BEER CONSUMPTION IN THE CZECH REPUBLIC AND ITS DETERMINANTS*

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The study identifies the main beer consumption determinants in the Czech Republic and quantifies their influence on the beer consumption. The analysis covers three areas – identification of the main determinants of Czech beer consumption, quantification of the influence of these factors on beer consumption, and examination of beer consumption forecasting possibilities. Time series of selected variables containing annual data of the 1994–2014 period are analysed. The main determinants are defined in accord with the general economic theory, their influence is measured using an econometric model, and quality of the model for prognostic purposes is verified using an ex-post prognosis. Based on empirical analysis, the price of lager beer, income, and influence of financial crisis were determined as the main determinants of Czech beer consumption. In addition, inelastic reaction of beer consumption on their changes was proven. The estimated model may be considered suitable for prognostic purposes. The Czech beer market and/or beer consumption in the examined period can be considered as specific, but stable.

OLSM method, market relationships, brewering industry, time series, forecast, price, model

INTRODUCTION

World beer market is relatively undiversified. From the economic theory viewpoint it can be characterized as oligopolistic with still concentrating tendencies (B o n , 2014). It is also influenced by globalization tendencies. In line with B e c v a r o v a , Z d r a h a l (2015) we may state that 'the impact of globalization processes in agribusiness with their positive and negative implications has been significantly gaining grounds also in Europe'.

World beer production had increased since the 1990's until 2008. After a decline in 2009, beer production grew again, especially in Asia, South America and Africa, a fall was recorded in Europe. In 2014, the global beer production amounted to 1983.3 million hectoliters. According to statistical data the Czech Republic occupies the 22nd position in the world (K i r i n H o l d i n g s , 2014).

Czech brewing industry belongs to one of the most important and also the most popular industries of the Czech economy. Its position even improved when the former Czechoslovakia split into two independent republics, because the consumption of beer in the Slovak Republic is much lower (about 58%) than in the Czech Republic (N a g y o v a , 2000; Z u f a n , 2002). So future beer consumption and its prediction is an important factor for the Czech economy.

Beer belongs among the most favourite beverages all over the word. It applies especially to inhabitants of

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the Czech Republic. Czech people prefer Czech draught beer, the most common is probably lager beer. On the other hand, quite commonly the lager consumption is altered with some kind of beer specialty. The Czech Republic, along with Germany and Austria, belongs to the three greatest beer consumers worldwide (almost 145, 113, and 108 l per capita per year, respectively).

Currently, the most important driving forces in the Czech brewing industry are the following: long-term industry growth rate, marketing innovation, and cost efficiency (Z u f a n, 2002).

The demand for beer in the Czech Republic has been satisfied by the production of many world-famous Czech breweries as well as micro-breweries. Pilsner Urquell, Staropramen, Heineken, Budějovický Budvar, Lobkowicz, Holba, Bernard, Nymburk and Samson belong to the largest beer producers on the Czech market, while one may visit and taste beer also in about 350 Czech micro-breweries (sometimes it is quite complicated to distinguish between brewery and micro-brewery and to categorize them – see e.g. M a i e r , F a b i a n o v a , 2011).

The economic theory predicts that an individual consumer's demand for beer is a function of the price of beer, the prices of substitutes and complements, the consumer's income, the product's characteristics, and the consumer's level of consumption capital (T r e m b l a y , T r e m b l a y , 2005). Important substitutes for beer include other alcoholic beverages, such as wine and distilled spirits, and soft drinks (C o l e n , S w i n n e n , 2010).

Modelling of agri-food chains is quite common. In some cases the relationships are straightforward, while in others the relationships are very complicated and difficult to model. The beer market in the Czech Republic might be considered as very specific. The basic assumptions about the consumers' behaviour probably do not hold water. Thus, quantification of the relationships among the main determinants in this market may be difficult and their explanation very complicated.

The Czech brewery is also in the focus of researchers. While e.g. S y r o v a t k a et al. (2015) deal with the evaluation of wine and beer consumption elasticity in reaction to prices fluctuation, others (e.g. C h m e l i k o v a , 2011) discuss the area of performance measurement systems for small and medium enterprises. S p a c i l , T e i c h m a n n o v a (2016) pay attention to the intergenerational analysis of consumer behaviour across two European markets (Czech, British).

The aim of the study is to determine and quantify the main factors influencing consumption of beer in the Czech Republic. The examination is based on the general economic assumption of consumption and its main determinants. This assumption is analysed and tested for the selected market. Simultaneously, the possibilities and difficulties of Czech beer market modelling are discussed.

MATERIAL AND METHODS

The research hypothesis is defined as follows: The beer market in the Czech Republic runs in compliance with the general theory just with some specifics. Thus, the main determinants can be defined, the relationships at the market modelled and succesfully forecasted.

The objective of the study was fulfilled in the following steps: (1) identification of the main determinants of beer consumption in the Czech Republic based on general economic theory; (2) quantification and discussion of the influence of the main determinants using the econometric model; (3) verification of the quality of estimated models for prognostic purposes using ex-post prognosis.

The analysis of beer consumption in the Czech Republic is based on the assumption of general market relationships. The main factors of beer consumption are selected according to the general economic theory, where consumption (C) is influenced by price of the commodity (P) and income (In): $C = f(P, In)$, and demand is determined by supply, thus, consumption (C) is influenced by production (Pr): $C = f(Pr)$.

Then, general relations were modified into specific for the Czech beer market and appropriate models specified and estimated in power form. Parameters of the models were estimated using Ordinary Least Squares Method (OLSM) and quality of the estimated models was verified using appropriate tests for autocorrelation of residuals, heteroscedasticity, normal distribution of error term, etc. Explanation of the econometric model specification and its verification is provided e.g. in G u j a r a t i (1988), S e d d i g h i et al. (2000), D o u g h e r t y (2002) or G u j a r a t i (2011).

The individual time series of individual factors were examined, too. Descriptive statistics as mean, minimal and maximal value, mode, median, standard error and coefficient of variation were calculated. Long-term development of individual factors was analysed using the trend functions. The trend function was estimated in the general form $y = f(UV, TV)$, where y stands for examined variable, UV for a unit vector, and TV for a time vector. The appropriate form of trend function was selected according to the values of adjusted coefficient (or index) of determination . Introduction into the time series analysis is provided e.g. by R a w l i n g s et al. (2001), K o o p (2005), L i n d et al. (2005) or H o f f m a n n , B r a d l e y (2007).

Quality of the estimated models for prognostic purposes was tested based on ex-post prognosis and it was proven using Mean Average Percentage Error (MAPE) according to the following formula:

$$MAPE = \frac{1}{n} \sum_{t=1}^{n} \left| \frac{y - \hat{y}}{y} \right| \times 100$$

The examination of beer consumption is based on the time series of selected variables. The time series contain annual data of the 1994–2014 period. The

Table 1. Descriptive statistics of analysed time series

Statistics	Consumption	Production	Price_lager	Price_draught	Income
Mean	152.74	18.67	16.26	8.36	16.99
Min	139.47	17.18	11.70	5.85	6.33
Max	160.50	19.90	20.78	10.84	25.58
Mode	153.90	–	–	–	–
Median	154.30	18.60	16.01	8.48	17.29
Standard error	6.14	0.82	2.50	1.40	6.06
Variation coefficient (%)	4.02	4.37	15.39	16.76	35.68

source: own calculations, 2016

Table 2. Consumption of beer – estimate

	Coefficient	Standard error	t-Ratio	P-value
Const	5.74654	0.143036	40.18	2.72e-018***
l_Price _draught	−0.658588	0.146751	−4.488	0.0003***
l_Income	0.248891	0.0649377	3.833	0.0013***
DV	−0.0556539	0.0150049	−3.709	0.0017***

Const = constant DV = dummy variable

source: own calculations, 2016

data set was provided by the Czech Statistical Office (w w w . c z s o . c z) and the Czech Union of Breweries and Malt-houses. (www.ceske-pivo.cz). All calculations were done using software Gretl.

RESULTS

The general relations were modified into specific for the Czech beer market and appropriate models specified and estimated in power form.

According to the methodology, the analysis was performed in the following three steps. Firstly, the main determinants of Czech beer consumption were defined, then the influence of these determinants on the beer consumption was estimated, quantified and discussed and, finally, quality of estimated models was tested for prognostic purposes.

Determinants of beer consumption

The beer consumption is examined based on the assumption about the main consumption determinants generally as it was defined in the Material and methods part. Prices and income are commonly assumed to be the main determinants of consumption. In the case of the Czech beer market price of lager beer (CZK/500 milliliter), price of draught beer (CZK/500 milliliter), income (thousand CZK) and beer production (million hl per year) were selected as the most important economic factors influencing domestic consumption (in litres(l)

per capita per year). Descriptive statistics of all analysed factors are shown in Table 1. Especially the variation of the time series might be crucial for beer consumption modelling and forecasting.

Table 1 shows the range, mean values and variation of individual time series of variables assumed to be the main determinants of beer consumption in the Czech Republic (beer production, price of lager beer, price of draught beer, and income). It is obvious that the variation in the time series of income is much bigger that the variation in the other examined time series. The value of variation coefficient (35.68%) indicates a steep increase of income in the analysed period. On the other hand, consumption and production of beer in the Czech Republic might be considered stable in the examined period (coefficient of variation reaches the level of approximately 4%). The time series of beer prices are characterized by a certain level of variation; coefficient of variation equals approximately 16% in both cases. One may also assume a significant change in the time series of lager beer and draught beer between years 2009 and 2010 due to an increase in excise duty that resulted in a price increase in the beginning of 2010 (M a i e r, 2012). However, the assumption on a significant price increase was not proven in the examined time series.

Modelling of beer consumption

As mentioned above, prices of beer and income were selected as the most probable determinants of

Table 3. Price of lager beer – trend function

	Coefficient	Standard error	t-Ratio	P-value
Const	11.7733	0.190291	61.87	2.23e-023***
Time	−0.407792	0.0151548	−26.91	1.37e-016***

Const = constant

source: own calculations, 2016

Table 4. Price of draught beer – trend function

	Coefficient	Standard error	t-Ratio	P-value
Const	5.85505	0.121429	48.22	2.47e-021 ***
Time	0.227506	0.00967056	23.53	1.63e-015 ***

Const = constant

source: own calculations, 2016

beer consumption in the Czech Republic. Besides these factors, beer consumption may be affected also by a financial crisis as beer cannot be considered a necessary good and so its consumption should be affected by the crisis. Therefore, the influence of financial crisis will be incorporated into the following model as one of the factors influencing beer consumption in the Czech Republic.

The employed research procedure consists from specification of the econometric model in power form based on the economic theory. To quantify the influence of selected factors on beer consumption, several models were specified. Table 2 shows the model describing beer consumption significantly affected by its main determinants.

The final form of estimated model contains the price of draught beer, income, and dummy variable (DV) describing the impact of financial crisis on the beer consumption. Other factors were not proven significant, thus, they are not included in the model. It is obvious that the beer market is specific, just price of draught beer and income seem to be relevant to consumers. Moreover, economic crisis significantly influenced consumers' behaviour. On the other hand, the assumed influence of beer production on consumption was not proven. According to the estimated model it is evident that the beer consumption modelling is feasible. Since the Czech beer market might be considered specific, the assumptions of economic theory are more or less valid. Increasing income and decreasing price of draught beer should cause the decrease of beer consumption. Similarly, the presence of financial crisis reduces beer consumption.

Besides, all estimated parameters show inelastic reaction of beer consumption to the change of all explanatory variables. Price of draught beer was proven as the most important factor influencing beer consumption. However, the reaction of beer consumption is still inelastic.

Quality of the estimated model is satisfactory, the requirements for model specification as well as the requirements for the estimate itself. All estimated parameters are statistically significant at the significance level of $\alpha = 0.01$, the model as a whole is statistically significant according to F-test also at $\alpha = 0.01$ (p-value 0.000056). Adjusted coefficient of determination equals 0.67 and the properties of the model are sufficient also from the econometric viewpoint.

Forecasting of beer consumption

As the significant model describing beer consumption was estimated, quality of the model for prognostic purposes can be verified. It can be tested based on the ex-post prognosis for the period 2012–2014. To forecast the beer consumption based on the econometric model, firstly the values of explanatory variables should be calculated. For that purpose trend function might be selected as a suitable tool.

Tables 3 and 4 show parameters of estimated linear trend functions for the price of lager beer and the price of draught beer. Linear trend function was found as a suitable form to describe the long-term tendency of the analysed time series (adjusted coefficient of determination for the price of lager beer equals 0.9744 and for the price of draught beer 0.9668). Thus, the ex-post prognosis for the analysed prices is calculated using these functions.

Table 5 contains real values and values of the ex-post prognosis for the price of lager beer, draught beer and beer consumption for the period 2012–2014. As it is obvious from the values of MAPE, all estimated models, i.e. the trend functions of beer prices and the econometric model of beer consumption, are suitable

Table 5. Ex-post prognosis of beer consumption

Year	Consumption	Prognosis	Price_lager	Prognosis	Price_draught	Prognosis
2012	145.60	142.58	19.66	19.52	10.12	10.18
2013	144.02	147.43	19.98	19.93	10.55	10.41
2014	144.01	146.02	20.78	20.34	10.84	10.63
MAPE (%)		1.95		1.03		1.29

MAPE = Mean Average Percentage Error

source: own calculations, 2016

for prognostic purposes (values of MAPE between 1 and 2%). Thus, the derived model can be used for forecasting the beer consumption with a high level of probability.

DISCUSSION

The beer market behaves upon the general economic circumstances with several specifics. Price and income might be considered as the most relevant factors influencing the beer consumption. Moreover, individual preferences, habits of consumers and globalization should be also in point of view of the researchers. Significant influence of income on beer consumption has been proven also by S y r o v á t k a et al. (2015). The income and price elasticity of beer consumption is very low. This conclusion has been proven also by S e l v a n a t h a n, S e l v a n a t h a n (1993), M a i e r (2012) or S y r o v á t k a et al. (2015).

The estimated model has proven non-linear relationships among the selected variables as it was concluded also by C o l e n, S w i n e n (2016). According to C o l e n, S w i n n e n (2016) the relationship between income and beer consumption has an inverse U-shape. It means that beer consumption initially increases with rising incomes; but at higher levels of income beer consumption falls. Contrary M a i e r (2012) recommends a linear relationship in examination of the beer market in the Czech Republic.

For the consumption of beer individual preferences plays an important role. As M a i e r (2009) or M a i e r (2012) mentioned, the brand selection for the consumers is crucial. Also the role of microbreweries is important in the Czech Republic. Similarly, P e t t i g r e w (2002) has proven the importance of image management on the beer market in Australia.

C o l e n, S w i n n e n (2016) also emphasized the influences of globalization on world beer market. They concluded that increased globalization has contributed to a convergence in alcohol consumption patterns across countries all arround the world. In originally beer drinking countries the share of beer in total alcohol consumption reduced, while this is not the case in countries which traditionally drank mostly wine or spirits.

Last but not least many studies focused on beer consumption have emphasized the relationship between alcohol consumption and heart disease or risk of cancer, see e.g. P o t t e r et al. (1982), K a b a t et al. (1986), G r o n b a e k et al. (1995), R o m e o et al. (2007). The examination of this relationship is also important these days; it may provide strong recommendations for the consumers.

CONCLUSION

The aim of the study was to define the main determinants of beer consumption in the Czech Republic and to quantify and explain their influence. The aim was fulfilled based on the economic theory and econometric modelling. The analysis was processed based on the time series of selected factors of annual data for the period 1994–2014.

Firstly, the main determinants of beer consumption were identified. Then, an appropriate form of econometric model was selected. In this step several models were specified, estimated and verified. Finally, quality of the estimated model for prognostic purposes was examined.

The analysis has shown that the price of draft beer and income might be considered the main determinants of beer consumption in the Czech Republic. Moreover, the influence of financial crisis has been proven. The influence of other assumed factors, e.g. beer production or price of lager beer, was not found significant at the examined market.

As the Czech beer market is a specific one, inelastic reaction of consumption to changes in its determinants is appropriate. The Czech beer consumers might be regarded as a consistent specific group with own needs and customs. Reflecting this fact, the Czech beer market might be considered specific, but stable. Even though one may assume problems with modelling the specific Czech beer market, the possibility of beer consumption modelling and forecasting in the Czech Republic does exist.

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