What Australian Consumers like about Fruit Juice: Results from a Hedonic Analysis

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Abstract

Fruit juice is a heterogenous product. Firms in the Australian fruit juice industry compete primarily through the development of new products, and not through price. Consumers are given a choice of different fruit blends, sizes and concentrations. The development of products with a wide range of characteristics has occurred because manufacturers and retailers evidently believe that consumers place a value on these characteristics.

The primary aim of the paper is to investigate the part played by the quality attributes of fruit juice in influencing fruit juice consumption. The focus of the study is on the overall market valuation of the various fruit juice characteristics, and is not particularly concerned with consumers' valuation via their preferences nor producers' factor costs. Data collected from a major South-East Queensland supermarket is employed to try to infer the value consumers place on these attributes. The methodology followed is based upon Lancaster's (1991) attributes model. Two models are proposed in this paper: a linear and polynomial model. According to the results, consumers pay a premium for nutrition, convenience and information. Models such as these are important adjuncts for marketers of fruit juice, as the estimation of implicit prices are potentially useful tools in strategic marketing.

Introduction

In recent years the Australian fruit juice industry has evolved from a monopolistic competitive market to an oligopolistic market structure. The two firms that dominate the market, Berri and Golden Circle, compete primarily through the development of new products, and not through price. Fruit juices have many different characteristics. For example, they are sold in different types of packaging, sometimes they have additives, such as sugar and vitamins, and they are housed in different sized containers. Presumably this is done because manufacturers and retailers believe that consumers place a value on these attributes. To gain an idea of what these values are, linear and polynomial models are used to estimate implicit prices for a number of characteristics of

fruit juices. The methodology of this paper follows Lancaster (1991). Supermarket scanner data from a Woolworths store located on the Gold Coast – a region with approximately 400 000 people – and information from a supermarket survey were used in the estimation.

The Model

The hedonic price models developed by Lancaster (1991) and Ladd and Zober (1977) have been applied widely in the food industry. Examples include wine (Nerlove 1995), breakfast cereals (Stanley 1991), wheat (Ahmadi-Esfahani and Stanmore 1997), tobacco (Samikwa and Brorsen 1998), peanuts (Florkowski 1999), and frankfurters (Harris 1997).

In this paper a hedonic price function is used to determine the relative importance of different fruit juice characteristics. The utility model proposed by Ladd and Zober (1977) is an amalgamated function of services, which relate to various product characteristics. A consumer's utility is expressed as a function of a number of services as shown in equation (1.0).

$$U = f(s_1, s_2, \ldots, s_h) \qquad (1.0)$$

where s_i is the service provided by commodity i.

For food, services may come in the form of nutrition, taste, convenience or aesthetics. Ladd and Zober (1977) assume that each characteristic can contribute positively or negatively to individual consumption services. They provide a methodology to assign monetary values to a product's attributes. "For each product the consumer purchases, the price paid for the product equals the sum of the marginal yields of the characteristics provided by the product, multiplied by the marginal implicit prices of the product's characteristics" (Ladd and Zober 1977:92). Regression techniques have been used to determine marginal implicit prices. In such models P_i, the price of a product, is the dependent variable and the characteristics of that product are the independent variables. A similar approach is followed in this study. The explanatory variables used with the dependent variable, price, are outlined in Table 1. More details of these variables including expected signs on the coefficients are provided in Appendix Table A1.

Table 1 Variables used in the hedonic analysis

Variable Name		Comment
(a) Nutrition variables		
• CONC	Juice concentration	Per cent of fruit juice in the beverage
• SUG	Sugar level	Grams of sugar per serving
• VIT	Vitamin content	Grams of ascorbic acid per serving
• CHILL	Measures whether the variable is stored at ambient (room) temperature	Measured with a dummy variable = 1 if product sold in the chilled section, 0 otherwise
• HEART	Does the product have the Australian Heart Foundation seal of approval?	Dummy variable = 1 if approval given, 0 otherwise
• CALC	Some fruit juices have added calcium, increasing healthiness	Dummy variable = 1 if calcium added, 0 otherwise
(b) Taste variables		
• TASTE	Orange juice (there were four different flavours containing orange juice); apple juice (there were three of these) pineapple juice (there were two of these); and other (there were four of these).	A series of dummy variables were used to take account of different flavours. For example, in the orange juice category, there were four flavours: orange juice, orange juice and passionfruit, orange juice and mango, and orange juice and pineapple. Juices were scored as 1 or 0 depending on whether one of these combinations was present. The same procedure was followed for the other juice types.
(c)Convenience, information and packaging variables		
• TOP • UND • MID • LOW	These variables capture the shelf position of the product. TOP is omitted as the reference position.	Dummy variables take a value of 0 or 1 depending on the shelf upon which the product is displayed.
• PLAST • TETRA • GLASS • TIN	These four variables take account of packaging. TIN is the base variable against which the others are measured.	Dummy variables are scored as 0 or 1 depending on the type of packaging.
• RSEAL	Captures whether the product can be resealed. Eg. screw top, sports bottle.	Dummy variable scored as 1 if the product can be resealed, 0 otherwise
• TRANS	Measures whether the product is in transparent packaging.	Dummy variable: 1 in transparent packaging, 0 if not

• RECYC	This variable indicates whether the packaging can be recycled.	Dummy variable = 1 if recyclable, 0 if not
• KIDS	Smaller portions, 125ml to 330ml, are captured by this variable	Dummy variable takes on a value of 1 if the juice is sold in small volume containers.
(d) Market Structure		
• BERRI	Four dummy variables are used to take account of different manufacturers	1 if Berri, 0 otherwise
• GC		1 if Golden Circle, 0 otherwise
• GEN		1 if generic, 0 otherwise
• OC		1 if other, 0 otherwise
• AUS	Dummy variables denote country of ownership of manufacturer	1 if Australian owned, 0 if not
• IMP		1 if juice contains imported ingredients, 0 if not

Data and estimation procedures

The data used in this paper were provided by a Woolworths store located on the Gold Coast. The supermarket, located in the Oasis complex in Broadbeach, stocks over 260 fruit juice brands, the majority of which are also found in other Woolworths stores. The price variable was obtained from supermarket scanner data provided by the store's management. Scanner data were collected from the week beginning the 13th of March 2000. Data on non-price characteristics of fruit juice, such as location and ingredient attributes, were collected by store visits, and informal interviews with Woolworths' management and staff.

Results and Discussion

Following the general to specific modelling approach, the model was estimated and tested for multicollinearity and heteroscedasticity. The parameter values and the signs associated with each characteristic provide information with respect to the relative importance of the services fruit juice provides. Coefficients are interpreted as cents per serving since the dependent variable, price, is expressed in cents per serving. Two models, estimated using SHAZAM, are presented in Table 2.

Table 2: Coefficients and standard errors

Variable	Model 1:Polynomial		Model 2:Linear	
	Coefficient	Standard error	Coefficient	Standard error
• Constant	68.21*	6.63	43.11*	6.39
(a) Nutrition				
• SERV	-2.93*	0.62	-1.23*	0.39
• $SERV^2$	0.09*	0.02		
• SUG	-3.04*	0.70	-0.58*	0.22
• SUG^2	0.09*	0.02		
• CON	0.17*	0.04	0.13*	0.02
• HEART	10.23**	6.74	10.30	7.25
(b) Taste				
• CHILL	10.05*	1.84	9.85*	1.90
• PINE	-7.22*	2.06	-5.52*	2.05
• TOM	-20.56*	5.00	-12.79*	6.10
• BER	14.81*	4.59	15.70*	5.60
(c) Convenience				
• RSEAL	-10.32*	2.03	-8.10*	2.09
• KIDS	5.44*	2.98	12.90*	2.77
• RECYC	6.22*	1.56	7.41*	1.89
• PLAST	8.41*	2.19	7.01*	2.44
• GLASS	45.21*	4.69	48.62*	6.02
• MID	-2.87*	0.99	-2.43*	1.14
• BOT			3.56*	1.68
• GEN	-6.44*	2.54		
Adjusted R^2		0.72		0.68
F-statistic		6.439*		4.52*
Akaike		112		130
Schwartz		143		163

Notes:* $p \leq 0.05$: ** $p \leq 0.1$

A plot of the number of servings against the price per serving showed that the price per serving falls as the volume of the container increases. The coefficient for servings per package, SERV, is negative and significant. The implicit price is approximately 3 cents per serving. Consumers, it seems, discount each additional serving in a container of fruit juice by 3 cents. The serving parameter in conjunction with the serving squared term, $SERV^2$, provides a more accurate description of the relationship between the number of servings and the price per serving. Consumers receive a discount of $(-3\ s + 0.085\ s^2)$ cents per serving for a given product, where s is the number of servings, *ceteris paribus*.

The sugar level per serving varies substantially across fruit juice brands. The plot of price per serving against sugar level indicates a negative correlation between the two variables. According to the results of the model, consumers receive a discount of 3.05 cents for every additional gram of sugar per 200 ml serving. Again the SUG variable in conjunction with the sugar-squared variable, SUG^2, possibly provides a more accurate representation of the relationship between sugar level and price per serving. Consumers receive a discount of $(-3\ sug + 0.09\ sug^2)$ cents per serving given a particular sugar level (*sug*), *ceteris paribus*.

A plot of price per serving against the concentration of the 260 fruit juices in the sample shows that there is a slight positive correlation between the variables. The marginal implicit price of 0.2 cents per serving means that consumers pay a premium of 0.2 cents per serving for a 1% increase in the concentration level of the fruit juice.

The coefficient for heart tick, HEART, is positive. The parameter is significant at the 10% significance level. A Heart Foundation endorsed fruit juice is 10.2 cents per serving more expensive than a non-endorsed juice. This may reflect consumer's willingness to pay for a product that is perceived to be healthy. However, a supply story is more likely. Businesses that apply the heart tick to their products are required under the arrangement to pay the association a percentage of annual sales, thus increasing unit costs. A statistically significant relationship between the price per serving and the calcium variable could not be established. This may be due to the possibility that consumers do not think of fruit juice as being a source of calcium. Other things being equal, ambient juices are approximately 10 cents cheaper per serving than chilled juices. This may be a consequence of the expensive logistical costs chilled juices incur.

Only three out of the 14 original flavour variables tested were significant. The flavour variables were measured relative to orange juice. Results indicated the following, *ceteris paribus.*

- The coefficient on the pineapple variable, PINE, is significant and negative. According to the results of the model, pineapple juice is 7.2 cents per serving

cheaper than orange juice, *ceteris paribus.* This may reflect the fact that pineapple juice is usually sold in large tins under the Golden Circle label. Pineapple juices sold in tins are cheaper per serving than conventional one litre and two litre juices. This may have influenced the value of the PINE coefficient.

- Also statistically significant and negative were the TOM and BER coefficients. Tomato juice is 20.5 cents cheaper per serving than orange juice, *ceteris paribus.* Raspberry, boysenberry and blackcurrant juices are, as a category, approximately 15 cents more expensive per serving than orange juice, *ceteris paribus*. This may reflect the cost of the chemical extraction process, berry fruits incur.
- As a category, the flavour of a fruit juice doesn't significantly affect the price of juice, *ceteris paribus.* The overall lack of explanatory power supports the hypothesis that the flavour of a fruit juice product is not a statistically significant influence on price. This suggests that cross subsidisation occurs between fruit flavours.

The coefficient on the KIDS variable is positive and significant. The implicit price for children's juices (these are juices sold in containers ranging in size from 125 ml to 330 ml) is approximately 5.5 cents per serving. In other words, with other variables held constant, children juices incur a premium of 5.5 cents per serving in comparison to conventional juices.

The RESEAL variable was negative and significant. The implicit price for non-resealable juices is 10.3 cents. This suggests that consumers discount fruit juices in resealable containers by 10.3 cents per serving.

The RECYC variable is significant and positive. The implicit price for recyclable products is 6.2 cents, which means consumers pay a premium of 6.2 cents per serving for recyclable materials, assuming all other factors are held constant.

The PLAST and GLASS variables are significant and positive. The implicit prices for plastic and glass are 8.4 cents and 45.2 cents respectively. This indicates that fruit juice

sold in PET containers are 8.4 cents more expensive per serving than tin cans, *ceteris paribus*. Most juices sold in glass are small volume products (200 ml – 500 ml) and 'gourmet' juices. Moreover many of the organic juices that command a hefty premium are packaged in glass. These two effects may explain the higher implicit price of glass.

Only the MID variable is significant of those variables intended to capture the importance of shelf position. The implicit price of the middle tier is –2.9 cents per serving which means that fruit juice sold in the middle tier is approximately 3 cents cheaper per serving than products housed on the other tiers, *ceteris paribus.* The linear model suggests that juices housed in the bottom tier are 3.5 cents more expensive per serving than their competitors on the top tier. This may reflect the position of mature brands being placed on the top tiers. Such brands are often much cheaper than more popular brands.

Finally the GEN variable is negative and significant. According to the results, generic fruit juices are approximately 6.5 cents cheaper per serving than branded fruit juices, *ceteris paribus.* Generic products tend to have fewer characteristics than branded goods, which lowers unit cost. The hypothesis that generic products are cheaper per serving than their branded counterparts is supported by this result.

Limitations

Implicit prices of a hedonic study are only as good as the information upon which they are based. The data set used in the calculation of the Model was attained from one store. However, due to the centralised buying arrangements of the Grocery chain, there is a large degree of uniformity between stores' prices. A limitation of the model may be its failure to completely account for the market structure. Accounting for the nature of the fruit juice industry proved to be a difficult task in light of the limited data available. Information on product mark-ups may have enhanced the model, but further research would be needed to establish this.

Finally identification of the underlying supply and demand functions for characteristics is difficult when little prior information is available. Consequently the approach followed in this paper developed reduced form models that focused neither on consumers' valuations nor producers' factor costs.

Conclusions

This study has sought to calculate the implicit values of fruit juice attributes. According to the estimated model, consumers pay a premium for convenience, nutrition and information. In particular as the quality of fruit juices increase, which is measured by concentration, sugar level and storage temperature, the price per serving of fruit juice increases. However, it was discovered that the flavour of fruit juice doesn't have a statistically significantly impact on the price per serving of juice. Certainly the market structures of the food retail and fruit juice industries are significant influences on the prices of brands. The hedonic model constructed may be useful to product developers in positioning new brands against competitors with implicit prices acting as a tool for strategic pricing.

It is important to recognise that this analysis does not provide information on demand or supply side factors likely to affect price. The variables are reduced form coefficients, so interpreting the results requires care.

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Appendix Table A1

Characteristic	Description	Relationship to service*
SERV	Servings per package[#]	C(+ -)
SUG	Milligrams of sugars per serving	N(-) T(+)
VIT	Vitamins in mg per serving	N(+)
ORAN	1 if orange flavour	N(+) T(+)
ORANPASS	1 if orange & passionfruit flavour	N(+) T(+)
ORANPINE	1 if orange & pineapple flavour	N(+) T(+)
ORANMAN	1 if orange & mango flavour	N(+) T(+)
APPLE	1 if apple flavour	N(+) T(+)
APPBER	1 if apple & Berry flavour	N(+) T(+)
APPMAN	1 if apple & mango flavour	N(+) T(+)
PINE	1 if pineapple flavour	N(+) T(+)
PINEMAN	1 if pineapple & mango	N(+) T(+)
GRFRT	1 if grapefruit flavour	N(+) T(+)
TOM	1 if tomato flavour	N(+) T(+)
BERRY	1 if berry flavour	N(+) T(+)
TROP	1 if tropical flavour	N(+) T(+)
OTHER	1 if other flavour	N(+) T(+)
TRANS	1 if transparent packaging	C(+)
CONC	Concentration of juice (%)	N(+)
HEART	1 if product is endorsed by Heart Foundation	N(+)
TOP	1 if 1st tier (top)	C(-)
UND	1 if 2nd tier	C(+)
MID	1 if 3rd tier (eye level)	C(+)
LOW	1 if 4th tier	C(+)
BOT	1 if 5th tier (bottom)	C(-)
BERI	1 if brand is under Berri Corp	
GC	1 if brand is under Golden Circle Corp	
GEN	1 if product is generic e.g. home-brand	
OC	1 if other company	
AUS	1 if Australian owned	B(+)
IMP	1 if imported fruit	B(-)
CAL	1 if juice contains calcium	N(+)
CHILL	1 if product is located in chilled section	N(+)
TIN	1 if packaging is tin	
TETRA	1 if packaging is Tetra pack	
PLAST	1 if packaging is plastic	
GLASS	1 if packaging is glass	
HAND	1 if packaging has a handle	C(+)
RECYC	1 if packaging can be recycled	B(+)
KID	1 if marketed to children	C(+)
RESEAL	1 if product is resealable	C(+)

Notes: * Services: N - nutrition, T – taste, C – convenience, B – bliss [#] 1 serving ≈ 200 ml