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ECONOMETRIC ANALYSIS OF PRODUCER DISCOUNT POLICY

Abstract: In the paper we present econometric analysis of producer discount policy used by one of the Polish brewer companies. The range of analysis is limited by data availability and concerns such contractor characteristics like value of given discount, type of product, amount of order, distribution channel, region, market segment. An effort of reconstructing producer discount policy will be taken.

Key words: sales modelling, econometric discount modelling, econometric analysis of sales promotions.

1. Introduction

Producers differ their discount policy for contractors, giving discounts which value depends not only on the amount of order, but also on some contractor characteristics such as region or place of order. Due to such producers behaviour the question has raised: do breweries really condition their price (discount) on some reasons other than amount of order? And if so, what are these reasons? Many contractors have observed big differences among given discounts at the same amount of order. These contractors have started to suspect brewery of having not fair discount policy and favouring some of the contractors by selling them beer at lower prices. The way of masking such policy was introducing a lot of contractor characteristics and conditioning the value of discount on the combination of these characteristics. Verification of the above hypothesis was based on the specific econometric models. Similar analysis can be found i.e. in [Hendel, Aviv 2006; Yasuda 2005].

The aim of research was to prove the above hypothesis and show which combinations of contractor characteristics are important in producer discount policy.

2. Empirical data characteristics

Empirical data come from the computer system of one of Polish breweries and contain records of 39,293 single transactions in the period of one month. Each record had the following information:

1) regular and trade prices which were the basis for computing the discount,
2) amount of order,
3) type of transaction (regular or sell-out),
4) owner of contractor (each owner could have more than one contractor),
5) contractor,
6) region of contractor,
7) point of sales (place of order),
8) distribution channel,
9) segment of contractor.

All the above contractor characteristics may have – potentially – some influence on given discount, so these characteristics were treated as 'cross sections' of contractors and for these sections values of discount was analyzed. Table 1 presents basic descriptive statistics for variables *items* (amount of order) and *discount* (given discount) and Figure 1 presents frequency distributions of these two variables.

Table 1. Basic descriptive statistics for variables *items* and *discount*

Variable	Average	Median	Min	Max
items	0.482510	0.200000	–1200	6804
discount	0.0368324	0.0399396	0.00000	0.999526

Source: own research.

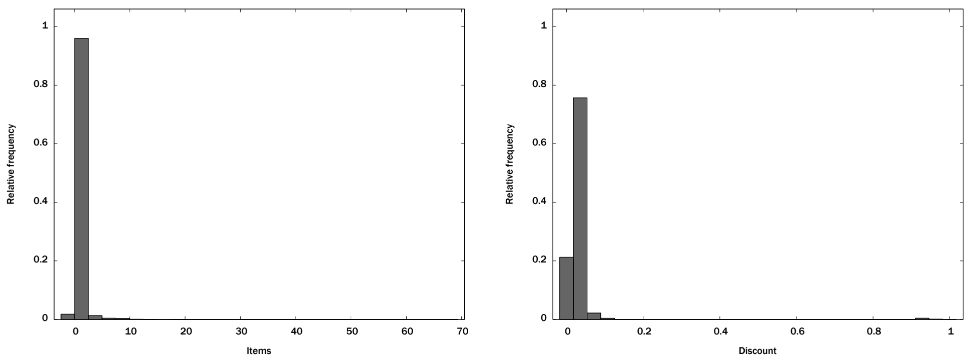

Figure 1. Frequency distributions for variables *items* and *discount*

Source: own research.

Values of discounts were varying from 0% to over 99% which was the case of sell-out. Furthermore the least value of order –1200 means that this was an invoice correction. Such observations could be outliers in empirical regressions, so for correctness of further analysis these observations were removed from the dataset. All empirical models were estimated for dataset with the following restrictions:

1) *items* > 0,
2) *discount* < 0.2.

Number of available contractor characteristics suggests that there could be 6 sections, but in fact region and point of sales were two ways of showing the same characteristics, which can be read from Table 2.

Table 2. Cross table for variables region and point

Value of variable *region*	Value of variable *point*			
	1	2	3	4
0	15.969	0	0	0
1	0	9.266	8.721	5.337

Source: own research.

Cross analysis for variables *region* and *point* showed that variant 0 of variable *region* means the same as variant 1 of variable *point*. The rest of variants of variable *point* brought together gave variant 1 of variable *region*. Because of this relation variable *region* was omitted in main analysis. Finally only sections *owner*, *contractor*, *point*, *channel* and *segment* were analyzed.

3. Methodology of research

The basis for verification if particular section has influence on given discount was comparison the estimates of so called 'general models'[1] with estimates of so called 'local models'. In both types dependent variable was value of discount and independent variables were amount of order, dummy variable with value 1 for sell outs and 0 for normal sale and block of dummy variables for describing contractor characteristics. Difference between global and local models was that global model was estimated for all available data and local models were estimated only for particular section[2]. Specification of global and local models were as follows[3]:

$$discount_i = \alpha_0 + \alpha_1 items_i + \eta_i, \tag{1}$$

$$upust_i = \alpha_0 + \alpha_1 items_i + A \cdot Seg + \eta_i, \tag{2}$$

where *Seg* means block of dummy variables with value 1 for particular contractor section and *A* is a vector of parameters.

[1] Theory of global and local models and their aggregation can be found i.e. in [Bołt, Krauze, Kulawczuk 1985].

[2] Example of use general and local models in demand analysis can be found i.e. in [Rieskamp, Busemeyer, Mellers 2006].

[3] Similar specification, but without distinction for general and local models, can be found i.e. in [Berkovec 1985].

If discount depends only on the amount of order and transaction type (regular or sell out), then in models (1) and (2) only parameters α_0 and α_1 should be statistical significant and all parameters in vector *A* should be insignificant. Significance of block *Seg* may also be check by *F* test for difference in error term variance between model (2) and (1).

Local models, estimated only for transactions in particular contractor section, had the following specification:

$$discount_{i,j} = \alpha_0 + \alpha_1 items_{i,j} + \eta_i, \tag{3}$$

where *j* indicates contractor section (*owner*, *contractor*, *point*, *channel*, *segment*).

If all contractors are treated in the same way and the only cause of discount is amount of order, estimates of parameter α_1 in models (1) and (3) should be stable and dummy variables from matrix *Seg* should be insignificant.

The question is: what if estimates of general and local models would be different? There are two cases:

1. If general specification (1) estimated for particular contractor section differs from the same specification estimated for full sample, it means that in this particular section contractors are treated in different way than others (producer has different policy for this section).
2. If general model (2) differs from model (1), it means that given discount depends on many contractor characteristics simultaneously.

4. Empirical results

Because number of all possible combinations of contractor sections was large and then number of all possible local models was large, in the paper local models only for section 'point of sales' are presented. All models were estimated in Gretl. Tables 3 and 4 present estimates of global models (1) and (2).

Table 3. Estimates of general model (1)[4]

	Coefficient	Standard error	*p* value	
const	0.0313888	0.000100928	<0.00001	***
items	0.000588016	8.35817e-05	<0.00001	***

Source: own research.

[4] Number of asterisks has the following meaning: one asterisks means significance at level $\alpha = 0.1$, two asterisks mean significance at level $\alpha = 0.05$, and three asterisks mean significance at level $\alpha = 0.01$.

Table 4. Estimates of general model (2)

	Coefficient	Standard error	*p* value	
const	0.0248392	0.000450155	<0.00001	***
items	0.00173104	6.12343e-05	<0.00001	***
DSegment_2	0.00740278	0.00121047	<0.00001	***
DSegment_3	0.0197171	0.000983088	<0.00001	***
DSegment_4	0.0154233	0.000487858	<0.00001	***
DSegment_5	0.00668646	0.00119957	<0.00001	***
DSegment_6	0.0207457	0.000521237	<0.00001	***
DSegment_7	0.0176597	0.000453689	<0.00001	***
DSegment_8	0.00540347	0.00105745	<0.00001	***
DSegment_9	0.00647725	0.00100814	<0.00001	***
DSegment_10	0.0223526	0.000503417	<0.00001	***
DSegment_11	0.00513542	0.0010874	<0.00001	***
DSegment_12	0.0205783	0.000720397	<0.00001	***
DSegment_13	0.0210169	0.00049984	<0.00001	***
DSegment_14	0.00663665	0.000967094	<0.00001	***
DSegment_15	0.0178801	0.000813267	<0.00001	***
DSegment_16	0.0207935	0.000883682	<0.00001	***
DSegment_17	0.0212827	0.000549794	<0.00001	***
DSegment_18	0.00488936	0.00108223	<0.00001	***
DSegment_19	0.0090471	0.000999219	<0.00001	***
DSegment_20	0.00670876	0.00133879	<0.00001	***
DSegment_21	0.0208401	0.000634462	<0.00001	***
DSegment_22	0.00267015	0.00113099	0.01824	**
DSegment_23	0.00549297	0.00128275	0.00002	***
DSegment_24	0.0048827	0.00125151	0.00010	***
DChannel_nr_2	−0.00270599	0.00100655	0.00718	***
DChannel_nr_3	−0.0245921	0.001017	<0.00001	***
DChannel_nr_4	−0.0199012	0.00106003	<0.00001	***
DPoint_nr_2	−0.00969999	0.000175469	<0.00001	***
DPoint_nr_3	−0.0110983	0.000175516	<0.00001	***
DPoint_nr_4	−0.0106969	0.000209223	<0.00001	***

Source: own research.

Results for model (1) show the significance of amount of order, so this is what we rather expected. Adjusted *R*-square had value $R^2 = 0.001241$ and standard error had value $S_e = 0.018261$.

Results for model (2) show significance of all variables, including dummies from matrix *Seg* describing contractor characteristics. Adjusted *R*-square had value $R^2 = 0.501320$ and was higher than in model (1). On the other hand, standard error had value $S_e = 0.012904$ and was lower than in model (1). Furthermore *F* statistics in test for omitted variables for null hypothesis that all parameters in vector *A* are 0, had value $F(29.38992) = 1350.33$ and was considerably higher than critical value $F_\alpha = 1.71$ (for $\alpha = 0.01$). Concluding, results of above estimates show that given discounts depend not only on amount of order, but also on some contractor characteristics.

In the next step 4 local models (specification (3)) were estimated for transactions in section 'point of sales' (4 cases in this section). Tables 5-8 present results of these estimations.

Table 5. Estimates of local model (3) for section point_nr = 1

	Coefficient	Standard error	*p* value	
const	0.037884	0.000153059	<0.00001	***
items	0.000155081	0.000107183	0.14795	

Source: own research.

Table 6. Estimates of local model (3) for section point_nr = 2

	Coefficient	Standard error	*p* value	
const	0.0278511	0.000202666	<0.00001	***
items	−5.59649e-05	0.000172859	0.74613	

Source: own research.

Table 7. Estimates of local model (3) for section point_nr = 3

	Coefficient	Standard error	*p* value	
const	0.0262965	0.000211624	<0.00001	***
items	0.000892047	0.000259794	0.00060	***

Source: own research.

Table 8. Estimates of local model (3) for section point_nr = 4

	Coefficient	Standard error	*p* value	
const	0.0273831	0.000248849	<0.00001	***
items	0.00106762	0.000229657	<0.00001	***

Source: own research.

Results of analysis presented in Tables 5-8 show that in two cases variable *items* (amount of order) was insignificant (Tables 5 and 6). This means that in these two points of sales discounts do not depend on the amount of order. In two other cases of section 'point of sales' (Tables 7 and8) variable *items* was significant. It should be noticed then that coefficients got in sections 3 and 4 (0.000892047 and 0.00106762 respectively) are higher than coefficient (0.000588016) in global model (1), which means that in these two points of sales amount of order has more influence on given discount, on average, than in other two points of sales.

5. Conclusions

Presented in this paper analysis clearly showed that amount of order not always is the only one and crucial reason of given discount and, depending on the number of contractor characteristics, given discount can differ. This conclusion can be divided into the following three detailed conclusions:

1. Amount of order in the most cases has influence on given discount, which was confirmed by estimates of model (1).
2. Estimates of local model (3) show that producer of beer differs given discounts for contractors according to point of sales (contractors can order beer only in one, particular place, pointed out by producer).
3. General model (2) shows that producer differentiatess contractors according to more thaen just one characteristics, which means that brewery has not clear discount policy and give discounts according to not widely known policy.

Presented in this paper analysis has a preliminary character and needs development and extensions to show which particular section combinations have the most influence on given discounts. Nevertheless this preliminary stage, presented in this paper analysis, shows that econometric models are useful for producer discount policy analysis.

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EKONOMETRYCZNA ANALIZA POLITYKI RABATÓW CENOWYCH

Streszczenie: w artykule zaprezentowana zostanie ekonometryczna analiza polityki rabatowej stosowanej wobec swoich kontrahentów przez pewnego producenta piwa w Polsce. Zakres analizy opiera się na danych dotyczących rodzaju produktu, wielkości udzielonego rabatu, kanału dystrybucji, regionu, segmentu rynku, zamówionej ilości itp. Zostanie podjęta próba określenia polityki rabatowej stosowanej wobec poszczególnych kontrahentów.