Definition of relevant market in beer industry: Application of LA-AIDS model

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Abstract. The aim of our article is to investigate whether there exists a relevant product market narrower than beer. We use multilevel budget LA-AIDS model to estimate the demand elasticities of the biggest beer brands and selected beer segments on US scanner data. We then perform a critical loss analysis to investigate if the proposed segments constitute separate relevant markets. Results of our paper can be helpful to competition authorities in their assessment of future mergers in the beer industry.

Keywords: competition, beer, demand estimation, LA-AIDS.

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1 Introduction

Any competition analysis aiming at market power assessment or investigating the intensity of market competition has to begin with the definition of a market. A competition policy uses a concept of relevant market that identifies boundaries of competition between firms.

Paramount to the relevant market definition is a Hypothetical Monopolist Test. According to this test, a relevant market is constituted by a set of products that could be profitably monopolized - i.e. set of products on which a hypothetical monopolist (a firm controlling the supply of given products) could increase its profits by instituting a small, but significant non-transitory price increase (SSNIP).[3] Relevant market definition is crucial in any merger assessment, as it puts the proposed merger into the perspective relative to the size of the whole (relevant) market and the level of competition on that market.

Beer brewing industry, which has increased in its concentration manifold in last couple of decades, is one of the areas, where relevant market definition for the purpose of merger assessment will play an increasingly important role in the forthcoming future. Most market players have recently grown and increased their market share primarily through mergers rather than organic growth.[4] After several last decades filled with frequent mergers, beer brewing industry has become a global market with few leading players.[5]

In nearly all merger decisions concerning beer brewing industry and issued by the European Commission, the relevant product market was considered to be beer. In this article we investigate, whether the relevant market is not in fact narrower.[6] With increasing concentration of the market caused by mergers to come, results of our analysis could be useful in order to predict the post-merger level of competition on the market and to estimate whether the proposed merger significantly impedes the effective competition on the relevant market.

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[3]As significant is considered a price increase by 5-10 %. This price increase is used to approximate the level of market power a given company has. The closer substitute other products are, the less likely a hypothetical monopolist is to institute SSNIP. The relevant market thus results in defining a set of products that consumers consider interchangeable.

[4]Examples of recent major mergers between beer producers are Heineken/BBAG (2003), InterBrew/Becks (2001), InterBrew/Brauerglide (2002), Heineken/Scottisch & NewCastle (2008), InBev/AnHeuser Busch (2008)

[5]Since year 2000, 90 % of the world beer production comes from four biggest producers (Anheuser-Busch InBev, South African Breweries (SAB), Heineken, Carlsberg. For more information see e.g. [7]).

[6]European Commission itself has stated on several occasions that the relevant market could be narrower, but has never used narrower market definition in the final decision. For example in Interbrew/Becks merger decision (2001), the EC states that a separate market for premium beer could exist.

We start our analysis at the most detailed level and estimate the own price elasticity of demand for main beer brands and then for six chosen beer segments. Given these estimates, we analyse the size of the relevant market (whether it is a single beer brand, a beer sector or wider definition) by empirically estimating the Hypothetical Monopolist Test. We focus our analysis only on an off-trade market, which is normally treated as separate market from an on-trade market.[7]

2 Model

For the estimation of beer demand we use an Almost Ideal Demand System (AIDS) of Deaton and Muellbauer [4]. We assume a multi-stage budgeting, where in the first (upper) level the overall beer expenditure is allocated between different beer segments, in the second (bottom) level the demand for individual beer brands is estimated. Multi-stage budgeting specification helps us to solve the curse of dimensionality and allows to obtain more efficient estimates both for beer segments and individual beer brands. On the other hand, it implicitly requires compliance with the weak separability of utility function.[8]

We have investigated the following beer segments: dark beers (known for their taste), imported beers (specific by their origin), light beers (with low caloric content), craft beers (mostly only local and produced in limited amounts), non-alcoholic beers (suitable for drivers) and premium beers (representing the mainstream beer). Segments are set according to the market segmentation common in the beer brewing industry. Individual beer brands were assign to each segment according to marketing information of the producers.[9]

The bottom level of our model takes the following form:

$$w_{int} = \alpha_{in} + \beta_i \ln(Y_{mnt}/P_{mnt}) + \sum_{j=1}^{I} \gamma_{ij} \ln p_{jnt} + \epsilon_{int}, \tag{1}$$

$$i = 1, \ldots, I, \quad n = 1, \ldots, N, \quad t = 1, \ldots, T, \quad m \in \{1, \ldots, M\}$$

where w_{int} is the expenditure share of the ith brand from total segment expenditures in the store n and week t, Y_{mnt} denotes the overall expenditure of respective segment m, P_{mnt} is the price index and p_{jnt} is the price of the jth brand. To avoid non-linear estimation when using translog price index, we use lagged Stone index[10] defined as:

$$\ln P_{mnt} = \sum_{i=1}^{I} w_{in(t-1)} \ln p_{int}. \tag{2}$$

Upper level of the model, describing expenditure allocation between the segments, is formulated in similar manner:

$$w_{mnt} = \alpha_{mn} + \beta_m \ln(Y_{bnt}/P_{bnt}) + \sum_{k=1}^{M} \gamma_{mk} \ln P_{knt} + \epsilon_{mnt}, \tag{3}$$

$$m = 1, \ldots, M, \quad n = 1, \ldots, N, \quad t = 1, \ldots, T$$

where w_{mnt} denotes the expenditure share of the mth segment from the overall beer expenditures, whose real values is given by the term Y_{bnt}/P_{bnt}. P_{knt} refers to the price index of the kth beer segment in store n and week t .

We impose restrictions to ensure the sum of all expenditures is equal to 1 (4), segment expenditures are homogeneous in prices (5) and Slutsky's substitution matrix is symmetric (6).

$$\sum_{l=1}^{I(M)} \alpha_{ln} = 1 \qquad \sum_{l=1}^{I(M)} \gamma_{lj(k)} = 0 \qquad \sum_{l=1}^{I(M)} \beta_l = 0 \tag{4}$$

[7]Off-trade market contains beer sales where the sale of beer and its consumption take place at different locations. Off-trade mostly comprises of beer sales in supermarkets and retail stores. On-trade market is represented mostly by beer sales in restaurants and hotels. On-trade and off-trade markets constitute different relevant markets due to the differences in distribution, packaging and existence of buyer power on the off-trade market. It can be assumed that consumer preferences do not significantly vary between on-trade and off-trade market.

[8]This means that the change in price of one brand in a certain segment affects the demand for all brands in other segments in the same way.

[9]Useful cross-check information was also acquired from [14].

[10]As suggested by [5], we use lagged expenditure shares to calculate the price index to avoid simultaneity bias leading to inconsistent estimates.

$$\forall n \in \{1,\ldots,N\}, \quad \forall j \in \{1,\ldots,I\}, \quad \forall k \in \{1,\ldots,M\}$$

$$\sum_{j(k)=1}^{I(M)} \gamma_{lj(k)} = 0 \qquad \forall l \in \{1,\ldots,I\}(\{1,\ldots,M\}) \tag{5}$$

$$\gamma_{lj(k)} = \gamma_{j(k)l} \qquad \forall l,j,k. \tag{6}$$

Elasticities for individual beer brands and beer segments were calculated as

$$\varepsilon_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \beta_i \frac{w_j}{w_i}, \tag{7}$$

where δ_{ij} denotes Kronecker delta. We use a simplified formula which assume that $w_j = \partial \ln P / \partial \ln p_j$. As shown in [8], this simplification does not change the resulting elasticities.

3 Data

For estimation of our model we use scanner data from U.S. (Chicago metropolitan area) dated from June 1991 until November 1995.[11] Our final dataset consists of panel data on sales volume and prices of individual beer brands in 36 retail chain stores during 220 weeks. All data come from Dominick's Finer Food company, the second biggest retail chain in the Chicago area at that time. Even though the data are not very recent, vast majority of analysed beers is still being sold today. Since consumer substitution pattern has not shown any significant variation during the 220 weeks under investigation, results of our analysis are most likely valid even past the analysed time frame. In order to capture the substitution effects between selected beer brands, we use only data on 6-pack beers abstracting from the substitution effect between different sizes of the same beer brand.

We have detrended and seasonally adjusted the data from weather-induced effect on beer consumption by using average outside temperature.[12] A strong influence on beer sales from several national holidays (Memorial Day, Father's Day, Independence Day, Labor Day, Thanksgiving, Christmas) and sporting events (Super bowl) has also been captured.

4 Estimation

For the model estimation we use fixed effect SUR estimator.[13] SUR estimator allows to include cross-equations constraints (5) and (6) and also captures covariances of cross-equations disturbances, which were significant in our model. When estimating a demand system, one should always check for the endogeneity and consider using instrumental estimators if necessary. Some authors (e.g. [9]) use Hausman-Taylor estimator, which only solves the endogeneity of store specific unobservable effect. Since our data come from retail chain in geographically small area, such effect turned out very small. Only demand shocks across all stores were a potential problem in our case.

We have conducted Hausman tests with estimates from IV 2SLS estimator using lagged own price and wholesale costs as instruments. In most cases, the test rejected the null hypothesis and recommended using the IV estimator. However lack of appropriate instrumental variables did not allow us to use IV estimation. On the other hand, since prices were mostly set independently of demand shocks, potential endogeneity was not considered a very significant problem.[14]

At first we estimate the bottom level of our model. Tabulating full estimation results would be too excessive, so we only briefly comment on them.[15]. The own-price elasticities of almost all beer brands

[11]We would like to hereby acknowledge the James M. Kilts Center, Booth School of Business at University of Chicago that has provided us with the data.

[12]Data on outside temperature were acquired from National Oceanic and Atmospheric Administration (NOAA). Weakly mean temperature at Chicago O'Hare airport has been calculated from hour-by-hour daily temperature data.

[13]Our estimator is a special case of SUR-GLS estimator using only within data variability, for more information see [1, chapter 6].

[14]This is in line with [2], who have analysed the pricing decisions of managers on the same data as we use. Meza (see [11]) (using the same data as well) also shows that retail prices fall in the periods of high demand in order to attract more customers, who once in store also buy other goods with higher margin.

[15]Full estimation results are available on request.

falls in the interval $(-4, -2)$, only one non-alcoholic beer shows inelastic demand curve. Overall, brands from premium and imported beer segments have the most elastic demands, which suggests quite small brand loyalty within the segments. This is surprising esp. with the imported beers, as data show slightly higher demand for German beers during German national holidays. One would thus expect rather high brand loyalty. The least elastic demand have been found for non-alcoholic beers, which is in line with our expectation (non-alcoholic beers are mostly consumed by drivers and hence not substitutable by regular alcoholic beers). Low elasticity is also reported for dark beers, which probably shows high valuation of customers for taste, alcohol content and other unique attributes of dark beers. The demand elasticities for every single beer are quite high to render any beer a relevant market in itself. Thus we focus mainly on the elasticities of beer segments and market delineation on the level of beer segments.

The estimated coefficients, standard errors and elasticities for the upper level of the model are presented in Table 1 [16].

	Premium	**Light**	**Dark**	**Imported**	**Non-alc.**	**Craft**
$\ln(Y/P)$	-0.006*	0.004*	0.006*	-0.004*	0.009*	0.010*
s.d.	(0.002)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
$\ln(P_{\text{Premium}})$	-0.102*	0.050*	0.007*	0.010*	0.002	0.033*
s.d.	(0.010)	(0.005)	(0.003)	(0.004)	(0.005)	(0.004)
$\varepsilon_{\text{Premium}}$	-1.218	0.110	0.017	0.024	0.005	0.074
$\ln(\text{P}_{\text{Light}})$	0.050*	-0.115*	0.016*	0.028*	-0.013*	0.034*
s.d.	(0.005)	(0.005)	(0.002)	(0.002)	(0.003)	(0.003)
$\varepsilon_{\text{Light}}$	0.374	-1.902	0.125	0.213	-0.105	0.266
$\ln(\text{P}_{\text{Dark}})$	0.007*	0.016*	0.017*	-0.007*	-0.002	-0.032*
s.d.	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$\varepsilon_{\text{Dark}}$	0.062	0.222	-0.760	-0.113	-0.039	-0.465
$\ln(P_{\text{Imported}})$	0.010*	0.028*	-0.007*	-0.004	-0.012*	-0.015*
s.d.	(0.004)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
$\varepsilon_{\text{Imported}}$	0.097	0.222	-0.053	-1.028	-0.091	-0.112
$\ln(\text{P}_{\text{Non-alc.}})$	0.002	-0.013*	-0.002	-0.012*	0.028*	-0.003
s.d.	(0.005)	(0.003)	(0.002)	(0.002)	(0.004)	(0.002)
$\varepsilon_{\text{Non-alc.}}$	-0.024	-0.134	-0.025	-0.125	-0.747	-0.034
$\ln(\text{P}_{\text{Craft}})$	0.033*	0.034*	-0.032*	-0.015*	-0.003	-0.019*
s.d.	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)
$\varepsilon_{\text{Craft}}$	0.254	0.295	-0.288	-0.142	-0.032	-1.176
Constant	0.167*	0.167*	0.167*	0.167*	0.167*	0.167*
s.d.	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)

Table 1 Segment level estimation

The statistical significance of the parameters is smaller relative to the inter-segment estimations, but the majority of coefficients still remains significant. The level of the own-price elasticities is in line with our bottom level estimates. The premium and light beer segments show the highest price elasticity of demand, whereas non-alcoholic and dark beer segments report low own-price elasticities. Interesting are negative cross-price elasticities with the non-alcoholic segment. One wonders whether regular beers, which are bought for home celebrations, are really complements to non-alcoholic beers that might be bought for visitors arriving to the celebration by car.

5 Critical Loss Analysis

In order to quantify the Hypothetical Monopolist Test, we use Critical Loss Analysis (CLA). CLA calculates the level of sales that a hypothetical monopolist could lose due to a 5-10 % price increase in order

[16] Symbol * indicates statistically significant estimates at least on 5% significance level.

to preserve at least the level of profit before the price increase. For more information on Critical Loss Analysis see e.g. [3]. Price elasticity of demand, under which the original level of profit (i.e. before the price increase) is equal to the level of profit after the SSNIP is called *break-even critical demand elasticity* ($\varepsilon_{c,be}$). Its level is compared to the actual estimated demand elasticity (ε) for analysed set of products. If $\varepsilon > \varepsilon_{c,be}$, then the set of products does not constitute a relevant market as a close enough substitute exists making the actual demand more elastic (than required by the critical loss elasticity) and rendering the SSNIP not profitable. If the opposite is true, the tested set of products is the relevant market.

A second version of CLA exists - the profit-maximizing critical loss analysis.[17] Under this version of CLA, the question is whether a profit-maximizing monopolist would increase a price by at least 5-10 % in order to achieve a profit-maximizing price. Critical demand elasticity is equal to the elasticity of demand, under which the hypothetical monopolist would increase its price by at least 5-10 % in order to set its price on profit-maximizing level [18].

Since both approaches are performed by the competition authorities when using CLA, we have also performed both types of critical loss analysis. In this section, we assume constant marginal costs equal to wholesale price of each beer brand. We also assume linear demand curve, which is in line with AIDS being first-order approximation of any demand system. The following formulas ((8), (9)) describe the calculation of the break-even critical elasticity and profit-maximizing critical elasticity, where m is initial profit-margin and t is the level of price increase.[19]

$$\varepsilon_{c,be} = \frac{1}{m+t} \qquad (8)$$

$$\varepsilon_{c,pm} = \frac{1}{m+2t} \qquad (9)$$

Table 2 shows profit-margins, estimated elasticities for the segments and the level of break-even and profit-maximizing critical demand elasticity for price increase of 5 % and 10%.

			SSNIP = 0.05		**SSNIP = 0.1**	
	m	ε	$\varepsilon_{c,be}$	$\varepsilon_{c,pm}$	$\varepsilon_{c,be}$	$\varepsilon_{c,pm}$
Premium	0.175	1.218	4.45	3.64	3.64	2.67
Light	0.161	1.902	4.74	3.83	3.83	2.77
Dark	0.108	0.760	6.31	4.80	4.80	3.24
Imported	0.084	1.028	7.47	5.44	5.44	3.52
Non-alcoholic	0.185	0.747	4.26	3.51	3.51	2.60
Craft	0.150	1.176	5.00	4.00	4.00	2.86

Table 2 Profit-margin, estimated elasticity and critical demand elasticities

As can be seen, $\varepsilon < \varepsilon_{c,pm} < \varepsilon_{c,be}$ for all the estimated segments and a given increase in price. It can be concluded, that irrelevant of whether the profit-maximizing or the break-even version of CLA is used, proposed beer segments constitute separate relevant markets. A hypothetical monopolist over each segment could profitably increase its price by 5-10 % (or such price increase would be profit maximizing).

6 Conclusion

In the last ten years, the increasing concentration of the beer brewing industry also meant an increasing number of merger cases assessed by national competition authorities and the European Commission. As the first and very crucial step in every competition case is the definition of a relevant market, competition authorities have been faced with the question whether beer is a relevant market in itself or whether narrower relevant product markets exist. Increasing concentration of the beer brewing market puts more pressure on correct relevant market definition in order to estimate the price effects of the merger.

We have used LA-AIDS model to estimate the own-price elasticities for selected beer segments and conducted Critical Loss Analysis to find out, whether a relevant market narrower than beer exists. Our

[17] For more informations on the difference between the break-even critical loss analysis and profit-maximizing critical loss analysis, see [12].

[18] For more information on Critical Loss Analysis, see [10]

[19] Detailed derivation of the formulas and more detailed intuition can be found in [15].

results show that a hypothetical monopolist over any one of our proposed segments would have enough market power to implement the SSNIP, making each of the analysed segments a separate relevant market. Relevant market in the area of beer brewing thus seems narrower than all of beer and a merger between two beer producers with overall small market share but which both focus on a certain beer segment, might constitute a competition concern.

Our results on the size of the relevant product market are deduced solely on the estimation of the demand function. Further research should be done on potential supply side substitution, likelihood of entry and existence of buyer power - all of which can render SSNIP unprofitable and affect the definition of the relevant market. Analysis of these areas was beyond the scope of this article and will be looked into in the future. Regardless of the shortcomings, demand estimation still remains a crucial first step in every relevant market definition.

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