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THE IMPACT OF GENERIC ADVERTISING AND THE FREE RIDER PROBLEM: A LOOK AT THE U.S. ORANGE JUICE MARKET AND IMPORTS

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Abstract

Increased demand for an advertised product may increase price, which, in turn, may lead to a free rider problem where competitive imports increase and result in a smaller price increase than otherwise. A study of Florida Department of Citrus advertising for orange juice indicated that the free rider problem has notably limited the impact of advertising on price in the U.S. market. High U.S. orange juice demand, which in part has been a result of advertising, has attracted substantial amounts of orange juice imports. Imports have eroded the impact of advertising on price by an estimated two-thirds.

Key Words: advertising impact, imports, orange juice

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The Impact of Generic Advertising and the Free Rider Problem: A Look at the U.S. Orange Juice Market and Imports

Many agricultural commodities produced in the U.S. compete with imports in the U.S. market. Imports tend to reduce prices which, although beneficial to consumers, reduce farmer incomes. In some cases, commodity groups have been formed to improve farmer prices and incomes by increasing domestic and sometimes foreign demand through advertising. However, the benefits of such demand shifts may be offset by increased imports. Advertising by itself may initially increase demand and price which, in turn, may increase imports which then may reduce the initial price increase. This situation has been referred to as the free rider problem (Lee and Fairchild[1]).

The U.S. orange juice industry is an example where the free rider problem is relevant. The U.S. orange juice market has been supported over the years by brand advertising by private firms and generic advertising through the Florida Department of Citrus (FDOC). There is no advertising by importers of orange juices.[a] For the free rider problem, FDOC generic advertising, in particular, may be important since it tends to treat orange juice more as a general commodity[b] and, hence, may provide support to imports. Until the late 1970s, the U.S. imported very little orange juice. During this period, U.S. orange juice exports exceeded imports. For example, in 1970-71, U.S. orange juice imports were 19.3 million single strength equivalent (SSE) gallons, while U.S. orange juice exports were 50.9 million SSE gallons (U.S. Department of Agriculture[2]; U.S. Department of Commerce[3]). However, with freezes in Florida reducing U.S. orange juice production, along with growth in the Brazilian orange juice industry, the U.S. import-export situation change dramatically in a few years. By the mid 1980s, U.S. imports of orange juice had increased to over 500 million SSE gallons while U.S. orange juice exports had remained relatively flat at 56 to 74 million SSE gallons. Since this period, U.S. orange juice production and exports have been increasing, while imports have been decreasing. Nevertheless, in 1993-94, U.S. orange juice imports were 405 million SSE gallons while U.S. orange juice exports were 105 million SSE gallons. Hence, advertising in the U.S. market by U.S. firms and the FDOC has apparently supported not only domestically produced orange juice but also foreign imports. The purpose of this paper is to provide a closer examination of the U.S. orange juice industry and this free rider problem.

The Free Rider Effect on Price

A look at some simple supply and demand relationships reveals the free rider problem. For some commodity, let domestic demand be

(1) $q = \mathrm{f}(p, a)$

and supply be

(2) $q = \mathrm{g}(p) + \mathrm{h}(p)$

where q and p are quantity and price, a is advertising and the functions g and h are for domestic and import supply, respectively (See Kinnucan, et al.[4] for discussion on advertising in demand equations).

At equilibrium, the price p is such that demand equals supply or $\mathrm{f}(p, a) = \mathrm{g}(p) + \mathrm{h}(p)$. Totally differentiating the equilibrium condition yields

(3a) $\partial \mathrm{f}/\partial p * \mathrm{d}p + \partial \mathrm{f}/\partial a * \mathrm{d}a = (\partial \mathrm{g}/\partial p + \partial \mathrm{h}/\partial p) * \mathrm{d}p$

which, after dividing by da and rearranging gives

(3b) $\mathrm{d}p/\mathrm{d}a = (\partial \mathrm{f}/\partial a)/(\partial \mathrm{g}/\partial p + \partial \mathrm{h}/\partial p - \partial \mathrm{f}/\partial p)$.

Expression (3b) shows the impact of advertising on price. This impact is positive, given demand is negatively sloped ($\partial f/\partial p < 0$), domestic and import supplies are positively sloped ($\partial g/\partial p > 0$ and $\partial h/\partial p > 0$) and the effect of advertising on demand is positive ($\partial f/\partial a > 0$). A positively sloped import supply indicates the free rider problem; that is, in absence of the free rider problem, when there are no imports or import supply is perfectly inelastic ($\partial h/\partial p = 0$), the impact of advertising on price is greater.

For some commodities the amount produced may be fixed or nearly so and the given supply is allocated among markets according to demand. Such a situation approximates the world orange juice (OJ) market as discussed by Spreen and Behr[5] (the present orange tree population along with current growing conditions largely determine supply for a given season). For simplicity, focus on the two major producers in the world -- the U.S. and Brazil -- and consider the allocation of OJ supplies from these two producers to two markets--the U.S. and the rest of the world (ROW). Let q_1 and q_2 be fixed supplies from the U.S. and Brazil, respectively. Also, let $f_1(p_1, a)$ and $f_2(p_2)$ be the demand functions for OJ in the U.S. and the ROW, respectively, with p_1 and p_2 being prices in the two markets.

Consider the case in which no trade is allowed and the equilibrium prices in the U.S. and the ROW are p_1 and p_2, respectively. Assume that $p_1 > p_2$. The no-trade prices suggest benefits can be obtained by shipping product from the low price market to the high price market. If trade is now allowed, new equilibrium prices will be reached where $p_1 = p_2 = p$, assuming transportation costs are zero (positive transportation costs can be introduced as shown by Takayama and Judge[6]) and, for the moment, ignoring tariffs. When trade occurs, the price equilibrium is determined by excess demand in the U.S. which can be written as ED = $f_1(p, a) - q_1$ and excess supply in the ROW which can be written as ES = $q_2 - f_2(p)$. With trade, the U.S imports OJ and we have an equilibrium where ED = ES or

(4) $f_1(p, a) - q_1 = q_2 - f_2(p)$.

To obtain the impact of advertising on price, totally differentiate (4) to find

(5a) $\partial f_1/\partial p * dp + \partial f_1/\partial a * da = -\partial f_2/\partial p * dp$

or, after dividing through by da and rearranging,

(5b) $dp/da = -(\partial f_1/\partial a)/(\partial f_1/\partial p + \partial f_2/\partial p)$.

The advertising impact shown in (5b) would also hold with trade occurring when ES exists in the U.S. and ED exists in the ROW (i.e, the U.S. exports OJ). For this situation, the equilibrium condition is (4) multiplied through by minus one, and, hence (5a) and (5b) follow as before.

ED in the U.S. can be reduced to a level where no trade will occur by imposing an appropriate tariff (see, e.g., Tomek and Robinson[7]), in which case, the advertising impact is found by totally differentiating $f_1(p, a) = q_1$, i.e.,

(6) $dp_1/da = -(\partial f_1/\partial a)/(\partial f_1/\partial p_1)$.

The advertising impact (6) is, identical to result (3b) when supplies are perfectly inelastic.

The impact of advertising on price is shown graphically in Figures 1.1 through 1.3. In Figure 1.1, which depicts the U.S. OJ market, supply is fixed at q_1, and demand is initially given by the downward sloping line labeled as $f_1(p_1, a_0)$ where the advertising level is fixed at a_0. In Figure 1.2, which depicts the ROW OJ market, supply is fixed at q_2, and demand is given by $f_2(p_2)$. Figure 1.3 shows the corresponding ED(a_0) in the U.S. market and ES in the ROW market and the trade equilibrium. The trade equilibrium price is pt_0 where the U.S. imports the amount *ab* (in Figure 1.1) which equals the amount *cd* (in Figure 1.2) exported from the ROW. This amount also equals *0e* (in Figure 1.3). If advertising is increased to a_1, demand in Figure 1.1 shifts outward to $f_1(p_1, a_1)$ and excess demand in Figure 1.3 shifts outward to ED(a_1), resulting in new, higher trade equilibrium price and volume levels of pt_1 and $a'b' = c'd' = 0e'$, respectively. Hence, given trade, the impact of advertising on price is pt_1 - pt_0.

Now consider the situation of no trade. Note that ES equals zero at p_{20} while ED(a_0) and ED(a_1) equal zero at price p_{10} and p_{11}, respectively. If the U.S. imposes a per unit tariff of the amount $T > p_{11} - p_{20}$, ES can be viewed as shifting upward intersecting the price line above p_{11} or excess demand can be viewed as shifting downward intersecting the price line below the point p_{10} - ($p_{11} - p_{20}$). In this case, the price differential between the two markets is smaller than the tariff, and, there are no gains in trading. Without trade, the equilibrium price in the U.S. market increases from p_{10} with advertising at a_0 to p_{11} with advertising at a_1. The without-trade advertising impact on price of $p_{11} - p_{10}$ is larger than the with-trade impact on price of pt_1 -pt_0, because in the no-trade situation imports do not increase with advertising and reduce price.

Presently, the U.S. imposes a tariff on imported OJ but under current market conditions the tariff does not keep out all imported OJ and (5b) applies. However, U.S. OJ production (q_1) is expected to grow faster than U.S. demand ($f_1(p_1, a)$) and ED($f_1(p, a) - q_1$) is expected to decrease and eventually reach a point where no trade occurs with p_1 still exceeding p_2, in which case, result (6) would apply. For no trade, we require $p_1 - p_2 < T$ where T is the tariff. It is possible that this condition may persist for a time as U.S. OJ production expands, making this a relevant case. If U.S. OJ production continues to grow, the U.S. price p_1 under no trade may become less than p_2; i.e., ES may occur in the U.S. market and ED in the ROW. In this case, the U.S. would export OJ and (5b) would apply.

Dividing (5b) by (6), we see that the advertising impact when trade occurs is less than the impact when trade does not occur by the factor $(\partial f_1/\partial p)/(\partial f_1/\partial p + \partial f_2/\partial p)$. In elasticities, this result can be written as

(7) $e_1/(e_1 + e_2 * w)$

where $e_1 = (\partial f_1/\partial p) * p/q_1$, $e_2 = (\partial f_2/\partial p) * p/q_2$ and $w = q_2/q_1$.[c]

Application

Research (McClain[8]; Behr and Brown[9]) suggests that the retail OJ price elasticity in the U.S. is about -0.7 while the FOB OJ price elasticity for the ROW is about -0.4. Presently, the retail OJ price in the U.S. is \$3.30 per pound solids (PS) while the U.S. FOB OJ price is \$1.10 per PS, suggesting that the FOB OJ price elasticity in the U.S. is -0.7*1.10/3.30 = -0.23, assuming a constant absolute mark up between the FOB and retail levels (Tomek and Robinson[7]). The U.S. market is also about the same size as the ROW so that w is approximately one in (7). Hence, using these estimates in (7), the impact of OJ advertising on price when trade occurs is about 2/3 less than when trade does not occur (0.23/(0.23 + 0.5) = 0.32). This is a measure of the free rider problem for OJ. The results also suggests caution in cutting advertising as U.S. OJ production expands and the Florida citrus industry finds itself in the no trade situation where the resulting advertising impact would be about three times larger than otherwise.

Consider now a model of the allocation of U.S. and Brazil OJ production to the world, focusing on OJ supply, demand, and prices in the upcoming ten years. First, we review the supply situation. Rapid expansion of orange production in Brazil and Florida, the latter which accounts for roughly 95% of the U.S. OJ production, has resulted in increased OJ supplies in recent years (Behr and Brown[9,10]). A large number of orange trees were planted in Florida and Brazil following the freezes in Florida during the 1980's. With the supply of OJ reduced by the freezes, OJ prices and grower returns were relatively high. Increased supplies in the past few seasons have resulted in lower prices. Given present low prices, along with the expectation that prices will continue to remain low into the future, additional tree plantings, other than for replacement, are not expected in the upcoming years (Behr and Brown[10]). Hence, it is assumed that the present orange tree population in the U.S. and Brazil will remain constant over the projection period, and future orange production levels are estimated by aging the tree population. Tree losses, due to disease and whether phenonmena, are assumed to be offset by (replacement) tree plantings. Since the tree population both in Florida and Brazil is relatively young, and young trees produce more fruit as they mature, orange production levels are projected to increase substantially in the upcoming years even with the tree population held constant.

Following McClain[8], we focus on the demand for OJ in four markets --- (1) the U.S., (2) Europe, (3) Canada, and (4) the rest of the world (ROW). Over the production period, demand in each market increases (prices constant) according to growth rates as in McClain[8]. In recent years, OJ demand in the U.S. and Canada has grown moderately while demand in Europe and the ROW has grown much faster. Following Behr and Brown[9], we assume annual growth rates in demand of 1.5% in the U.S. and Canada, and 4% in Europe and the ROW. For each market, demand is also specified as a function of the price of OJ using price elasticities as in McClain[8], and Behr and Brown[9]. The assumed price elasticities were -0.7 at the retail level for the U.S., -0.4 at the wholesale level in Europe and Canada, and -0.7 at the wholesale level for the ROW.

Projected OJ supplies from the two sources (the U.S. and Brazil) are allocated to the four markets (the U.S., Europe, Canada and the ROW), using the spatial equilibrium model suggested by Takayama and Judge. Our model is a non-linear programming model. To complete the model specification requires incorporation of transportation costs and tariffs. Table 1 shows the transportation cost assumptions, based on McClain[8], Behr and Brown[10], and updated information obtained from the citrus industry. The U.S. imposes a tariff of $0.34 per PS and Europe imposes an *ad valorem* tariff of 19% which were also included in the model. Based on the GATT, the U.S. and European OJ tariffs will be reduced by 15% and 20%, respectively, over the next six years; the tariff levels in the model are adjusted accordingly. Orange juice supplies from the U.S. and Brazil are allocated so as to maximize the sum of the area under the inverse demand function in each market minus transportation costs and tariffs.

For each season the model was simulated for two levels of U.S. demand. The first level of demand assumes the FDOC OJ advertising level in 1993-94 of $18.7 million continues into the future in real dollars. The second level of demand assumes FDOC OJ advertising does not occur in the future. Based on a sample of U.S. retail stores, Lee and Brown[11] found that 1993-94 FDOC OJ advertising increased the quantity of OJ demanded by about 1.5%. Following this result, we assume that the demand for OJ in the U.S. is reduced by this percentage over the projection period when advertising does not occur.

Table 2 shows U.S. and Brazil projected OJ production and market allocations with advertising. From the 1995-96 season to 1998-99, Brazil OJ production is projected to grow 11.2% and then remain flat at the 1998-99 level for the remainder of the projection period through 2004-05. U.S. OJ production is projected to increase 21.4% from 1995-96 to 2004-05. As shown in Table 2, the U.S. is the largest market followed by Europe, the ROW, and Canada.

Table 3 shows how projected U.S. and Brazil OJ production levels, separately, are allocated by market when advertising occurs. Notice the corner solutions which are also maintained when advertising occurs. Brazil supplies the U.S. market in 1995-96 and 1996-97, but thereafter does not; the U.S. does not supply Europe or the ROW but does supply Canada after 1999-2000. Notice that during the 1997-98 and 1998-99 seasons that the U.S. neither exports or imports OJ. This two season period is when the U.S. OJ market is essentially in isolation and we would expect that shifts in U.S. demand or supply might result in greater price variability.

The simplicity of these results, however, needs to be recognized. In particular, it should be noted that in reality the U.S. has been and can be expected to continue to be, to some extent, both an importer and exporter of OJ. Even when U.S. OJ production is not sufficient to meet domestic needs and the U.S. imports substantial amount of OJ, the U.S. also exports some OJ, in response to foreign demand for specific OJ products. Likewise, even when U.S. OJ production by itself exceeds demand in the U.S. market and exports increase, imports can be expected for such reasons as blending requirements and the maintenance of inventory levels. The model, then, needs to be recognized as a simplification that attempts to capture the basic forces in the marketplace. The main focus of this analysis is the solution for prices (with advertising versus without advertising). These solutions are essentially unchanged when additional constraints for minimum levels of exports from Brazil to the U.S. and from the U.S. to the other three markets are imposed on the model to force the U.S. to be both an importer and exporter of orange juice in each season.

Table 4 shows projected U.S. FOB prices, with advertising versus without advertising, over the projection period. The projected price in the U.S. market decreases and then increases over the next ten years as supply initially grows faster than demand and then slows below the growth rate in demand. The difference between the with-advertising versus without-advertising price projections shows that advertising increases price by about $0.08 per PS during the 1997-98 to 1998-99 no-trade period, versus \$0.02 to \$0.03 per PS during the period in which the U.S. trades. This is a measure of the free rider problem and confirms the result that price can be expected to be eroded by about two-thirds by foreign imports.

Conclusions

The results of this study indicate that the free rider problem in international trade may notably limit the impact of advertising on price. The intent of advertising is to increase demand for the advertised product. Increased demand for an advertised product in the U.S. market can be expected to increase price, which, in turn, may increase imports and result in a smaller price increase than otherwise.

A study of Florida Department of Citrus advertising for orange juice indicates that the free rider problem has significantly limited the impact of advertising on price in the U.S. market. High U.S. OJ demand, which in part has been a result of advertising, has attracted substantial amounts of OJ imports. The imports have eroded the impact of advertising on price by an estimated two-thirds. As production of OJ in the U.S. and Brazil expands, as is expected, the difference in the U.S. OJ price and the price in the rest of the world may become less than the tariff, in which case, importing OJ would not be profitable. In this case, the U.S. OJ market would essentially be in isolation and the erosion of the impact of advertising on price would cease. As U.S. OJ production increases further, the U.S. OJ price may decrease relative to the price in the rest of the world, resulting in U.S. OJ exports. In this case, the U.S. market would no longer operate in isolation and erosion of the impact of advertising on price would again be realized.

Table 1. Assumed transportation costs for the spatial equilibrium model

Producer	Market			
	U.S.	Europe	Canada	ROW
	---- dollars per pound solids ----			
U.S.	--	0.17	0.03	0.10
Brazil	0.07	0.07	0.10	0.10

Table 2. Projected orange juice production for the U.S. and Brazil, and allocation to markets with advertising

Season	Production			Market Allocation			
	Brazil	U.S.	Total	U.S.	Europe	Canada	ROW
	---- million SSE gallons ----						
1995-96	1,473	1,367	2,840	1,427	908	144	360
1996-97	1,616	1,450	3,066	1,487	1,007	156	417
1997-98	1,637	1,516	3,153	1,516	1,046	158	433
1998-99	1,638	1,566	3,203	1,566	1,055	155	427
1999-00	1,638	1,602	3,240	1,602	1,065	153	421
2000-01	1,638	1,628	3,266	1,609	1,084	152	422
2001-02	1,638	1,645	3,283	1,612	1,100	150	421
2002-03	1,638	1,655	3,293	1,612	1,114	148	418
2003-04	1,638	1,658	3,296	1,610	1,126	146	414
2004-05	1,638	1,660	3,298	1,606	1,138	144	410

Table 3. Projected orange juice allocation of U.S. and Brazil orange juice production, by market with advertising

Season	U.S. Production Allocation				Brazil Production Allocation			
	U.S.	Europe	Canada	ROW	U.S.	Europe	Canada	ROW
	- - - - million SSE gallons - - - -							
1995-96	1,367	0	0	0	59.25	908	144.45	360.48
1996-97	1,450	0	0	0	36.58	1,007	155.73	416.90
1997-98	1,516	0	0	0	0	1,046	158.05	432.66
1998-99	1,566	0	0	0	0	1,055	155.49	427.31
1999-00	1,602	0	0.33	0	0	1,065	152.17	421.05
2000-01	1,609	0	19.51	0	0	1,084	132.03	422.09
2001-02	1,612	0	32.99	0	0	1,100	117.13	420.85
2002-03	1,612	0	42.98	0	0	1,114	105.41	418.36
2003-04	1,610	0	48.86	0	0	1,126	97.49	414.20
2004-05	1,606	0	54.76	0	0	1,138	89.68	410.05

Table 4. Projected U.S. orange juice FOB prices, with advertising versus without advertising

Season	With Advertising	Without Advertising	Difference
		---- dollars per pound solids ----	
1995-96	1.10	1.08	0.03
1996-97	0.98	0.96	0.02
1997-98	0.96	0.89	0.07
1998-99	0.88	0.81	0.07
1999-00	0.84	0.82	0.02
2000-01	0.89	0.87	0.02
2001-02	0.95	0.93	0.02
2002-03	1.02	1.00	0.02
2003-04	1.10	1.07	0.03
2004-05	1.18	1.15	0.03

Footnotes

[a] U.S. orange juice imports that enter Florida help support FDOC orange juice advertising, with imports being assessed an equalization tax equivalent to the self-imposed tax Florida citrus growers pay. The tax paid by the Florida citrus growers along with the equilization tax support the FDOC and its advertising programs. U.S. orange juice imports that do not enter Florida are not assessed an equilization tax. The free rider problem then applies to the latter orange juice imports that do not contribute to FDOC advertising. It is also noted that those orange juice imports that are re-exported (and duty drawback is obtained) do not present a free rider problem. Imports that do not remain in the U.S. do not erode price by increasing supply.

[b]FDOC advertising does stress Florida in its orange juice advertising but some consumers may not know that some of the orange juice they consume is imported.

[c]The foregoing results can be extended in two directions. First, the variable a in our analysis, which represents advertising could, more generally, stand for any demand shifter such as the price of another good, income, cross or competitor advertising and preference changes. Changes in exchange rates could be viewed as resulting in changes in the own-price as well as prices of other goods, in which case, exchange rate changes may also lead to a demand shift as described by variable a. Second, supplies q_1 and q_2 in equation (4) could be varied, as opposed to being fixed. Differentiation of (4) with respect q_1 or q_2 results in $dp/dq_1 = dp/dq_2 = 1/(\partial f_1/\partial p + \partial f_2/\partial p)$. This expression indicates the impact of supply changes on price when trade occurs. When trade does not occur (say, because the tariff level is too high), a change in U.S. supply q_1 would result in a larger impact on price than when trade occurs; i.e., $dp_1/dq_1 = 1/(\partial f_1/\partial p)$ without trade. The extension of the advertising results to various demand shifters, as well as shifts in supply, suggests that OJ prices

may be somewhat more variable when we are in a no-trade situation.

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