Demographic Influence on the U.S. Demand for Beer

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Research indicates that the U.S. beer market is experiencing shifting demand away from typical American macro-beers towards costlier craft beers. According to the Beer Institute, aggregate consumption of domestic beer decreased approximately 1.5 percent from 1990-1997. Also, 1997 per capita beer consumption reached the lowest level since 1977. As a result, macro-brewers are frantically searching for reasons why Americans are consuming less beer (Levitt, 1997). Meanwhile, from 1994-1996, production in the craft beer segment grew 37.2 percent, 31.7 percent, and 27.7 percent respectively (Stiligoj, 1997). The number of craft brewers has increased to over five times the number of firms that existed in 1990 (Sftiligoj, 1997). As of November 1, 1996, the number of specialty brewers had grown to approximately 1,037, while the number of macro-breweries had fallen to less than 30 (Holleran, 1997).

While micro-brewers are inevitably changing the landscape of the market, there is some debate over what the future holds in store for the current craft beer craze. Sfiligoj (1997) notes the growing consumer attraction to the unique tastes and homespun images of the brands, as well as the relatively high survival rate for specialty brewers. Yet according to Holleran (1997), recent stock reports from domestic specialty brewers indicate that things do not appear promising for the endurance of the segment (8). Concern also exists pertaining to the future of the macro-beer segment of the beer industry. The question remains as to whether aggregate consumption will continue to decline, or if macro-brewers can expect increasing demand in the future.

The U.S. demand for beer has been estimated in the past. Lee and Tremblay (1992) estimated the per capita demand for beer to determine the effect of advertising on beer consumption. Horowitz and Horowitz (1965), Hogarty and Elzinga (1972), and Ornstein and

Hassens (1985) have also performed estimations of the demand for beer. However, prior beer demand estimates use aggregate industry data in order to determine what affects demand throughout the entire market. The purpose of this paper is to estimate the demand faced by two particular firms within the industry in order to make inferences regarding shifting demand and demographic influence on the market.

In the following, it is assumed that the changes in beer consumption previously discussed are results of shifting demographics. It is the hypothesis of this research that an aging U.S. population is the primary cause of the shifting demand. This paper empirically estimates the demand for beer using a multiple regression analysis. The demand for beers produced by Anheuser-Busch (the largest producer of domestic beer) is estimated to determine what affects the demand for macro-beers. The demand for beers produced by Boston Brewing Company (the largest producer of domestic craft beer) is estimated to determine what affects the demand for craft beers.

I. Theoretical Model

A. Macro-Beer Model

Economic theory implies the following macro-beer demand function:

$$Q = f(P, P_{sub}, DEMO)$$

Q is quantity demanded, P is the price of the good, P_{sub} is the price of substitute goods, and DEMO is demographic factors.

The three theoretical variables are included in part based on the work done by Lee and Tremblay (1992). Their empirical results indicate that the most important determinants of demand are the price of beer, the price of substitutes, and demographic factors.

The effect of price on quantity demanded is expected to be negative. Demand theory

states that price and quantity are inversely related and there is no reason to suspect that beer differs from other conventional goods.

Demand theory also indicates that the price of substitute goods is positively related to demand. For the purpose of this analysis, beers produced by Adolph Coors Co. (the third largest producer of domestic beer) are a substitute for beers produced by Anheuser-Busch. In prior beer demand estimates (such as the estimation performed by Lee and Tremblay in 1992), distilled spirits and colas were considered substitutes to determine how aggregate demand throughout the entire market is affected by changes in the variable. However, the purpose of this analysis is to determine how demand faced by individual firms within the market is affected. It is assumed that if the price of Anheuser-Busch beer increases, a consumer would then be more likely to purchase a Coors product as opposed to whiskey or cola. Therefore, the hypothesis that the price of Coors beer is positively related to the demand for Anheuser-Busch beer will be tested.

Finally, beer producers attribute changes in aggregate consumption to demographic factors. According to the Beer Institute, consumption increases during years that the total population that are in their twenties increases. This effect is attributed to health and social concerns. According to *U.S. Industries Profiles*, older consumers tend to be more health conscious than younger persons, therefore reducing their consumption of high calorie beverages. Also, older Americans tend to be less tolerant towards alcohol abuse as a result of the social costs it imposes (95-96). Therefore, the notion of moderate alcohol consumption is stressed when an older population subsists. Consequently, the hypothesis shall be tested that as demographics tend towards a younger population (ages 20-29), consumption of macro-beers increases.

B. Micro-Beer Model

Economic theory implies the following micro-beer demand function:

$$Q = f(P, DEMO)$$

Q is quantity demanded, P is the price of the good, DEMO is demographic factors.

The effect of price on quantity demanded is included based on the law of demand and is expected to be negative.

Changes in the consumption of craft beers are attributed to demographic factors as well. According to Levitt (1997), aging and more affluent baby boomers are not satisfied with drinking run-of-the-mill beers. They want higher quality items and unique tastes. Furthermore, these older consumers are more inclined to sample the different options that the market has to offer. So while research indicates that older consumers tend to consume less beer than younger persons, it is reasonable to deduce that older consumers are attracted to craft beers as a result of the variety that they offer. Put simply, older beer drinkers may be more concerned with quality rather than with quantity. Consequently, the hypothesis shall be tested that as demographics tend towards an older population (ages 30-39), consumption of micro-beers increases.

Unfortunately, data could not be obtained for a substitute craft beer. Even Pete's Brewing Company (the second largest producer of craft beer) is a private company and does not release financial data. As a result, the substitute good explanatory variable is omitted from the micro-beer demand model.

II. Empirical Model

A. Macro-Beer Model

The macro-beer demand equation to be estimated is

$$B = b_0 - b_1 P + b_2 S + b_3 DEMO1 + b_4 DEMO2.$$

The dependent variable is consumption of beer produced by Anheuser-Busch, b_0 is the intercept P is the price of beer produced by Anheuser-Busch, S is the price of beer produced by Adolph

Coors Brewing Company, DEMO1 is the total U.S. resident population between the ages 20-29 divided by the total U.S. resident population, and DEMO2 is the total U.S. resident population

The dependent variable is the quantity of Anheuser-Busch beer consumed (in barrels) annually. The price of the beers produced by Anheuser-Busch are measured by their unit value. The price of the beers produced by Adolph Coors are also measured by their unit value. For both firms, the unit value is obtained by dividing annual beer revenues by the number of barrels sold.

The first demographic variable (DEMO1) is the U.S. resident population between the ages of 20-29 proportional to the total U.S. resident population. The second demographic variable (DEMO2) is the total U.S. resident population. The total U.S. resident population is included as a time trend variable.

Annual quantity and revenue data are from the *Anheuser-Busch Companies 1997 Annual Report*, and the *Adolph Coors Companies 1997 Annual Report*. Demographic data are from the U.S. Census Bureau. Time series data are observed for an eleven-year period (1987-1997). Table 1 of the appendix presents the data used in the regression.

B. Micro-Beer Model

The micro-beer demand equation to be estimated is

$$B = b_0 - b_1P + b_2DEMO1 + b_3DEMO2.$$

The dependent variable is consumption of beer produced by Boston Brewing Company

b_0 is the intercept,,b_1P is the price of beer produced by Boston Brewing Company

b_2DEMO1 is the total U.S. resident population between the ages of 30-39 divided by total U.S. resident population, and b_3DEMO2 is the total U.S. resident population

The dependent variable is the quantity of Boston Brewing Co. beer consumed (in barrels) quarterly. The price variable is measured by its unit value and is obtained by dividing quarterly

revenue data by the number of barrels sold.

The first demographic variable (DEMO1) is the U.S. resident population between the ages of 30-39 proportional to the total U.S. resident population. The second demographic variable (DEMO2) is the total U.S. resident population. The total U.S. resident population is included as a time trend variable. Quarterly quantity and revenue data are from the Boston Brewing Company home page. Demographic data are from the U.S. Census Bureau. Time series data are observed for a ten-quarter period (1996.2-1998.3). Table 2 of the appendix presents the data used in the regression.

III. Empirical Results

The macro-beer regression equation is estimated using the ordinary least-squares method and the data discussed. The empirical results are reported in Table 3 of the appendix. The regression results (absolute value of t-statistics in parentheses) are

$$\underset{}{B = -1714590249} \underset{(2.2)}{} \underset{}{-1695347P} \underset{(1.9)}{} \underset{}{+1145413S} \underset{(2.4)}{} \underset{}{+195095.69DEMO1} \underset{(2.2)}{} \underset{}{+6.18DEMO2.} \underset{(2.3)}{}$$

The empirical results support the expectations of the macro-beer demand model. The price of Anheuser-Busch beer is negative and statistically different from zero. The significant inverse relationship confirms that the fundamental law of demand is applicable to beer. A one dollar increase in price results in a 1,695,347 barrel decrease in consumption. The price of beers produced by Adolph Coors is positive and statistically significant, which supports the hypothesis that Coors beers are substitutes for Anheuser-Busch beers. A one-dollar increase in the price of beers produced by Adolph Coors results in a 1,145,413 barrel increase in consumption. The percentage of the resident population between the ages of 20-29 is positive and statistically

different from zero, which is consistent with the current belief among producers that consumption increases as this segment of the population increases. A one percent increase in the percentage of the population between the ages of 20-29 results in a 195,095.69 barrel increase in consumption. The total U.S. resident population is positive and statistically significant from zero. A one-person increase in the total population results in a 6.18 barrel increase in consumption.

The F-statistic indicates that the equation is significant at the .01 level. The R-squared indicates that 94.1 percent of the variation in quantity demanded is accounted for in the regression equation. The adjusted R-squared indicates 89.4% of the variance. Therefore, the goodness of fit for this regression is acceptable.

The micro-beer regression equation is estimated using the ordinary least squares method and the data discussed. The empirical results are reported in Table 4 of the appendix. The regression results (absolute value of t-statistics in parentheses) are

$$B = -11037772 - 2397P + 2173.88DEMO1 + .031DEMO2.$$
$$\quad (1.78) \quad (3.66) \quad (1.77) \quad\quad (1.94)$$

The empirical results support the expectations of the micro-beer demand model. The price of craft beers is negative and statistically different from zero. The negative relationship confirms that while craft beers dominate the high priced segment of the beer market, the law of demand still holds. A one-dollar increase in price results in a 2,397 barrel decrease in consumption. The percent of the resident population between the ages of 30-39 is positive and statistically different from zero, which supports the hypothesis that as this older segment of the population increases, consumption of craft beers increases. A one percent increase in the

percentage of the population between the ages of 30-39 results in a 2,173.88 barrel increase in consumption. The total U.S. resident population is positive and statistically different from zero.

The F-statistic indicates that the equation is significant at the .05 level. The R-squared indicates that 79 percent of the variation in quantity demanded is accounted for in the regression equation. The adjusted R-squared indicates 67 percent of the variance. Because of the relatively low R-squared and adjusted R-squared statistics, it is apparent that the equation may not account for all variance in demand. There are several possible explanations for these results. The results are likely to be attributed in part to the duration of time examined in the analysis. Unfortunately, quarterly data could only be obtained for a two and a half-year period. Obviously, the eleven year period observed in the macro-beer equation is more sufficient for examining the effects of demographic changes, since demographics do not vary a great deal over just ten quarters. Also, data could not be obtained for a substitute craft beer. A more efficient analysis is certainly feasible in the future, as more yearly data become available and may be included in the regression.

IV. Concluding Remarks

The purpose of this research is to examine the demand faced by two firms within the U.S. beer market in order to make inferences regarding shifting demand and demographic influence on the market. Over the past decade, the U.S. has experienced negative growth in the 20-29 year old segment of the population. This phenomenon is believed by many to be the primary cause for the negative growth in beer consumption. The results of this analysis are consistent with the hypothesis that growth in the U.S. beer market is dependent on the growth of this segment of the population. The results show a statistically significant positive coefficient estimate on the 20-29 year old demographic variable. As a result, it is valid to infer that as the U.S. begins to once

again experience positive growth in this segment of the population (as projected by the Census Bureau following the year 2000), growth in the consumption of macro-beers shall proceed.

Consumption of domestic craft beer has more than doubled over the past four years despite the fact that aggregate beer consumption has decreased. This increase in consumption has coincided with an approximate 8.1 percent increase in the population between the ages of 30-39. It is the hypothesis of this analysis that craft beer consumption is dependent on the growth of this segment of the population. A statistically significant positive coefficient estimate on the 30-39 year old demographic variable provides support for the hypothesis. It can therefore be inferred that as this segment of the population begins to experience negative growth (as projected by the Census Bureau following the year 2000), growth in the consumption of craft beers shall falter. While the micro-beer demand model does suffer from a number of weaknesses, the combined results of the double regression analysis provide support for the hypothesis that shifting demand between craft and macro-beers occurs due to demographic changes.

APPENDIX

Table 1 Macro-Beer Regression Data

Year	Qd	Price	Psub	Population 20-29 /Total Population	Total Population
1987	77,300,000	$98.38	$74.73	0.167	242,765,000
1988	79,000,000	$101.63	$77.30	0.163	244,970,000
1989	82,200,000	$104.05	$77.54	0.1584	247,195,000
1990	88,100,000	$110.28	$76.90	0.157	249,440,000
1991	87,900,000	$120.95	$79.04	0.1582	252,221,000
1992	88,900,000	$123.83	$80.06	0.1519	255,002,000
1993	89,700,000	$124.27	$80.47	0.1448	257,647,000
1994	91,300,000	$128.20	$82.47	0.1401	260,292,000
1995	90,900,000	$132.06	$83.23	0.1366	262,735,000
1996	95,100,000	$132.14	$86.91	0.1353	265,179,000
1997	96,600,000	$132.84	$88.54	0.1348	267,604,000

Table 2 Micro-Beer Regression Data

Quarter	Qd	Price	Population 30-39/Total Population	Total Population
1996.2	341,000	177.48	0.1505	264,949,000
1996.3	294,000	175.5	0.1659	265,682,000
1996.4	301,000	177.48	0.165	266,324,000
1997.1	281,000	166.54	0.1658	266,814,000
1997.2	387,000	147.7	0.1633	267,419,000
1997.3	357,000	155.92	0.1624	267,877,000
1997.4	326,000	152.97	0.1613	268,765,000
1998.1	311,000	166.11	0.1604	269,073,000
1998.2	324,000	172.25	0.1596	269,816,000
1998.3	310,000	168.4	0.1588	270,258,000

Table 3: Macro-Beer Demand Equation: Regression Coefficients
(dependent variable = Quantity Demanded)

Variable	Coefficient	t-ratio
Constant	-1,714,590,249	2.22
Price	-1,695,347	1.9*
Price of Substitute	1,145,413	2.35*
Resident Population Between 20-29	195,095.69	2.21*
Total Resident Population	6.2	2..26*

N = 11
F = 19.94
R-squared = .94
Adjusted R-squared = .89
*Significant at the .05 level, one tailed test

Table 4: Micro-Beer Demand Equation: Regression Coefficients
(dependent variable = Quantity Demanded)

Variable	Coefficient	t-ratio
Constant	-11,037,772	1.78
Price	-2,397	3.65**
Resident Population Between 30-39	2,173.88	1.77*
Total Resident Population	0.031	1.93*

N = 10
F = 6.36
R-squared = .79
Adjusted R-squared = .67
*Significant at the .10 level, one tailed test
**Significant at the .01 level, one tailed test

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