THE EFFECT DEMOGRAPHICS HAVE ON THE DEMAND FOR ORANGE JUICE

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Abstract

This paper investigates how the demand for orange juice is affected by the demographics of consumers. There are many variables in the orange juice demand equation and demographics are only one. Demographic variables are important in determining the tastes and preferences of different regions. The data that has been collected is weekly data over a two year period of time. The seemingly unrelated regression method will be used to examine the data. This project will be beneficial to orange juice advertising firms and companies that sell orange juice.

Introduction

Most people associate the state of Florida with beautiful beaches or Walt Disney World. While this is a good description of the coast of Florida, the center of the state is different. Much of these parts of Florida are covered by orange groves. In fact, Florida is by far the largest orange juice producing state in the country. There have been many things that have impacted the demand for orange juice in the past. This study will determine how the changing demographics of the United States population has affected orange juice demand.

The fundamental concepts in economics include the laws of supply and demand. When prices are raised quantity demanded falls and vice versa. What aren't made explicit in simple supply-demand graphs are all the factors that affect the demand for goods. Some important factors in the demand for orange juice include price, tastes and preferences, substitutes, price of substitutes, purchasing power, and seasonality. Something that is often overlooked is the demographics of the consumers who are purchasing the orange juice. These demographics include race, income level, region, household size, and others. Prior studies have found that demographics help predict tastes and preferences. The three demographic variables reviewed in this paper are the percent of the United States population which is black, Hispanic, and Asian.

Examining these demographics should assist in predicting the differences in demand for orange juice across the cities.

Problem Setting

The problems that this study addresses are what effects different demographics have on the demand for orange juice. This is important because it gives the orange juice industry an idea of where most of the demand for orange juice is coming from and also where there is the most room for expanded levels of orange juice demand. This is very relevant as the minority population increases to historic levels every year in the United States.

Research Question

The question that this research is trying to answer is whether the demographics of different cities in the United States have an effect on the demand for orange juice. If the demographics do have an effect, what is the effect?

Literature Review

There have been some prior studies on the relationship between demographics and the demand for agricultural products. The majority of these picked out different demographics to concentrate on and developed a model which pointed out the affects those demographics had on that particular product.

This review starts with some background information on the orange juice industry. There are three major types of orange juice. These three types include frozen concentrated orange juice (FCOJ), not-from-concentrate orange juice (NFC), and refrigerated orange juice from concentrate (RECON). Of the orange juice purchased in the United States, 98 to 99 percent falls in one of these three types. NFC is considered to be the highest quality of orange juice and is the

fastest growing in gallons sold in the United States at this time. The Rotterdam Model was the base for this study (Brown 2000).

Binkley (2002) studied consolidation that was going on in the orange juice industry. Florida is by far the largest orange juice producer in the United States. In fact, it produces over 90 percent of the orange juice in this country. Brazil and Mexico are the major exporters to the United States. Orange processors in Florida purchase over 95 percent of the state's orange production.

Storage is a very important aspect in the orange juice industry because it is such a seasonal product. Consumption is somewhat seasonal with demand being at the peak during cold season. Production is very seasonal. FCOJ stocks are at the lowest in November and at a high in May. Frozen concentrate orange juice can be stored for over a year at appropriate temperature levels. NFC also lasts over a year when it is either frozen or chilled (Binkley 2002).

Prices for orange juice can be affected by income and location (Binkley 2002). The higher income areas in the United States tend to have higher OJ prices. Also, transportation theory would suggest that areas further away from Florida would have higher prices because of higher shipping costs. There was no relationship between distance from Florida and price of orange juice (Binkley 2002).

Wilson and Marsh (2005) identified the impacts of demographics on meat demand. The demographics of this country have shifted throughout the last century. There is more cultural diversity in the United States today. The percentage of whites has decreased and percentage of other races has increased. The age of our population has also varied from the past. Mortality and fertility rates have both declined. This means there are less people being born, but people are living longer lives. In the past most females did not have jobs. This trend has changed and there

are more women in the workforce than ever before. People in the U.S. are more educated than ever before. This study concluded that age, residency, household size, education level, and percent of women in the labor force had impacts on the demand for meat.

The study concluded that the own price effects of meat demand are different from zero as expected. The cross-price effects for beef and poultry were also significantly different from zero indicating that beef, pork, and poultry are substitutes for one another. The null hypothesis that demographic and health parameters weren't significant was rejected. Demand for beef, pork, and poultry may have been affected by these variables. The Rotterdam was the base model for this study. It was chosen because it is consistent with demand theory, flexible, and most of all it is very useful in capturing non-price effects (Wilson 2005).

As age increased the demand for beef increased while pork and poultry was lower. An increase in ethnic diversity shifted consumption to poultry and away from pork and beef. The percent of women with jobs and the education level of the population had the largest impact. As females enter the labor force demand for pork and poultry has risen and the demand for beef declined. Poultry was the benefactor from the increased education level of the population. This result was consistent with the speculation that the demand for poultry would rise when people have less time to cook. The poultry industry is further along in the prepared meals category than the beef and pork industry's (Wilson 2005).

While meat is not the same as orange juice, there are some major points that are useful in the orange juice study. Overall, this study states that demographics do affect demand for agricultural commodities. Also, it seems that the population is becoming more interested in the nutrition facts. This really affects the orange juice industry because orange juice is a great source of many vitamins and minerals. Poultry increased as women entered the workforce and the

education level was higher. The most important hypothesis that this study proves is the different demographic impacts.

Heien (1988) also looked at demographic effects for beef products. This study concluded that household size, region, tenancy, and ethnic origin were all significant. Employment status, shopper, and occupation were demographic effects that were insignificant in this study. The analysis also proved that there were strong own-price and cross-price effects among meats. This paper was based on the Almost Ideal Demand System (AIDS).

A study conducted by Blisard (2003) looked ahead to 2020 to determine the possible effects of demographics in the future. This study determined that the future population increase alone will increase spending on food in the U.S. by 26.3 percent. The demographic changes will increase per capita food purchases by 7 percent.

The same study states that income disparities have a large effect on where families spend their money on food. That is, higher income households spend more money on food than lower income. Food groups with the largest increase in consumption include food away from home, fruits, prepared foods, vegetables, and dairy. Also, people above the age of 74 will spend the most money on cereal and bakery goods, and fruit. Black households typically spend less than whites. They spend more on fish, meat, and eggs. The Northeastern United States spends the most on foods and the North Central spends the least (Blisard 2003).

The change in the demographic profile of the United States has connotations that will influence where, when, and what people will eat. The recent trend has been that United States residents are becoming older, more educated, financially better off, and more ethnically diverse (Blisard 2003).

Fruit and fruit juices are substantially affected by this change in demographics. For every ten percent increase in income, household spending on fruits and fruit juices will rise 1.62 percent. Households with children age nine or under spend more money on fruit and fruit juices than households with older children (Blisard 2003).

Data

The data set used in this study is provided to the Florida department of citrus by ACNielsen. The information that it provides is for 52 of the United States' largest cities and their surrounding areas. This is weekly data with 120 weeks provided starting with the week ending April 23, 2005 and ending with the week ending August 4, 2007.

It starts by giving us the amount of total orange juice sold in gallons and dollars. Next, the juices are separated into which specific type they are. The different types of orange juice in the study are frozen concentrate orange juice, not from concentrate orange juice, and refrigerated orange juice from concentrate. Substitutes for orange juice are then listed with the amount sold in gallons and dollars also. The substitute juices included in the data set are grapefruit juice, orange juice blends, grapefruit juice blends, grapefruit juice cocktails, orange juice drinks, and orange blend drinks. Advertisements are also accounted for in the information which is provided. For each different sub-category the percent of stores in the city with a prominent newspaper article and the percent of stores with a store display are listed.

At the end of the data set is the demographic data. The variable that is used for income is average household EBI (effective buying income). It tells us how much income the average household in each city has for all purchases. The percentage of the city which is Black, Asian, and Hispanic is listed next. These are the three ethnic variables that are included in the data and the demographic variables that are included in this study.

Table 1. Variable Statistics

Variable	Mean	Standard Deviation
Orange Juice Gallons Sold	172,435	149,689
Orange Juice Price	$5.05	$0.71
Substitute Juice's Gallons Sold	9,176	8,014
Substitute Juice's Price	$5.00	$0.61
Percent Black	12	8
Percent Asian	4	4
Percent Hispanic	12	12
Per Capita Income	$19,606.12	$2,232.96

Table 1 illustrates some descriptive statistics of the data used in the model. Each of these averages is for the total United States and not sorted by city or region. It represents all 120 weeks of data collected. The average orange juice gallons sold was 172,435 with a standard deviation of 149,689. The average price per gallon of orange juice was $5.05 with a standard deviation of 71 cents. The combined average for substitute juices gallons sold was 9,176 with a standard deviation of 8,014. The average price for these substitutes was $5.00 with a standard deviation of 61 cents.

The demographic variables included in this chart are different because they are divided into percentages already. These percentages represent the average United States city. The average United States city has twelve percent black with a standard deviation of eight. The mean percent Asian is four with a standard deviation of four. Lastly, the mean percent Hispanic is twelve with a standard deviation of twelve. The average person in the United States has an income of $19,606.12. The standard deviation for income is $2,232.96.

These means provide an information base for the orange juice market. One peculiar statistic is the fact that the average substitute price is only five cents lower than the average orange juice price. This may be the reason that there is such a difference in orange juice gallons sold and substitute juice's gallons sold.

Results

The first step taken after examining the data was to build a model. The dependent variable in this model is total orange juice gallons. The explanatory variables are orange juice price, substitute's prices, per capita buying income, percent Black, percent Asian, percent Hispanic, percent of stores with a prominent orange juice newspaper advertisement, percent of stores with an orange juice display, and seasonality. Also added into the list of variables are nine interaction terms. The first interaction is price and the three ethnicity variables. The next is cross price and the three ethnicity variables. The final interaction illustrated is advertising and the three ethnicity variables. The equation is illustrated below:

$$q1 = k0 + k1*za1 + k2*zb1 + k3*zc1 + k4*x1 + k5*x1*za1 + k6*x1*zb1 + k7*x1*zc1 + k8*p1 + k9*p1*za1 + k10*p1*zb1 + k11*p1*zc1 + k12*ps1 + k13*ps1*za1 + k14*ps1*zb1 + k15*ps1*zc1 + k16*a1 + k17*a1*za1 + k18*a1*zb1 + k19*a1*zc1 + k20*w + k21*w2$$

Log form is used for the dependent variable in the 52 equations. It is also the form displayed for price, cross price, and income. The reason to put these four variables into log form is to determine the price, cross price, and income elasticity's for orange juice. It also helps when examining the interactions.

The advertising variable is a variable which comes from the percent of stores with a feature orange juice advertisement. The advertising numbers for the cities are between zero and 100. The interaction terms with advertising note how the cities with different demographics respond to changes in advertising.

Most of the coefficients are statistically significant, with the exception of the second seasonality variable and the interaction of advertising and percent Asian (Table 2). New Orleans was one of the cities which the data was provided for, but after the hurricane the demographics of New Orleans are still in question.

Examining the income, price, and cross price parameters gives us some background on the commodity. The coefficient for income is about .17. This means that for every one percent increase in income the demand for orange juice will rise .17 percent. The parameter estimate for price is almost exactly one. This illustrates that orange juice is a unit elastic commodity. The prices of substitutes have a coefficient of .85. For every one percent increase in price of orange juice substitutes the demand for orange juice rises .85 percent.

Investigating the three demographic variables demonstrates that there is a change in orange juice demand between different ethnicities. The cities with the highest percentage of people who are Black and Hispanic have less demand for orange juice. The opposite is true for the cities with a large percentage of Asians. The coefficient for percent Black and percent Hispanic are -.58 and -.32 respectively. This reveals that for every one percent raise in percent of the population that is black the demand for orange juice decreases .58 percent. For the Hispanic population it decreases .32 percent. As the Asian population rises one percent the demand for orange juice increases .40 percent.

The last variable to examine is the advertising variable. The coefficient for this variable is .0006 which means that as advertising rises one percent the demand for orange juice rises .06 percent. This may look like a small number but from one store to another demonstrates important information. If one store has a feature advertisement for orange juice and another one doesn't the store with the advertisement will sell six percent more orange juice than the other store. That is a fairly substantial increase.

The interaction terms examine the change in different elasticity's when the demographic variables are changing. The first variable scrutinized with an interaction is income. As reported before the income elasticity is fairly low at .17. However, when interacted with percent black it

rises by .05. When interacted with percent Asian the elasticity drops .03 and percent Hispanic it increases .03. These coefficients convey the fact that demand for orange juice is more elastic with respect to income for Blacks and Hispanics, but it is less for the Asian population.

The next variable interacted with the demographics is price. This exemplifies how the price elasticity changes as the population becomes more diverse. The results demonstrate that the Asian population is the most sensitive to prices. The price elasticity rises .01 as the Asian population expands. The Black and Hispanic population are less sensitive to prices as elasticity declines .009 and .012 respectively.

Following the interactions to price are the cross price interactions. All three demographics have similar results when interacting with cross prices. As the cross prices rise the cross price elasticity's become lower. This would suggest that the cities with a more diverse population are less sensitive to the price of orange juice substitutes than other cities.

The last variable which has an interaction is the advertising variable. As explained earlier, the advertising is a percentage which is between zero and 100. Examining the coefficients for the interactions between advertising and demographics illustrates that advertising increases orange juice demand more with respect to the Black and Hispanic population. The opposite holds true with respect to the Asian population.

Table 2. Demand Model Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Intercept	-4.60131	0.1104	-41.66	<.0001
Percent Black (za)	-0.58528	0.00621	-94.3	<.0001
Percent Asian (zb)	0.405496	0.0166	24.35	<.0001
Percent Hispanic (zc)	-0.32089	0.00552	-58.09	<.0001
Income (x)	0.170875	0.0116	14.76	<.0001
Interaction (Income and Black)	0.056983	0.000664	85.86	<.0001
Interaction (Income and Asian)	-0.03165	0.00193	-16.4	<.0001
Interaction (Income and Hispanic)	0.032973	0.000603	54.65	<.0001
Price (p)	-0.99938	0.0145	-68.87	<.0001
Interaction (Price and Black)	0.012473	0.000728	17.13	<.0001
Interaction (Price and Asian)	-0.01169	0.00172	-6.8	<.0001
Interaction (Price and Hispanic)	0.009358	0.000545	17.16	<.0001
Cross Price (ps)	0.854982	0.0147	58.36	<.0001
Interaction (Cross Price and Black)	-0.00665	0.000848	-7.84	<.0001
Interaction (Cross Price and Asian)	-0.04661	0.00241	-19.31	<.0001
Interaction (Cross Price and Hispanic)	-0.01817	0.000617	-29.45	<.0001
Advertising (a)	0.000657	0.000078	8.42	<.0001
Interaction (Advertising and Black)	0.000084	4.71E-06	17.82	<.0001
Interaction (Advertising and Asian)	-0.00003	0.000021	-1.34	0.183
Interaction (Advertising and Hispanic)	0.00002	4.09E-06	4.91	<.0001
Seasonality (Sine) (w)	-0.05454	0.00206	-26.45	<.0001
Seasonality (Cosine) (w2)	0.000098	0.00214	0.05	0.9637
				N=6120

Implications

The results of this study should be important to orange juice marketing firms in the United States. As America becomes more diverse the tastes and preferences in the country will change with the different demographics. As the results demonstrate, demand for orange juice does change with the different demographic groups. When there are a larger percentage of Black and Hispanic citizens in a city the demand for orange juice declines. When the percentage of Asians increases the demand for orange juice rises. This exemplifies the different tastes and preferences throughout these ethnicities.

The interactions between demographics and price and also between demographics and advertising should be of extreme interest. The price interactions demonstrate which ethnicity is more sensitive to prices and vice versa. This represents an opportunity to realize what stores orange juice retailers should offer items for sale or present the customers with coupons to purchase the juice for a lower price. The advertising interactions point out that advertising actually is more successful in cities with higher Black and Hispanic populations. Since these are the two ethnicities that have negative effects on orange juice demand the orange juice companies may want to raise the amount of advertising in those cities.

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