The Demand for Nutritionally-Enhanced Varieties and Implications for Food Product Competition: The Case of Orange Juice

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A Selected Paper presentation at the AAEA Summer Meetings July 30 - August 2, 2000 at Tampa, Florida.

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Introduction

A distinguishing characteristic of the retail food sector is the large number of products. The typical supermarket carries some 50 thousand items, choosing them from the over 300 thousand available. New product introductions, while recently not as high as the early part of the 1990's, exceeded 11 thousand in 1998. Product variation can be a means to segment markets and engage in price discrimination. For example, a firm may introduce quality-enhanced versions of standard products that appeal to higher income, less price responsive customers. Some economists argue that brand proliferation and promotion are anti-competitive strategies employed by large food companies against smaller rivals, especially private labels, who cannot maintain diverse product lines.

However, consumers desire variety, and new products are often in response to perceived shifts in taste and demand. Important recent examples involve food products addressed to health and nutrition concerns. These often sell for higher prices than regular versions of corresponding items, in part due to higher costs, but also perhaps because food companies view consumers concerned with nutrition as less price responsive and thus less resistant to higher prices.

Overwhelming evidence links diet to health. As a result, the demand for nutritionally-enhanced food products has been the focus of numerous studies. The issue has received considerable attention from both academics and the general public as companies began producing and marketing to the demands of health conscious consumers in the 1980s and 1990s. These studies incorporate a wide range of observable characteristics; those most frequently employed

are income, household composition, education, location, race/ethnic origin, and employment status.

In Morgan's appraisal of dietary studies, she finds that there is evidence, although weak, of a positive relationship between income and dietary status. Nearly all studies incorporating regional variables have found that the poorest dietary status was for southern households. Two other frequently used variables are education and race. Scearce and Jensen found that the general education level of the female household head had a positive impact on dietary status. Studies have consistently found blacks have lower calcium levels than do whites (Adrian and Daniel; Allen and Gadson; Bunch and Hall).

Population-based food and nutrition studies consistently demonstrate that women are more likely than men to comply with dietary guideline recommendations, which is partially attributed to their greater liking for the taste of healthy foods and their increased awareness of the importance of a healthy diet (Turrell, 1998). In a 1993 survey, Thompson, et al. found men and smokers were low consumers of fruits and vegetables, an indication that product health attributes are less important for them. Using a mail survey, Turrell determined that socioeconomic groups differed significantly in their attitudes toward healthy foods. Those individuals in his welfare sample reported liking fewer healthy foods and were "least consistent with dietary guideline recommendations" (Turrell, 1997).

The purpose of this study is to examine consumer demand for food product variations geared to nutrition, and the competitive implications of this demand. We study orange juice, focusing on frozen concentrate and refrigerated, by major brands and nutritional enhancement. Markets for both refrigerated and frozen juice are dominated by three major national

manufacturers – Minute Maid, Citrus Hill, and Tropicana. Refrigerated orange juice is generally viewed as superior to frozen, both in terms of flavor and convenience, so demand and demand elasticities should be different.

The major nutritional enhancement for orange juice is added calcium. Introduced in 1987 by Citrus Hill, who was quickly followed by Minute Maid, calcium-enhanced orange juice was marketed as both frozen and refrigerated products by both companies. Consumers were not quick to adopt these products though. In 1989 and 1990, the years covered by this study, across 54 regional markets in the US the calcium sales shares of the total orange juice market averaged 6% and 5%, respectively. Subsequent to this period, as the media has focused more attention on the need for more calcium in the American diet, especially children and women, sales of calcium-enriched orange juice have risen dramatically. All three of the major manufacturers now sell versions of their product fortified with calcium in both frozen and refrigerated packages. Consumer Reports says every one of them is an especially good source of calcium. "These orange juices have as much calcium as milk. And the natural acids in the juice help your body absorb the calcium." However, in Consumer Reports' 1995 evaluation of orange juice, calcium-enhanced orange juices scored poorly and were reported as having a cooked, processed flavor.

In the next section, data employed in this study are discussed. Next, orange juice demand is examined with special emphasis on calcium-enhanced juice. This is followed by a section in which quantity-shares of calcium, frozen; calcium, refrigerated; and overall calcium are regressed on prices, regional dummies, and demographics with primary interest focusing on regional and demographic differences. Finally, some conclusions are drawn.

Data

All data on product sales came from Sales Area Marketing, Inc (SAMI), a product tracking firm which discontinued operation in 1991. This study used 1990 data, the last year available. SAMI tracked grocery product sales by monitoring grocers' warehouse shipments in 54 market areas, areas which accounted for 85 per cent of US grocery sales. The areas were aggregations of counties, chosen based on warehouse shipping patterns. The warehouses provided SAMI with data on case movements to supermarkets, along with corresponding retail sales and price data, with considerable care taken to correct the data for movements into and out of the region. Over 12 million product categories were tracked. Of these, 339 were food items, the balance being pet foods, paper and cleaning products, and health and beauty aids.

SAMI mainly sold the data to manufacturers, making it available in various forms, the most detailed being the "basic" reports. These list price, cases, sales, and share figures for every variation of every brand (e.g. Minute Maid Plain Orange Juice, Frozen in 16 oz. cans packed in 24-can cases), for the previous four weeks and year. An important exception to this level of detail is that private label data was only available as total cases and total sales in each market.

Demographic data for the study came from the US Bureau of the Census "USA Counties" CD-ROM, containing county data from numerous federal agencies. It was aggregated to match SAMI regions.

Demand for Calcium-Enhanced Orange Juice

A seven good demand model for orange juice was specified. The goal of demand estimation is two-fold. First, it is desired to obtain a sense of how the rather large increases in juice prices affected demands. The goods are: private-label refrigerated (PV RF), private-label

frozen (PV FZ), calcium-enhanced refrigerated (CAL RF), calcium-enhanced frozen (CAL FZ), other branded refrigerated (BR RF), other branded frozen (BR FZ), and total shelf-stable orange juices. Second, this level of aggregation allows the examination of the competition between the calcium products, which are relatively new products during the period covered by our data, and the more established juice categories.

The functional form employed in estimation is the Rotterdam system, which seems natural given that we have data for two years for the 54 SAMI markets. The absolute price version of the model is:

$$\bar{w}_{it}\Delta \ln q_{it} = \beta_i \Delta \ln Q_t + \sum_j \gamma_{ij} \Delta \ln p_{jt} + \sum_k \delta_{ik} R_{kt} + \varepsilon_i$$

where the *ws* are expenditure shares; R_{kt} is one if market *t* is in region *k*, 0 otherwise; β, γ, and δ are coefficients to be estimated; and:

$$\bar{w}_{it} = \frac{w_{it} + w_{it-1}}{2}$$

$$\Delta \ln z_t = \ln z_t - \ln z_{t-1} = \ln \frac{z_t}{z_{t-1}}$$

$$\Delta \ln Q_t = \sum_j \bar{w}_{jt} \Delta \ln q_{jt}$$

Readers interested in derivations should consult Barten (1964, 1968) and Theil (1965, 1967) or Phlips.

One of the advantages of the Rotterdam in this case is that it utilizes all the data without having to worry about the correlation of errors across years in a single market. It also makes it

relatively easy to impose all the restrictions implied by demand theory. That is, adding up, homogeneity, and symmetry are given by:

$$\sum_i \beta_i = 1, \ \sum_i \gamma_{ij} = 0 \ \ (\textit{adding up})$$
$$\sum_j \gamma_{ij} = 0 \ \ (\textit{homogeneity})$$
$$\gamma_{ij} = \gamma_{ji} \ \ (\textit{symmetry})$$

Since these restrictions depend only on unknown coefficients, they can be imposed globally. Finally, negativity is guaranteed if the matrix of price coefficients is negative semidefinite. This can be imposed on the estimation through use of the Cholesky decomposition (Lau). Indeed, initial estimates of the Rotterdam system, imposing only homogeneity and symmetry, produced a matrix of price coefficients which had one slightly positive eigenvalue, suggesting negativity was not satisfied. The system was re-estimated with negativity imposed. The demand estimates with all demand restrictions imposed and the implied price coefficients are not of great interest for our purposes. They are available on request.

Elasticity estimates along with their standard errors are given in table 1. The standard errors given in the table are actually the result of Monte Carlo simulations of each model. This is done for two reasons. First, a number of researchers have warned against the use of asymptotic standard errors when evaluating the significance of estimated elasticities (Dorfman, Kling, and Sexton; Green, Hahn, and Rocke; Miller, Capps, Jr., and Wells). Krinsky and Robb show that the Monte Carlo approach works well. Second, some of the categories of orange juice are found to be gross complements, which doesn't agree with intuition, other categories are found to be weak gross substitutes and it is desirable to get some sense of how significant such results are. The Monte Carlo experiments take the prices and real expenditure as fixed. For each model,

multivariate normal errors are drawn having covariance matrix equal to that estimated for that year and added to the predictions from the original model estimates. Then these new dependent variables are used to re-estimate the model. This is repeated 1000 times. Results are used to calculate the standard errors of the estimated elasticities. These are reported in table 1.

Table 1. Elasticities for Calcium-Enhanced Orange Juice (all demand restrictions imposed)

	PV RF	PV FZ	CAL RF	CAL FZ	BR RF	BR FZ	Expenditure
PV RF	-2.47*	-0.09	-0.06	0.19	1.21*	0.18	0.97
Std. Error[a]	(0.31)	(0.31)	(0.10)	(0.10)	(0.35)	(0.32)	(0.34)
PV FZ	0.03	-0.84*	0.05	-0.19*	-0.28	0.95*	0.08*
Std. Error	(0.17)	(0.34)	(0.09)	(0.09)	(0.27)	(0.27)	(0.23)
CAL RF	-0.27	-0.12	-0.30	0.45	-1.15	-0.44	2.21*
Std. Error	(0.29)	(0.47)	(0.54)	(0.36)	(0.69)	(0.43)	(0.34)
CAL FZ	0.77	-1.68*	0.75	-2.83*	0.63	0.80	1.55
Std. Error	(0.46)	(0.71)	(0.57)	(0.70)	(0.94)	(0.72)	(0.53)
BR RF	0.26*	-0.29*	-0.06	0.04	-1.09*	0.00	1.18
Std. Error	(0.08)	(0.11)	(0.06)	(0.05)	(0.16)	(0.10)	(0.10)
BR FZ	0.06	0.48*	-0.02	0.08	0.03	-1.67*	1.12
Std. Error	(0.13)	(0.20)	(0.06)	(0.07)	(0.19)	(0.23)	(0.19)

Notes: PV - Private label, CAL - Calcium enhanced, BR - Non-calcium Branded, RF - Refrigerated, and FZ - Frozen.

[a] Standard errors calculated using 1000 replications of a Monte Carlo experiment.

[*] An asterisk indicates the elasticity is at least twice its standard error, except for expenditure elasticities where an asterisk indicates the difference between the elasticity and one is at least twice the standard error.

Several things are worthy of note. For calcium and non-calcium, branded juice, the frozen form is the price sensitive category, with own-price elasticities significantly less than -1, while the refrigerated form is considerably less price sensitive. The opposite is true for private label, where frozen is less price sensitive than chilled. Calcium, refrigerated is own-price inelastic, while calcium, frozen is quite price sensitive. This contrast will recur in the next section. Calcium, refrigerated and private label, frozen orange juice are the only categories whose expenditure elasticities differ significantly from one, private label, frozen being

expenditure inelastic but calcium, refrigerated is expenditure elastic. Finally, every form of orange juice has significant interaction with some other juice with one exception, calcium, refrigerated orange juice.

At this point, calcium-enhanced orange juice is a relatively new product that had not made much of an inroad in the market. This was prior to media attention on Americans' need for more calcium in their diets, especially women and children. Thus, those who did consume calcium-enhanced orange juice were early adopters, who were likely to be less price sensitive, especially for refrigerated juice, and more expenditure elastic.

Early attempts at demand estimation included demographics as well as regional dummies, but signs and significance of these factors were problematic. It was decided to include only the regional dummies in the final demands to facilitate the imposition of negativity, which requires nonlinear estimation, and the simulation of these models to obtain standard errors for elasticities. This is not to imply, however, that demographics are not important. In the next section, this is examined in some detail.

Calcium Quantity Share Regressions

In this section, we concentrate on the role of demographic factors in the choice of calcium-fortified orange juice. For this purpose, simple methods are used: we estimate single-equation regressions in which the share (in terms of quantity) of calcium-enhanced juice is modeled as a linear function of its price, alternative prices, and demographic measures. We do this for chilled and frozen juice separately and for the two combined. The separation of frozen and refrigerated calcium juices has the advantage that they emphasize the role of demographics in the choice of *calcium*, free of confounding effects due to the choice between the refrigerated

and frozen form. For example, we have found that high income consumers display a marked preference for refrigerated juice. Furthermore, our previous work suggests little substitution between the two forms, and in any case this should be picked up through price responses.

In terms of demographics, the model is deliberately over-specified, incorporating nine variables measuring the demographic profile of the market, along with three geographic dummy variables. While variable selection is guided by previous studies of nutrition demand and nutritional status, it is avowedly exploratory. Hence the over-specification.. This is, we feel, especially appropriate here, where we are dealing with a very new product. Because of the resulting absence of strong a priori beliefs concerning the existence and even possible direction of many variables, we have no compunction about employing step-wise regression as a supplement to standard regression.

The demographic variables used are defined in table 2. Also included were three regional dummy variables, EAST, SOUTH, and WEST, with the Midwest the omitted reference region.

As just indicated, we have quite purposefully erred toward over-specification of the calcium models, which if nothing else is a pretext for in many cases not having firm expectations. INCOME is a case in point. Calcium added juice is hardly a luxury good: it is often priced the same as plain juice (prices are considered presently). Some previous studies have found a *ceteris paribus* negative effect for income in nutrition demand models, possibly due the negative effect of time costs in obtaining nutrition information.(Morgan) In the present case, higher income consumers, being accustomed to goods with the most attractive qualities, may be more aware of any sensory defects due to adding calcium.

Table 2. Variable Names and Descriptions

Variable	Description	Sources[a]
INCOME	The average per capita income in the SAMI market.	Census
COLLEGE	The percent of market population with a college degree	Census
KIDS	The percent of the population under 14 year of age	NCHS
POVERTY	The percent of the population below the poverty level	Census
OLDER	The percent of the population over 65.	Census
PCTFM	The percent of the population composed of women between 25 and 44 years of age.	NCHS
MINORITY	The percent of households in the market that are non-white	Census
PACKS	A measure of smoking	Tobacco Inst.
PIP	Market level health measure, explained below	NCHS

[a] Census indicates the data is from US Bureau of the Census "USA Counties" CD-ROM. NCHS - data is obtained from National Center for Health Statistics. Tobacco Institute - data from *Tax Burden on Tobacco - Historical Compilation 1997*.

On the other hand, because of nutritional awareness, we expect a positive effect of COLLEGE. We also have a reasonably strong expectation that KIDS will have a positive effect on calcium demand, although obviously the nutritional concern is not that of the children themselves but of their parents, since calcium deficiency is especially damaging at younger ages. Similarly, any effect of PCTFM will surely be positive, since calcium deficiency and potential osteoporosis is a greater problem for women, and remedial action is more efficacious at younger ages.

We include POVERTY not so much in an explanatory spirit but rather due to the important policy issues around the nutritional status of low income households. MINORITY, also a variable of particular policy relevance, is expected to be negative, since minority groups

have generally been found to have lower nutritional status and to have less knowledge of nutrition. OLDER is included because older Americans are an important segment of the population, possibly with different tastes and conceivably different attitudes toward new products (e.g. resistance).

The final two measures, PACKS and PIP, are included as health measures. PACKS is packs of cigarettes smoked per capita.[1] Clearly, smoking bears no direct relation to demand for calcium-enhanced orange juice. We include PACKS as a proxy for health concerns: a geographic area with fewer smokers should *ceteris paribus* be an area whose population is more willing to make life-style adjustments to achieve better health, such as shifting to nutritionally-orientated foods.[2] Hence we expect a negative effect. PIP is our direct health measure. Actually it is an inverse measure, being the mortality rate from chronic disease (primarily cancers and coronary problems) in the middle age (45 to 64) population of the market area[3]. If a region has a relatively large proportion of people who practice healthy lifestyles, including a healthy diet, we expect it to that extent to have lower mortality (that is, the proof is in the pudding–hence PIP). Because consumers with healthier diets tend to be attracted to nutritionally oriented foods, we expect PIP to carry a negative sign.

Simple statistics for the variables appear in table 3, which also includes all prices used in

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[1]This variable was constructed from state data (Chilcote), which was allocated to SAMI regions based on the proportion of region population in the component states.

[2]Ippolito and Mathios found a negative relation between smoking and consumption of fiber cereal.

[3]This variable was constructed from 1990 mortality data by cause for US counties from the National Center for Health Statistics.

Table 3. Descriptive Statistics

	Means	Std. Dev.	Minimum	Maximum
CALFZ	0.044	0.016	0.003	0.077
CALRF	0.071	0.034	0.012	0.163
CALCIUM	0.054	0.017	0.010	0.090
PFZC	2.278	0.145	1.971	2.579
PFZNC	2.050	0.160	1.580	2.425
PRFC	0.655	0.060	0.524	0.770
PRFNC	0.654	0.076	0.519	0.810
INCOME	13677	2078	9971	18945
COLLEGE	19.479	3.835	10.890	28.758
KIDS	0.219	0.020	0.187	0.301
POVERTY	13.328	4.148	8.030	25.602
OLDER	12.713	2.224	8.103	18.840
PCTFM	0.162	0.009	0.143	0.183
MINORITY	12.0	8.7	0.74	33.86
PACKS	98.9	18.7	63.8	162.7
PIP	593.1	78.7	395.4	748.0
EAST	0.204	0.407	0	1
SOUTH	0.315	0.469	0	1
WEST	0.167	0.376	0	1

Notes: Variable names are defined in the text.

the models. There is considerable variation in most variables, including the calcium shares, perhaps surprisingly so for the two health measures. Considering the prices, in the case of chilled orange juice there is virtually no difference between the average price of regular and calcium-enhanced orange juice, although this varied considerably over individual markets However, for frozen juice, the average price for calcium-added juice exceeded that for regular. There is no obvious cost basis for this. We attribute it the fact that during this period Tropicana, which unlike its two national competitors, had yet to introduce calcium-fortified orange juice, was following a low price strategy in frozen orange juice.

Three models were estimated for each year. Dependent variables are: frozen calcium

juice's share of the frozen market; chilled calcium's share of the chilled market; and calcium's share of the total orange juice market, irrespective of type. In all cases, results for the two years were qualitatively similar, so we will present results only for 1990. For each calcium, three models were estimated: one with all 16 variables (nine demographics, three regions, and four prices), we also estimated models using forward and backward step-wise regression. Our purpose here is not to estimate some sort of "structure" nor to find conclusive results. All we hope to do is to marshal evidence.

The calcium results are shown in table 4. We only present explicit results for the three complete models, preferring to confine those for the step-wise methods to discussion. All results are summarized in a subsequent table.

Table 4. Complete Model Results

	Frozen Calcium	Refrigerated Calcium	Total Calcium
PFZC	-3.55	-0.55	-2.96
PFZNC	5.30	-0.78	3.00
PRFC	0.50	0.09	0.82
PRFNC	-1.00	3.12	0.82
INCOME	-2.00	-2.42	-1.87
COLLEGE	-0.28	0.05	-0.60
KIDS	0.28	0.09	-1.05
POVERTY	-0.74	-2.00	-0.67
OLDER	0.72	-0.68	-0.76
PCTFM	1.38	0.24	0.65
MINORITY	0.77	-0.53	0.58
PACKS	-0.71	-1.63	-2.01
PIP	-1.56	-0.37	-1.30
EAST	-0.08	-1.60	-0.98
SOUTH	-1.86	-0.61	-1.80
WEST	-1.08	0.30	-1.38
Adj-R Sq	0.53	0.76	0.55

Notes: Variable names are defined in the text. Results presented are T ratios which have 37 degrees of freedom.

For the frozen concentrate model, we find a very strong response to both frozen prices, but response to chilled prices is absent. Thus, there appears to be a surprisingly ready willingness for frozen concentrate buyers to switch between the calcium and no-calcium forms in response to price; however, there is no evidence of movements between frozen and chilled, of any kind of juice (which we expected). Among the demographic measures, only three show any statistical impacts: INCOME, with a negative effect, and PCTFM and PIP, both in the expected direction. We have little to say about the first. PCTFM and PIP are of much greater interest. Given our interpretation of PIP, its results suggest that one reason healthier sub-populations achieve that status is they choose a healthier diet. PCTFM suggests that "target groups" do respond to foods designed for their particular health problems. The only remaining variable of importance is the SOUTH, found to be the region with lowest calcium consumption, ceteris paribus.

The absence of any evidence of importance for several of the remaining variables, particularly KIDS and PCTCOLL, is perhaps surprising. One reason, of course, is the likelihood of relations among them (e.g. PCTCOLL, PIP, and PACKS). We verified this by examining variance inflation factors, which were as large as 18. The two step-wise procedures shed further light on these results. Although the backward method basically echoes the full model results, the forward case only does so for prices. The only demographics which survive are KIDS and MINORITY, neither of which shows any muster in the full model. But their effect is in the expected direction, which fits reasonably well into a developing picture.

Matters are somewhat different in the model for refrigerated calcium share. In this case there is again a strong effect by the directly competing price (here refrigerated *non* calcium) but,

in contrast to the frozen model, "own" price has no effect whatsoever. As before, there is no evidence of competition between frozen and chilled. Thus, the evidence is that the calcium share only responds to regular chilled price, evidently not because it substitutes with calcium-added chilled juice, nor any type of frozen juice, but simply because consumers of plain chilled juice make adjustments in their use as price changes (which decreases the denominator in calcium's share). The only explanation for the apparent finding that demand for calcium enhanced juice is very elastic when it is frozen, but not when chilled, is that demand for frozen orange juice is generally more elastic, since it appeals to more economy-minded buyers. Still, we find the difference in the two models somewhat difficult to accept.

Of the demographic variables, only three are highly statistically significant. INCOME again has a strong negative effect Seemingly inconsistent with this is the strong negative effect of PCTPOV. However, in related work we found similar results, as have others.[4] For example, we have found that refrigerated juice appeals most particularly to high income *and* low income buyers.[5] The third important demographic variable is PACKS, with the expected sign. Thus, for both categories, a health measure is found important. Of the geographic variables, only EAST is significant, with a coefficient showing the lowest calcium consumption in the chilled category. Thus, in general we find calcium-added juice less acceptable in the East and South, and particularly acceptable in the Midwest.

For the refrigerated category, the forward and backward step-wise models are quite

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[4]See Binkley and Coe for evidence that low income consumers do *not* buy private label products, instead opting for more expensive branded products.

[5]The simple correlation between INCOME and PCTPOV is -.7.

similar, differing in that the former has both PACKS and PIP, while the latter has only PACKS, all with the expected signs. Either supports a strong health effect. The backward model includes MINORITY, as in the corresponding model for the frozen category. Both differ from the full model in that they find an important negative effect for OLDER, suggesting either new-product resistance or possibly a belief that by retirement it is too late to correct a calcium deficiency. Most surprisingly, both models include the price of plain frozen juice, the first evidence of any cross-category competition. The most plausible explanation is some limited substitution between plain chilled and plain frozen.

The third set of calcium models explains the calcium share for both juice forms combined. Not surprisingly, the results echo those from the two separate sets. The frozen prices are highly significant, but neither refrigerated price is, which further underscores the greater importance of frozen juice prices in the tradeoff between calcium-enhanced and plain juice. The highly significant demographics, INCOME, PCTFM, and PACKS, are important in at least one of the separate juice models, and there are no changes in sign.

In the forward step-wise procedure, the chosen model again contained the two frozen prices. However, it also contained the price for chilled calcium-enhanced, with the wrong sign. The fact that all previous models have found this variable of no importance, let alone the sign, would seem to undermine the credibility of the analysis. However, it is readily explained. As shown above, there is essentially no difference in price between calcium and non-calcium juice in the refrigerated category, but for frozen the calcium juice is more expensive. Thus, calcium-enhanced juice has a larger share for chilled juice. But calcium-enhanced juice is most popular in the West and Midwest, where refrigerated juice is most expensive. These effects become

confounded in a model combining both frozen and chilled juice, and so we get the peculiar result. We note also that the forward model did not contain SOUTH, despite its strength in the complete model, which undoubtedly is due to the same problem. A final difference with the complete model is the less surprising one of PIP's replacing PACKS. The final variable, INCOME, is strong in nearly every case. Both PIP and INCOME have the expected signs.

The backward selection simply verifies the complete model, containing all variables therein whose t-value exceeds 1 in absolute value except WEST, with all signs intact.

In table 5 we summarize the results of the demographic analysis. A "1" indicates that the variable in the left column appears in the model corresponding to that column, with the indicated sign. For prices, it is clear that frozen calcium orange juice buyers are more responsive to price than are buyers of the chilled variety, with a greater difference than we might have expected. Why this should be invites further work. High income markets consistently display less eagerness to buy calcium-enhanced orange juice. Again, it is not clear why this should be, but it's statistical strength certainly suggests it is not happenstance. We believe the most plausible explanation relates to lower nutrition knowledge due to high time costs. Information costs (but for reasons likely more related to inefficiency of information processing due to economic status and social background) is most probably behind a similar "calcium reluctance" on the part of poverty and minority households. Another explanation alluded to earlier is the fact that calcium-enhanced products scored poorly in terms of taste.

Of the four appearances of PCTFM, two are in models for frozen concentrate and two in model with both juices combined. Thus, consumption of calcium enhanced frozen orange juice is higher in markets with relatively more young women, but there is little evidence this is true of

Table 5. Summary of Significant Effects and Signs

	Frozen			Refrigerated			Total		
Variable	OLS	Fwd	Bwd	OLS	Fwd	Bwd	OLS	Fwd	Bwd
FROZCAL	-1	-1	-1	•	•	•	-1	-1	-1
FROZNC	+1	+1	+1	•	•	-1	+1	+1	+1
REFCAL	•	•	•	•	•	•	•	+1	•
REFNC	•	•	•	+1	+1	+1	•	•	•
INCOME	-1	•	-1	-1	-1	-1	-1	-1	-1
PIP	-1	•	-1	•	-1	•	•	-1	-1
PACKS	•	•	•	-1	•	-1	-1	•	-1
PCTFM	+1	•	+1	•	•	•	+1	•	+1
PCTCOL	•	•	•	•	•	•	•	•	•
PCTPOV	•	•	•	-1	-1	-1	•	•	•
MINORITY	•	-1	•	•	•	-1	•	•	•
KIDS	•	+1	•	•	•	•	•	•	•
OLDER	•	•	•	•	-1	-1	•	•	•
EAST	•	•	•	-1	-1	-1	•	•	-1
SOUTH	-1	•	-1	•	•	•	-1	•	-1
WEST	•	•	-1	•	•	•	•	•	•

Notes: For the indicated category of calcium-enhanced orange juice, OLS means results from the complete model; Fwd are results from the forward stepwise approach; and Bwd are the backward stepwise approach. A +1 means a significant positive effect. A -1 means a significant negative effect. A • means no significant effect.

chilled juice KIDS failed to demonstrate an important role in market-level calcium juice demand, contrary to our expectations. Much the same can be said of OLDER, although it was important in both step-wise models for refrigerated juice, with a negative effect. The education variable PCTCOL failed to show strength in any of the nine models. Education is generally found to be positively associated with improved nutrition, and we find it difficult to account for the result here.[6]

The sample evidence is strong that "healthier" markets, as measured by low smoking and low mortality, are markets more amenable to calcium-enhanced juice, and, by inference, are markets where nutrition concerns play a relatively strong role in choice of diet. This is not surprising, although that it rather clearly appears in data at this level of aggregation may be unexpected. This result suggests that any nutrition information programs targeted to mass audiences, such as through media and even school programs, may warrant differential emphasis across areas.

Summary and Conclusions

We have examined the demand for nutritionally-enhanced orange juice is two ways. First using a system approach, demands for private label; branded, calcium; and branded, plain orange juice were estimated. One striking finding was that calcium-enhanced, refrigerated juice was not only isolated from other juice categories, but it did not significantly respond to changes in its own price, while it reacted strongly to increases in spending on the orange juice category as a whole. Alternatively, the frozen form of calcium-enhanced juice is very price sensitive. Thus, in

[6]In univariate regressions with PCTCOL the sole factor, the coefficient was positive and significant at a ten percent level for refrigerated, but there was no effect for frozen.

the early stages of the product cycle the two forms of calcium-enhanced orange juice appear to have been perceived quite differently. The price sensitivity of frozen, calcium-enhanced orange juice may have been due to the competition in the frozen category. Tropicana was pursuing a low-price strategy at this time.

Next, we examined the effects of demographics on consumption of calcium-enhanced orange juice. This was done using simplified models relating calcium's share of its market (either frozen, refrigerated, or total) to prices, regional dummies, and demographics. Because our analysis is exploratory in nature all three models were estimated three times. Once as a "complete" model and then twice using step-wise regression (both forward and backward). The purpose was to look for factors which had consistent effects across the three models using the three approaches to estimation. The consistent results were: Prices of frozen (calcium and non-calcium) had significant effects on frozen and total consumption, while refrigerated price of non-calcium positively influences calcium, refrigerated. INCOME had a negative impact on calcium juice consumption across all three models. PCTPOV has a negative impact on refrigerated. Either one or the other or both of our healthy market variables (PIP and PACKS) negatively affected all three models, suggesting that healthier markets consume more calcium-added juice. PCTFM positively influences frozen and total calcium consumption. Similarly, OLDER negatively effect consumption of refrigerated calcium juice. PCTCOL, MINORITY, and KIDS have no effect on calcium consumption.

The price sensitivity of frozen calcium and lack of price sensitivity for refrigerated was consistent across both methods of analysis. A possible explanation is that frozen is the segment in which Tropicana was competing on price and consumers in this segment viewed price as more

important than the health benefits of calcium-enhancement. Alternatively, calcium, refrigerated managed to attract health-conscious consumers who were less responsive to price.

The other universally consistent effect was the negative impact of income. High income markets consumed less calcium-enhanced orange juice. There are two possible explanations. First, calcium-enhanced juice was slightly less palatable when introduced. It may be that higher income markets preferred taste over nutrition. Second, the higher opportunity cost of time in high income markets may have prevented consumers from realizing the benefits of this new source of calcium.

Perhaps just as interesting are the variables which did not effect calcium-enhanced juice consumption. More highly educated markets and markets with a larger population of minorities and children have no impact on consumption of calcium-enhances orange juice. We attribute the lack of effects for these factors to the newness of the product. Parents may have been reticent to "experiment" on their children, for example.

While ultimately the introduction of calcium-enhanced orange juice has been quite successful, in the beginning it must have been disappointing to Citrus Hill and Minute Maid. The evidence presented here does not preclude the possibility that these companies were using new product introduction as an anti-competitive strategy. The isolation of the calcium-enhanced, refrigerated from other categories is consistent with such a view. However, our evidence is also consistent with the companies rolling out these new products to see "if anyone would salute." The success of calcium-added juice suggests at least some segments of the consuming public find the availability of this nutritionally-enhanced product to be utility increasing.

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