of 3000 households, who regularly participated in the panel from 2002 until 2006. These households report purchasing fluid milk products at least 12 times a year. We observe a total of 525 323 purchase occasions during this 4 year period.

The Homescan Panel data contains information on prices, purchase occasions, number of items purchased, size of items purchased, type of purchase, along with the detailed demographic profile of the household where the item is purchased. In our analysis, we used the pricing information along with the households' demographic variables to estimate the probabilities of purchasing the specialty milk types.

Table 1 gives us the definitions, means, minimum, maximums, and standard deviations of the households' demographic variables used in estimation. The average household annual income in our sample is approximately \$55 000 and the average size of the household is 2.57. Approximately 25% of the households have kids under the age of 18 and 71% of the panel participants are married. Almost 29% of the household leaders are not fully employed. Although that number might be seen as a very high percentage, it includes all households where the adults might be retired, doing social work for non-profit, employed temporarily or working less than full-time. The education level of households is based on the highest education level

Table 1. Second stage explanatory variables

Variable	Explanation	Mean	Std. Dev.	Minimum	Maximum
HHIncome	Household Annual Income	55 368.97	30 299.52	2 500	115 000
HHSize	Household Size	2.569	1.325	1	9
HHKids	Dummy for Kids in Household	0.256	0.436	0	1
HHAge	Household Leader‘s Age	55.886	11.458	27	70
HHEducation2	Upto 12th Grade without Diploma	0.026	0.160	0	1
HHEducation3	High School Diploma	0.193	0.395	0	1
HHEducation4	Some College without Degree	0.337	0.473	0	1
HHEducation5	College Degree	0.323	0.468	0	1
HHEducation6	Graduate or Professional Degree	0.121	0.326	0	1
HHCompMarried	Married Household	0.716	0.451	0	1
HHCompNonRelated	Household Living with NonRelated	0.028	0.166	0	1
HHCompRelated	Household Living with Related	0.083	0.276	0	1
HHCompAlone	Household Living Alone	0.172	0.377	0	1
HHMaritalMarried	Household Married	0.718	0.450	0	1
HHMaritalWidowed	Household Widowed	0.082	0.274	0	1
HHMaritalDivorced	Household Divorced	0.094	0.292	0	1
HHMaritalSingle	Household Single	0.106	0.308	0	1
HHEmpBoth	Both Parents Employed	0.317	0.465	0	1
HHEmpFemale	Only Female is Employed	0.165	0.371	0	1
HHEmpMale	Only Male is Employed	0.229	0.420	0	1
HHEmpNone	No Adult is Currently Employed	0.289	0.453	0	1
HHLeaderFemale	Household Leader is Female	0.081	0.273	0	1
HHLeaderMale	Household Leader is Male	0.173	0.378	0	1
HHLeaderBoth	Household Leader is Both	0.746	0.435	0	1
HHRaceAsian	Asian Household	0.023	0.149	0	1
HHRaceBlack	Black Household	0.064	0.244	0	1
HHRaceHispanic	Hispanic Household	0.060	0.237	0	1
HHRaceOthers	Other Households	0.013	0.113	0	1
HHRaceWhite	White Household	0.841	0.366	0	1

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attained by any of the adult members in the house. Around 32% of the participants in the panel have a college degree and 33% have some college experience. The typical household has an annual income of around $55 000, have some education beyond high school, is a married couple where either both members are employed or retired together, and they also decide on the household purchases together.

While 84% of the data comes from white households, the ratio of minority households in the overall data is only 16%. However, the ratio of minority households is substantially higher among the specialty milk consumers. Table 2 shows the demand for specialty milk types by each demographic classification. The proportion of minority households who consume specialty milk is 25%. Moreover, the percentage of Asian and Black consumers, compared to other households, is more than twofold among the specialty milk consumers compared to the traditional milk consumers.

On average, specialty milk households are smaller in size, older than the rest, and have a lower ratio of children or do not have children at all. The ratio of single households is higher among the specialty milk consumers. Income affects the soymilk purchases differently than the organic milk and CFLF milk. The incomes of the organic milk and CFLF milk consum-

Table 2. Frequency analysis of specialty milk types by household profile

Analysis variable	Total sample	Soy milk		CFLF		Organic	
		no	yes	no	yes	no	yes
Frequency	525 292	510 044	15 248	498 666	26 626	512 366	12 926
Basic household information							
Income ($)	55 369	5 538	5 509	5 532	5 619	5 526	5 973
Presence of kids (%)	25.58	25.88	15.48	26.00	17.68	25.75	18.93
Size	2.57	2.58	2.25	2.59	2.26	2.57	2.35
Age	55.89	55.81	58.56	55.75	58.47	55.87	56.43
Composition (%)							
Living Alone	17.20	17.00	23.71	16.84	23.80	17.10	20.93
Married	71.65	71.91	63.05	72.02	64.76	71.74	68.17
Living with Non-Related	2.85	2.82	3.89	2.81	3.57	2.85	2.72
Living with Related	8.31	8.28	9.35	8.33	7.86	8.31	8.18
Education (%)							
Level 2–3	22	22	19	23	18	22	18
Level 4	34	34	33	34	31	34	33
Level 5	32	32	35	32	39	32	35
Level 6	12	12	13	12	12	12	13
Employment (%)							
Both	31.69	31.88	25.37	32.06	24.85	31.67	32.52
Female Only	16.52	16.42	19.86	16.31	20.36	16.47	18.37
Male Only	22.85	22.79	25.07	22.82	23.48	22.87	22.41
None	28.94	28.91	29.69	28.81	31.31	28.99	26.70
Primary Shopper (%)							
Both	74.58	74.82	66.57	74.92	68.19	74.70	70.02
Female	8.13	8.02	11.82	8.06	9.45	8.06	10.90
Male	17.29	17.16	21.61	17.02	22.37	17.24	19.08
Racial background (%)							
Asian	2.28	2.23	4.07	2.13	5.16	2.23	4.50
Black	6.36	6.06	16.19	5.89	15.20	6.16	14.17
Hispanic	5.96	6.02	3.84	5.95	6.04	5.98	5.04
Others	1.30	1.31	1.01	1.32	0.99	1.30	1.27
White	84.10	84.38	74.90	84.72	72.62	84.33	75.01

The frequency analysis above indicates the percentage of right hand side variables in terms of left hand variables. For example 16.19% of soymilk is purchased by black households whereas only 6.06% of all non-soymilk products are purchased by black households.

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ers are higher than average whereas the of soymilk consumers is slightly lower.

RESULTS

Nutrient pricing

Table 3 shows the results from the first stage hedonic regressions. Functional enhancements substantially increase the price of the final product. On average, being CFLF, by removing cholesterol and fat from the milk, yields a large premium of 23.5 cents per serving. Enhancing milk with vitamins and minerals also increases the value of milk by 2.5 cents per serving. Organic milk has an average premium of 11.7 cents per serving over non-organic milk with the same attributes. Unlike organic or CFLF, the soymilk has a large negative price discount. This can be interpreted to the mean consumers desire to avoid the soy taste. This result is consistent with Chema et al. (2006).

With an implicit price of 1.09 cents per gram, the protein content is the most highly valued macronutrient, followed by the carbohydrate, and lipid contents. The consumers are willing to pay more than double price for the protein content compared to carbohydrate and lipid.

We also observe disqualifying nutrients in the food choices, where the consumers place a high importance on their non-existence (Hoefkens et al. 2011). Cholesterol and sodium are highly undesirable attributes where the consumers are willing to pay to avoid their presence.

Purchase probabilities

Table 4 shows the logistic parameter estimates and odds ratios for the soymilk, cholesterol free lactose free (CFLF) milk and organic milk type. For all specialty milk types, the coefficient of the household size is significantly negative. Larger households have lower probabilities of purchasing specialty milks. On the other hand, the coefficient of the household age is significantly positive with an odds ratio greater than one. This indicates that elderly households are more health concerned and prefer specialty milk types more than other households. This result supports Huffman and Jensen (2004), who claim that the acceptance of functional enhancements increases with age.

Most of the demographic factors affect the probabilities in the same direction for all specialty milk types. The most striking result in all logistic estimations is the way the race affects the purchase behaviour. Minority households have a significantly higher probability of choosing specialty milk types than white households. In fact, the odds ratio for the Asians vs. White households and the Black vs. White households is greater than three. Almost 90–95% of black individuals are deficient in the enzymes that digest lactose. This ratio might even be higher among Asians. The outcomes of the logistic estimation support the scientific view that the Asians and Blacks suffer most from the lactose intolerance (Press 2005).

The employment status and education level also affects the consumers' decisions. If the household is employed, the chances of purchasing specialty milk are higher compared to an unemployed household. The households' attitude towards the functionally enhanced specialty milk types gets more favourable with a higher education level. Households with an education level of college degree or higher have a greater chance of purchasing specialty milks compared to those with lower education levels.

When we analyse the logistic demand for soymilk and CFLF milk, we observe that the price of soymilk attribute has a positive effect on the probabilities of

Table 3. Implicit prices of functional enhancements

Variable	Explanation	Mean	Std. Dev.	Minimum	Maximum
Soy	Price of Soy Label	–9.730	1.636	–20.576	–5.084
CFLF	Price of CFLF Label	23.562	3.428	9.369	36.119
OrgClaim	Price of Organic Label	11.737	1.873	6.586	32.527
VitMinLabel	Price of VitMin Label	2.481	0.251	1.897	3.015
Protein	Price of Protein Content	1.097	0.108	0.848	1.333
CarboHydrt	Price of Carb Content	0.401	0.040	0.311	0.505
Lipid_Tot	Price of Lipid Content	0.373	0.036	0.287	0.497
Cholesterol	Price of Cholesterol Content	–0.039	0.004	–0.048	–0.031
Sodium	Price of Sodium Content	–0.971	0.096	–1.192	–0.754
VitMinCont	Price of VitMin Content	0.346	0.034	0.269	0.422

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purchasing soymilk or CFLF milk. Although it might seem contrary to the demand theory to observe positive own-price effects, we need to recall that the soy attribute has a negative hedonic price. The hedonic regressions confirm that the soy taste is an undesirable attribute which the consumers are willing to pay to avoid. A positive increase in this attribute implies a reduction in willingness to avoid the soy taste, thus an improvement in the consumers' attitude towards the soy taste – consistent with the theory of demand. As the consumers become familiar with the soy taste, the chances that they will buy soymilk increases and the logistic estimation reveals that relationship. Another interesting result is the positive coefficient on the price of the organic dummy. If the price of the organic attribute increases, then the probability of purchasing soymilk or CFLF milk increases. This result indicates that the consumers view organic milk as an alternative to soymilk and CFLF milk. Given the high price premiums for the specialty milk types, organic milk can be a feasible alternative to soymilk for the households concerned about health/environmental issues.

The presence of children under 18 in the household increases the probability of purchasing CFLF milk but it has a negative effect on the soymilk and organic milk purchase probabilities. The gender of the household head also affects the probabilities of purchasing different specialty milk types. If the household head is male, then the probability of purchasing soymilk and

Table 4. Estimated logistics coefficients and odds ratios

Parameter	Soymilk		CFLF Milk		Organic Milk	
	estimate	odds ratios	estimate	odds ratios	estimate	odds ratios
Intercept	–3.950		–3.031		–3.157	
Price Parameters						
Soy	0.072	1.075	0.063	1.065		
CFLF	–0.008*	0.991	–0.009	0.991		
Organic	0.019	1.019	0.011	1.012	–0.033	0.967
Household Profile						
Size	–0.113	0.892	–0.244	0.783	–0.144	0.866
Age	0.026	1.027	0.026	1.026	0.004	1.004
Income	0.0014‘	1‘	0.0021‘	1‘	0.0047‘	1‘
Kids						
None	0.117	1.263	–0.055	0.896	0.123	1.279
Race						
Asian	0.485	2.458	0.624	3.368	0.414	2.323
Black	0.791	3.339	0.638	3.416	0.601	2.799
Hispanic	–0.468	0.947‘	–0.117	1.605	–0.322	1.113
Other	–0.394	1.02‘	–0.555	1.035‘	–0.264	1.179
Leader						
Both	0.036‘	1.125	0.201	1.247	–0.313	0.684
Female	0.045**	1.135	–0.180	0.852	0.245	1.195
Employment Status						
Both	0.061	1.424	–0.054	1.097	0.113	1.271
Female	0.028‘	1.377	0.045	1.213	0.017‘	1.155
Male	0.202	1.638	0.156	1.355	–0.002‘	1.133
Education						
Up to High School	–0.367	0.61	–0.452	0.587	–0.16	0.829
High School Degree	–0.083	0.81	–0.072	0.858	–0.043‘	0.933‘
Some College	0.11	0.983‘	0.067	0.987‘	0.080	1.056‘
College Degree	0.214	1.091	0.377	1.346	0.098	1.075
Marital Status						
Married	–0.117	0.791	–0.119	0.787	0.183	1.442

All variables are significant at 1% level unless indicated otherwise; *significant at 5% level; **significant at 10% level, (‘)insignificant

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organic milk decreases, whereas households with a female head have a lower probability of purchasing the CFLF milk. The results suggest that males prefer the CFLF milk and females prefer the soymilk and/or organic milk. Another interesting result is the effect of marriage on the household's preference. If the couple is married, the chances of organic milk purchase are higher, and marriage reduces the probabilities of purchasing soymilk and CFLF milk.

Demand elasticities

In order to get a better grasp of consumer sensitivities to different factors, we estimated the demand elasticities for each type of milk. Table 5 gives the outcome for the mean and median elasticity estimates. The logistic demand elasticities are normally calculated as percentage changes in purchase probabilities for percentage changes in explanatory variables. However, the household size and age change in single unit increments, so it makes more sense to calculate the elasticities for these variables based on the unit changes. Thus the terms HHSize and HHAge are percentage changes in purchase probabilities for a unit change in the household size and age, respectively.

Table 5. Logistic Demand Elasticities

Variable	Mean	SD	Median
Soymilk			
Soymilk Price	–0.685*	0.118	–0.666
Household Income	0.007	0.004	0.006
Household Size	–11.049*	0.204	–11.082
Household Age	2.582*	0.047	2.590
CFLF milk			
CFLF Milk Price	–0.199*	0.030	–0.196
Household Income	0.110	0.060	0.096
Household Size	–23.199*	0.768	–23.343
Household Age	2.439*	0.080	2.454
Organic milk			
Organic Milk Price	–0.384*	0.062	–0.378
Household Income	0.257	0.140	0.223
Household Size	–14.047*	0.170	–14.081
Household Age	0.401*	0.005	0.402

The income elasticities are calculated as the percentage changes in probabilities for percentage changes in income. The elasticities for household size and age are measured in terms of percentage changes in probabilities for unit changes in size or age.

*$p < 0.01$

Own-price elasticities are negative as expected. The elasticities with respect to the soy attribute price measure how the probabilities change when the consumers' attitudes towards the soy taste change. For example, the logistic demand elasticity of soymilk with respect to soy attribute price is –0.68. That means that a one percentage increase in the consumers' willingness to avoid the soy taste reduces their chances of purchasing soymilk by 0.68 percent.

Other than the income elasticity and the household size elasticity, the elasticities for soymilk and CFLF milk are very close to each other. Income elasticity of soymilk is almost zero. Thus, the income does not have much effect on the soymilk consumption behaviour. However, income affects the household's decision to purchase the CFLF and organic milk. Among all milk types, the income elasticity of organic milk is the highest. The household size elasticity is negative in all models. The mean elasticity with respect to the household age is positive as expected, however, the effect of the household age is much higher for the soymilk and CFLF milk compared to organic milk.

Differentiated sensitivity analysis

It is also of interest to see how the different consumer types respond to changes in the implicit prices, household income, size and age. In order to measure their response sensitivity within each group, we also used the elasticity estimates. Therefore, we calculated the logistic demand elasticities for each consumer type where the consumers are classified according to their racial background. Table 6 gives the results of these elasticity estimations for soymilk, CFLF milk and organic milk, respectively. We observe significant differences in elasticities based on the household's racial profile. Although white households have the highest income level, they are the most price sensitive and income sensitive group. Asian and Black households not only have higher probabilities of purchasing the specialty milk types, but they also have lower elasticities than other households. Because lactose intolerance is highest among the minority households, these households prefer the specialty milk types without lactose more than the white households. They are also less responsive to the changes in factors that might affect their decisions. That result is consistent with Richards et al. (2007), who claim nutrient consumption is a form of rational addiction.

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Table 6. Logistic Demand Elasticities by Race

	White		Black		Asian		Hispanic		Other	
	mean	std dev	mean	std. dev.	mean	std. dev.	mean	std. dev.	mean	std. dev.
Soymilk elasticities										
Soy	–0.693	0.120	–0.633	0.104	–0.633	0.085	–0.667	0.098	–0.655	0.092
CFLF	–0.203	0.030	–0.188	0.027	–0.189	0.024	–0.198	0.026	–0.195	0.025
Organic	0.221	0.036	0.205	0.034	0.205	0.030	0.215	0.033	0.212	0.033
HHIncome	0.007	0.004	0.007	0.004	0.010	0.004	0.008	0.004	0.007	0.004
HHSize	–11.086	0.120	–10.54	0.345	–10.80	0.220	–11.16	0.101	–11.12	0.109
HHAge	2.591	0.028	2.463	0.081	2.521	0.051	2.610	0.024	2.599	0.026
CFLF milk elasticities										
Soy	–0.591	0.104	–0.522	0.092	–0.514	0.076	–0.561	0.086	–0.560	0.080
CFLF	–0.202	0.030	–0.180	0.029	–0.179	0.025	–0.194	0.027	–0.195	0.026
Organic	0.133	0.022	0.119	0.021	0.118	0.018	0.127	0.020	0.128	0.020
HHIncome	0.110	0.060	0.103	0.055	0.145	0.059	0.113	0.062	0.103	0.059
HHSize	–23.371	0.450	–21.46	1.266	–21.63	0.954	–23.1	0.601	–23.49	0.402
HHAge	2.458	0.047	2.257	0.133	2.274	0.100	2.436	0.063	2.470	0.042
Organic milk elasticities										
Organic	–0.388	0.063	–0.366	0.061	–0.360	0.054	–0.375	0.057	–0.371	0.057
Income	0.255	0.140	0.251	0.131	0.355	0.143	0.266	0.143	0.238	0.136
HHSize	–14.086	0.094	–13.61	0.247	–13.70	0.200	–14.10	0.105	–14.05	0.138
HHAge	0.402	0.003	0.389	0.007	0.391	0.006	0.403	0.003	0.401	0.004

DISCUSSION

In this article, we applied a two-stage hedonic-discrete choice model of specialty milk consumption. In the first stage, we identified the implicit prices of milk attributes. Our results have important implications for dairy producers. In order to have a higher share in the premium-priced niche market of functionally enhanced milk, it is in the dairy producers' interest to remove cholesterol and lactose from their products. Many consumers are willing to pay extra for these functional enhancements. Being organic adds a 33% price premium whereas being LFCF adds a 66% price premium to milk products.

In the second stage, we applied a logistic model of the specialty milk type choice for soymilk, CFLF milk, and organic milk. The explanatory variables are based on the implicit attribute prices from the first stage and the household demographics. Peng et al. (2006) indicate that health concerned consumers are willing to pay a higher premium for functional enhancements in dairy products. Our results are consistent with their findings: smaller and elderly households have more health related concerns and they have a higher probability of participating in the specialty milk market.

Perhaps the most striking result is the effect of race on the households' purchase decision. Non-white households have a higher probability of purchasing the specialty milk types. This finding supports the previous studies where the functionally enhanced products have differentiated effects among different consumer profiles (Urala and Lahteenmaki 2004; Verbeke 2006). In particular, the likelihood of purchasing specialty milk types is almost 2–3 times more for the Asian and Black households than the White households. This result also supports the scientific view that race is a significant factor in the lactose intolerance so that the Asian and Black households are more sensitive to the presence of lactose in their diet. Moreover, these households have the smallest price and income elasticities, suggesting that they are loyal customers of the specialty milk types. For many households, cholesterol free and/or lactose free milk is a necessity rather than luxury. In fact, we find the income elasticity of soymilk to be insignificant.

The analysis of these results have important policy implications. The USDA emphasizes the presence of calcium, potassium, vitamin D, and protein as the major reason to recommend 3 cups of dairy products each day. This policy has both pros and cons. We have shown that the protein and vitamin &

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mineral content are highly valued nutrients among all consumers. It is also a right step by the USDA to specifically suggest fat free or low fat dairy products as cholesterol is a highly undesirable attribute by the consumers. However, the USDA recommends only the positive aspects of consuming milk. The current policy is unfortunately targeting the majority of the White households at the expense of the minority groups.

What is not mentioned by the MyPlate initiative is that the presence of lactose is a very undesirable attribute particularly among the non-white households. These households are more likely to be lactose intolerant and cannot drink milk like others. Therefore, the USDA should consider changing the current MyPlate initiative which recommends 3 cups of dairy products, because that is not possible for many households. For the lactose intolerant households, alternative dairy products should be recommended. A feasible alternative to the USDA's MyPlate initiative is the Healthy Eating Plate promoted by the Harvard School of Public Health. The Healthy Eating Plate replaces the milk glass with that of water, and suggests the vitamin & mineral supplements to make up for the missing micronutrients. The Healthy Eating Plate also recommends reducing the dairy products intake to the maximum of 1–2 cups per day.

The USDA recommends the soymilk (soy drink) as a viable alternative to the cow-based milk. Nevertheless, as we have shown here, the soy taste is undesirable to many and the majority of the consumers are willing to pay to avoid it. They consume soymilk primarily due to the absence of lactose in it and, after some duration, due to the habit formation. It should be of interest for the USDA to suggest digestive milk alternatives beyond soymilk. It should also be noted that the scientific research on processes to remove cholesterol and lactose will have the greatest welfare effects on the minority households, who suffer most from the maldigestion.

CONCLUSION

We can conclude that factors such as health-concerns due to the racial background are the primary motivations for the consumption of organic, CFLF or soy milk. These concerns are particularly evident in the purchase behaviour of the Asian and Black households, who are more prone to the lactose intolerance, therefore having to be more selective with their choice of dairy products. The Asian and Black households are also less sensitive to the changes in attribute prices and other factors affecting purchase probabilities. Thus, as suggested by Saba et al. (1998), we observe a strong habit formation when it comes to the choice of the type.

Dairy producers should specifically target the health-concerned minority consumers in order to better position themselves in the growing market of functionally enhanced milk products. Minority households are more likely to purchase these products since they view the specialty milk consumption as a necessity due to the health issues. After all, these households are loyal consumers of the specialty milk products and they are willing to pay a higher premium for those functional enhancements in dairy products regardless of their income level.

As suggested by Waldman and Kerr (2015), there is a strong heterogeneity in consumer preferences, which implies that the one-size-fits-all type of food policy is not the optimal solution. Instead, the USDA should craft the differentiated food consumption advisories for the differentiated American households. There is no single perfect diet, and the individual differences should be taken into account when making policy recommendations. Those who are lactose intolerant should not be restricted to the soymilk only. There are several alternatives to milk, such as the ayran, yoghurt, kefir, all of which are known to help with digestion. The promotion of these alternatives can be highly beneficial for creating healthy future generations.

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