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Abstract

We apply the Berry, Levinsohn, and Pakes (1995) market equilibrium model to data from 30 brands of beers sold in 12 U.S. cities over 20 quarters (1988-92) to estimate the consumers' taste for beer characteristics (price, alcohol content, and calories) as well as for the cultural region of origin (USA, Anglo-European, Germanic, and countries bordering the U.S.). Consumer heterogeneity is allowed with respect to age and income. Overall we end up with 7,200 beer brand observations (30x12x20) and 13,920 (58 random draws x 12 x 20) consumer observations. Empirical results indicate that indeed there is home bias with respect to foreign beers. Home bias is less accentuated among older and more affluent individuals.

JEL Classification: D12, F14, L66.

Keywords: Home bias, beer, country of origin, demand, differentiated products.

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1. Introduction

The "case of the missing trade," so named by Daniel Trefler (1995), is one of the major puzzles in economics. This puzzle has two sides. First, international trade is much too small compared to the theoretical predictions of standard Heckscher-Ohlin-Vanek theory (Trefler, 1995). An obvious resolution to this puzzle is then to relax the basic assumptions of this theory, such as no transportation costs, identical technologies, and identical homothetic preferences across countries. Trefler (1995) finds that a combination of Armington home bias in consumption and Hicks neutral international technology differences works best to lessen the gap between theoretical trade prediction and empirical observation. Second, comparisons of international and intranational trade show that countries trade much more within their borders than across borders, a phenomenon discussed in the economic literature under the names "border puzzle" or "home bias puzzle." The best known article documenting this puzzle is McCallum (1995), who finds that trade between Canadian provinces is more than 20 times greater than trade between a province and a U.S. state. While more recent studies such as Anderson and van Wincoop (2003) have found considerably smaller home bias estimates, there seems to be no question that a good understanding of the sources of home bias is important for explaining the missing trade puzzle.

Empirical studies on home bias usually employ the highly successful gravity equation using aggregate levels of data and asserting supply-side causes by relating this phenomenon to, e.g., transportation costs, co-location of intermediate inputs, and increasing returns (Davis, 1998; Hillberry and Hummels, 2002; Head and Ries, 2001). Such studies tend, however, to ignore domestic consumer preferences for the products in question, let alone that consumer preferences in a country like the United States are not monolithic, as there is a large variation in consumer characteristics that might influence the degree of home bias. In this paper, we use recent advances in the industrial organization literature to investigate to which extent product differentiation and differences in consumer preferences may explain home bias. The answer to this question is important in order to not only better understand the demand-side causes of the missing trade puzzle but also to understand the determinants of a bigger market for domestic products in a Krugman-style trade model (Krugman, 1980) in the presence of heterogeneous goods and increasing returns to scale.

To this end, this paper examines the effects of domestic consumer heterogeneity on choices of foreign and domestic beers using data at the product brand level. Beer provides an interesting case study for examining home bias. First, the country of origin can be easily identified by consumers. Second, beer comes in differentiated brands. Third, consumer heterogeneity can play a crucial role in shaping home biases. Fourth, foreign beers play a growing role in terms of their share in the American beer market.[1] Last, home bias has not been tested at the product brand level for beer.[2] To investigate the demand side determinants of home bias, we apply the Berry, Levinsohn, and Pakes (1995), hereafter BLP, market equilibrium model to 30 brands of beers sold in 12 U.S. cities over 20 quarters (1988-92) to estimate consumers' taste for beer characteristics (price, sales promotion, alcohol content, and calories) as well as for the cultural region of origin (USA, Anglo-European, Germanic, and countries bordering the U.S.). Overall, we confirm the existence of a home bias effect and also decompose it by consumer types.

2. Data and Methodology

In the BLP model (summarized here for expository purposes, see Nevo, 2000 and 2001), the consumer, in choosing a beer brand among competing products, maximizes utility driven by the brand characteristics as well as his/her own characteristics. The indirect utility function of consumer i, $i=1,\ldots,I$, from buying the brand j, $j=1,\ldots,J$, is given by

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[1] Data from the beer market have also recently been used to study the sources of imperfect exchange-rate pass-through at the brand level, see Goldberg and Hellerstein (2012).

[2] In fact, until recently, no comparable studies of home bias at the brand level existed at all. A very recent study by Friberg, Paterson, and Richardson (2011) has tackled the question of home bias in red wine consumption in New Hampshire and finds that there exists a substantial bias towards U.S. wines which cannot be simply explained by better availability of domestic brands. However, despite being a very interesting piece of research, the article does not address the question how home bias depends on consumer characteristics.

$$U_{ij} = \overbrace{\sum_{n=1}^{N} \beta_n x_{nj} + \alpha p_j + \zeta_j}^{\delta_j}$$
$$+ \underbrace{\sum_{m=1}^{M} \sum_{n=1}^{N} \varphi_{mn} d_{mi} x_{nj} + \sum_{n=1}^{N} \rho_n x_{nj} v_i + \sum_{m=1}^{M} \lambda_m d_{mi} p_j + \gamma v_i p_j + \varepsilon_{ij}}_{\mu_{ij}}. \quad (1)$$

The indirect utility given in equation (1) is decomposed into two parts: a mean utility term δ_j, which is common to all consumers, and a brand- and consumer-specific deviation from that mean, μ_{ij}. The (non-individual dependent) mean utility term δ_j in equation (1) is a linear function of the collection of *n*-th brand characteristics x_{nj} of brand *j,* where *n=1,...,N,* the price p_j of brand *j*, and a scalar ζ_j capturing unobserved (to the researcher) product characteristics.

The individual- and brand-specific term μ_{ij} contains five elements:

1. The double sum is an interaction term between individual and brand characteristics. Here, d_{mi} is the *m*-th characteristic of consumer *i,* where *m=1,...,M.* The *MxI* consumer characteristics matrix **D** is distributed with probability density function $h(D)$, whereas the *NxJ* brand characteristics matrix ***X*** is assumed to be exogenously given.
2. The sum over *n* represents the interaction of brand characteristics with an unobservable individual-specific scalar v_i capturing unobserved consumer *i* characteristics. The vector v is assumed to be normally distributed with probability density $g(v)$.

3.+ 4. The two price terms represent the interaction terms of brand price with observable and unobservable consumer characteristics.

5. Finally, the term ε_{ij} is an unobserved consumer- and brand-specific error term with mean zero, distributed with multivariate extreme value density function $f(\varepsilon)$.

The coefficient parameters $\theta_1 = (\alpha, \beta)$ and $\theta_2 = (\lambda, \Phi, \gamma, \rho)$ thus denote brand-specific and brand- and demography-specific parameters, respectively.

Let $k = 0$ denote an outside good if the consumer decides not to buy any of the *J* brands in the set of brands (*j=1,…,J*). We follow discrete choice theory in assuming that each consumer purchases a unit of the brand that yields the highest utility or the outside good. We also do not consider any stock-building behavior by consumers, analogous to a similar assumption in Goldberg and Hellerstein (2012).[3] Aggregating over consumers, the market share of the j^{th} brand corresponds to the probability the j^{th} brand is chosen. That is,

$$s_j(\delta, X, p, \theta_2) = \int\int\int I\{(D_i, v_i, \varepsilon_{ij}) : U_{ij} \geq U_{ik} \forall k = 0,..,J\}\, dH(D)\, dG(v)\, dF(\varepsilon), \tag{2}$$

where *H(D)*, *G(v),* and *F(ε)* are the cumulative distribution functions for the indicated variables which are assumed to be independently distributed.

The price elasticities of the market shares for individual brands are:

$$\eta_{jk} = \frac{\partial s_j}{\partial p_k}\frac{p_k}{s_j} = \begin{cases} -\dfrac{p_j}{s_j}\displaystyle\int\int(\alpha + \sum_{m=1}^{M}\lambda_m d_{mi} + \gamma v_i)s_{ij}(1-s_{ij})\, dH(D)\, dG(v), & \text{for } j = k, \\ \dfrac{p_k}{s_j}\displaystyle\int\int(\alpha + \sum_{m=1}^{M}\lambda_m d_{mi} + \gamma v_i)s_{ij}s_{ik}\, dH(D)\, dG(v), & \text{otherwise}, \end{cases} \tag{3}$$

where

$$s_{ij}(\delta, X, p, \theta_2) = \int\int I\{(D_i, v_i, \varepsilon_{ij}) : U_{ij} \geq U_{ik} \forall k = 0,..,J\}\, dH(D)\, dG(v). \tag{4}$$

To estimate the model, we use data from 30 brands of beer in 12 cities over 20 quarters (1988-1992).[4] In total, 7,200 beer brand observations are used (30 brands x 12 cities x 20 time periods). The 30 brands only include those that were sold in all 12 cities during all 20 time periods, thus in principle

[3] They cite brewing industry lore that customers consume beer within a few hours of purchase as argument that this assumption is not problematic.
[4] Our sample is thus comparable in length to the one used in Goldberg and Hellerstein (2012), but offers a wider regional scope because our sample is not limited to the Chicago metropolitan area.

ruling out home bias due to limited availability of foreign brands.[5] The cities are: Atlanta, Buffalo, Chicago, Cincinnati, Cleveland, Columbus, New Orleans, New York, Omaha, San Antonio, San Diego, and St. Louis. The data consist of two types of information: product (brand) characteristics and consumer characteristics. Brand characteristics include the retail price and $N=6$ other characteristics, namely, the percentage of a brand sold under promotion, alcohol content, calories per serving, and three country of origin dummies. Age and weekly household income are the considered consumer characteristics. All interactions of the brand characteristics price, alcohol content, calories, and country of origin with consumer characteristics are considered in the model.

Data on brand-level market share, retail price, and percent volume sold under promotion came from the Information Resources, Inc. (IRI) Infoscan database at the Food Policy Marketing Center of the University of Connecticut. The potential size of each market is computed by multiplying the state-specific per capita consumption of beer in a given quarter (from the Brewer's Almanac) by the population. Market shares were then computed by dividing brand dollar sales by the potential market size. The calorie and alcohol contents as well as the region of origin were obtained online. Four regions of origin are considered: USA, Germanic (Germany and the Netherlands), Anglo-European (Great Britain and Ireland) and border countries (Canada and Mexico). Table 1 summarizes the product characteristics of beers in the sample.[6] Compared to U.S. beers, imported beers are usually higher in calories and alcohol content (the lower average for Anglo beers with respect to alcohol content is solely due to one alcohol-free beer in this group). This is especially true for beers from the Border (Canada and Mexico) region, whereas beers of Germanic origin are closest to U.S. beers in those respects. Foreign beers are on average also considerably more expensive and less often subject to sales promotions than U.S. beers.

[5] While the brands in our sample were available during all periods and in all regional markets, it is of course possible that some brands were not sold in every store so that some limited scope for availability bias exists. However, Friberg et al. (2011) evaluated the extent of home bias in red wine consumption due to limited availability and found that this bias was not the major driving force behind the observed bias. We expect the same to hold for the beer market.

[6] In the estimation, percent of sales under promotion and percent calories content are in decimal form.

Observable consumer characteristics were obtained from 58 random draws from the Current Population Survey for each city and quarter (National Bureau of Economic Research, 2002). These variables are age and weekly household income. As Table 2 shows, the average consumer in the sample was about 38 years old and had a weekly household income of $738 at his/her disposal.[7] Another 58 draws from a normal distribution with zero mean and unit variance were obtained for the unobservable characteristics.

Instrumental variables are used to control for the potential endogeneity of retail prices arising from their correlation with unobserved product characteristics. Following Nevo (2001), 90 interactions between 30 brand dummies and three input prices as well as 12 city dummies are used as instruments. Input prices include the wages for supermarket workers in a given city, petroleum prices, and median housing price indices.

For estimation purposes, we define a "market" for each city and quarter combination, resulting in 240 markets, each with 30 brands of beer and 58 consumer observations, thus 7,200 beer brand observations and 13,920 consumer observations. We adapt Nevo's (2000) MATLAB-based algorithm, which minimizes the distance between observed and estimated market shares, using the generalized method of moments. The results are presented in the following section.

3. Results

Table 3 shows the BLP estimates. In parentheses, we report the t-statistics based on heteroskedasticity-robust GMM standard errors. The parameter estimates for the mean utility (δ_j) are all statistically significant. Price has a negative effect and promotion has a positive effect on the mean utility, as expected. Both a higher calorie and a higher alcohol content decrease mean utility. The mean utility results clearly point to a home bias in U.S. beer consumption. This bias is strongest for beer of

[7] In the estimation, both age and income were used in logs and demeaned.

Anglo-European origin; the biases against Germanic and border beers are smaller in size, being smallest for Germanic beer brands.

Taking into account consumer heterogeneity, we find almost all interaction terms to be statistically significant at the 1% level. A lower price matters considerably less for older consumers. Consumers with higher income are slightly more price-sensitive, which may appear somewhat counter-intuitive, but may be possibly explained by the fact that consumers with higher income also tend to be more educated and are more likely to compare prices. These consumers also tend to view more favorably beer that is higher in alcohol, whereas higher calorie content reduces utility. Older consumers, however, view both higher calorie and alcohol content less favorably.

In terms of the cultural region of origin of the beers, there is clearly a consumption bias for U.S. beer present in the mean utility. However, the actual bias also depends on consumer characteristics. Both older and higher income consumers view Anglo and -- to a lesser extent -- Germanic beers more favorably, whereas they exhibit a more pronounced bias against border country beer brands.

We also calculated 10,800 price elasticities of demand for beers (the square of 30 brands x 12 cities), side-stepping the problem of dimensionality that plagues differentiated product demand estimation. As Table 4 shows, all the estimated own-price elasticities are negative, as illustrated for the city of Chicago, Illinois. The own-price elasticities appear similar to estimates in the literature, although most previous estimates were obtained at a more aggregated level, so they are not directly comparable. As a general result, domestic beers tend to have somewhat higher own-price elasticities than foreign ones.

The price elasticities of demand with respect to the price of Budweiser (the leading domestic beer brand) are higher for domestic than for foreign beers, showing that domestic beers are closer substitutes for Budweiser. Interestingly, the price elasticities with respect to Harp (an Irish beer very similar to Budweiser in terms of alcohol content, calories, and lager type) are overall much lower in spite of its similarities to the domestically produced Budweiser. In addition, the average cross-price elasticity between foreign beers and Harp is higher than between domestic beers and Harp.

4. Conclusion

Applying the Berry, Levinsohn, and Pakes (1995) methodology to a large data set involving 12 cities and 30 brands of beers, the results point to bias toward domestically produced beers in U.S. beer consumption. Furthermore, this bias appears to be more accentuated for younger and lower-income consumers with respect to European beers, whereas border country beers are less preferred by older and higher-income consumers. The estimated price elasticities of demand further attest that although American consumers are somewhat less sensitive to price changes of foreign beer, they more easily switch to domestic beers than foreign ones in spite of common physical beer characteristics. The obtained results provide a detailed picture of the American consumer bias toward home vs. foreign made beers.

This paper shows that the payoff to go beyond the common aggregate studies of home bias in international trade is potentially high as one tests not only for home bias, but also gets a detailed insight into consumer behavior and consumer heterogeneity with respect to home bias. To obtain a more complete picture of the demand side origins of home bias, studies of different product markets in different countries, and in particular studies using multi-country data sets, may ultimately prove useful.

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Table 1: Brand Characteristics Summary

Variable	Mean	Standard Deviation	Min	Max
All Brands				
Price ($/gallon)	7.23	2.46	1.98	15.37
Calories (per 100 ml)	40.83	5.03	28.00	49.00
Alcohol (%)	4.70	0.99	0.05	6.11
Promotion (%, $)	28.92	20.60	0	93.94
U.S. Brands (53.33% of sample)				
Price ($/gallon)	5.38	1.20	2.49	8.47
Calories (per 100 ml)	39.63	5.23	30.00	49.00
Alcohol (%)	4.74	0.45	3.88	6.11
Promotion (%, $)	34.59	19.81	0	93.37
Germanic Brands (16.67% of sample)				
Price ($/gallon)	9.30	1.55	4.93	12.25
Calories (per 100 ml)	40.80	6.71	28.00	47.00
Alcohol (%)	4.92	0.50	3.96	5.41
Promotion (%, $)	23.01	18.65	0	85.91
Anglo Brands (13.50% of sample)				
Price ($/gallon)	10.80	1.53	7.47	15.36
Calories (per 100 ml)	42.00	0.71	41.00	43.00
Alcohol (%)	3.55	2.04	0.05	5.15
Promotion (%, $)	19.94	19.93	0	93.94
Border Brands (16.50% of sample)				
Price ($/gallon)	8.23	0.97	1.98	10.96
Calories (per 100 ml)	43.80	2.14	42.00	48.00
Alcohol (%)	5.29	0.42	4.79	6.04
Promotion (%, $)	23.86	19.95	0	85.37

Table 2: Demographics Summary

Variable	Mean	Standard Deviation	Min	Max
Household Income (weekly)	738.24	488.24	1	3846
Age	37.90	14.51	16	90

Table 3. Demand Parameter Estimates[8] (t-statistics in parentheses)

Variable	Mean	Deviations: Age	Income	Unobservables
Constant	-2.2899 (-56.9623)	-1.9370 (-32.0239)	-0.3085 (-10.7065)	0.5872 (11.6399)
Price	-1.9114 (-240.3829)	1.8131 (211.9395)	-0.0340 (-7.9748)	1.5313 (167.5248)
Alcohol	-0.1521 (-12.8064)	-0.2013 (-16.6196)	0.0575 (11.3320)	0.2919 (26.4671)
Calories	-2.6661 (-25.3947)	-1.7399 (-13.3502)	-0.6754 (-12.1340)	-1.3024 (-8.0900)
Promotion	2.6964 (61.5270)			
Anglo	-5.1466 (-65.1264)	3.6930 (32.8921)	1.7814 (43.4147)	-2.7046 (-21.8414)
Germanic	-2.3676 (-58.1909)	0.4585 (8.4750)	1.1879 (46.1875)	0.1038 (1.7480)
Border	-3.4980 (-109.0767)	-1.5912 (-2.1514)	-0.0830 (0.8332)	3.5363 (92.1264)

[8] For interpretation of coefficient estimates, also see footnotes 1 and 2 on page 5.

Table 4. Price Elasticity Estimates for Beer Brands in Chicago

Brand	Country of Origin	Own Price Elasticity	Cross Price Elast. w.r.t. Budweiser	Cross Price Elast. w.r.t. Harp
Amstel Light	Holland	-1.960	0.0986	0.042
Bass	England	-1.9311	0.1096	0.0365
Becks	Germany	-2.1939	0.1351	0.0409
Budweiser	USA	-2.7333	-	0.0208
Budweiser Light	USA	-2.2188	0.2319	0.0309
Busch	USA	-4.9349	0.5981	0.0095
Colt 45	USA	-3.3875	0.5053	0.0166
Coors	USA	-3.4176	0.4985	0.0166
Coors Extra Gold	USA	-2.6326	0.3427	0.025
Coors Light	USA	-2.8371	0.1949	0.0373
Dos Equis	Mexico	-1.697	0.0941	0.037
Guinness	Ireland	-1.6509	0.0996	0.0358
Harp	Ireland	-2.329	0.1487	-
Heineken	Holland	-2.1985	0.0138	0.0107
Kaliber	Ireland	-3.2125	0.2797	0.0354
Labatt	Canada	-2.103	0.1932	0.034
Lowenbrau	USA	-3.1263	0.403	0.0268
Michelob	USA	-2.6724	0.2989	0.032
Michelob Light	USA	-2.9887	0.4299	0.0205
Miller	USA	-2.6528	0.391	0.023
Miller Light	USA	-2.4952	0.4114	0.0083
Milwaukees Best	USA	-3.2554	0.2594	0.038
Molson	Canada	-3.9291	0.3966	0.027
Molson Golden	Canada	-3.1012	0.2283	0.0391
Moosehead	Canada	-2.5234	0.4149	0.0101
Old Milwaukee	USA	-2.7026	0.333	0.0194
Rolling Rock	USA	-2.1718	0.1274	0.0411
Schaefer	USA	-2.625	0.4139	0.0085
Schlitz	USA	-2.8859	0.43	0.0114
St. Pauli Girl	Germany	-2.854	0.4394	0.0111
Average: Home		-2.9258	0.3668	0.0227
Average: Foreign		-2.4372	0.2040	0.0300