

Sources of Microbrewery Competitiveness in the Czech Republic

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Abstract

This article aims to determine the reasons for the number of microbreweries increasing in the Czech Republic. The analysis compares various (micro)brewing industry indicators in selected traditional beer-drinking countries. The research questions are focused on relations among number of microbreweries and demographic aspects, market concentration aspects and some other beer market indicators. Furthermore, there were made simulation – for which conditions will be in the Czech Republic 400, 500 and 1 000 microbreweries. Statistically significant dependency on the number of microbreweries are beer market concentration (Gini index), the percentage of the total population made up of the 25 – 39 years age group, and the share of domestic beer consumption in cans. Since the beginning of Economic crisis the number of Czech microbreweries has been increasing exponentially and the results suggest that the microbrewery boom will have been continuing.

Keywords

Microbrewery, craft brewery, demography, market concentration, Plato, beer.

Maier, T. (2016) "Sources of Microbrewery Competitiveness in the Czech Republic", *AGRIS on-line Papers in Economics and Informatics*, Vol. 8, No. 4, pp. 97 - 110. ISSN 1804-1930. DOI 10.7160/aol.2016.080409.

Introduction

The production of fermented drinks made from cereals began soon after cereal cultivation. The beer hopping process is much younger. The cultivation of hop began around A.D. 859 (Behre, 1998). Thanks to the low amount of alcohol, the beer (or rather fermented drink made from cereals) became a social drink. Beer consumption has a powerful cultural role in many societies (Carroll, Swaminathan, 2000; Kirkby, 2003; McAllister, 2003, 2006), and in the Czech Republic especially it is a very important social phenomenon and very often pubs in small villages are the sole centre of social life. In the Czech lands, a different technique is historically used for beer production. The decoction technique is much better suited for the Czech type of beer as during its production a number of agents are produced which positively affect the sensory value of the beer (Kryl et al., 2012). The first commercial breweries emerged at the turn of the 12th and 13th century (Strizencova, 2014). The microbreweries segment is historically a phenomenon of a postindustrial era. Before this era, all breweries had many technological limits and they had very limited opportunities to grow.

The Czech brewing industry has a number of peculiarities when compared to other well

developed beer-producing countries. The first difference compared to the other main beer-producing countries is a remarkably high level of (main) product homogeneity. In 1994, 97.2 % of beer produced was pilsner and 2.8 % was dark lager (CBAMA) in Czech breweries. Porter (1980) has identified three generic strategies available to firms: low cost, differentiation, and focus. Because of the homogenous market, there were perfect condition for using second strategy for differentiation in the Czech Republic that in the first half of 90's. Moreover, there was no production of any top fermented beer. Porter (in frame of "focus") means that the firm should develop the ability to serve a particular target customer group very well (often at the expense of other potential customer groups) and this is strategy, which the microbreweries use mainly for younger consumers (demographic aspects). The only strategy which is not usable for microbreweries is the low cost strategy. Consider the American beer brewing industry - its market was virtually stagnant before the microbrewery movement. Specialty brewers tapped new beer business, bringing in new customers for as much as half of their markets (Backus, 1999). The number of breweries fell sharply during the communist era. Maye (2012) came to the conclusion that if a particular town has one

brewery then the inhabitants will not experience much variety. Especially at the beginning of communist era, many smaller breweries were closed and during the whole communist era the market was managed by the state on the basis of regionalism.

The Czech beer market has been changing very slowly, with dark beer making up 2.62 % of total production and top fermented beer making up 0.23% of total production within industrial breweries (CBAMA) in the Czech Republic in 2015. The USA saw a very similar situation in the past. In 1970s there were no specialty brewers. In 2003, specialty brewers commanded a 3.3% share of domestic beer production and a 2.9% share of total U.S. consumption (Tremblay, 2005).

As such, the Czech beer market is generally characterized by a high level of product homogeneity, but on for microbreweries the situation is different with the products of microbreweries characterized by considerably high product heterogeneity¹. It is very difficult to quantify the market share of microbreweries, because in the Czech Republic it is not obligatory for the breweries to publish beer production volumes. But if we take a microbrewery to mean a brewery with annual production of less than 10 000 hl, then according to the Customs Office (responsible for excise tax collection) we can deduce that the market share of microbreweries on domestic consumption was approximately 1.7 % in 2015. In 1994, 16 microbreweries were operating, and as such the market share of microbreweries was unimportant. Figure 1 shows the Czech microbreweries market share over 10 years (2006 – 2015). In 2009, the microbrewery market

¹ The product heterogeneity means that the production units (microbreweries) produce various kinds of beers (like ale, stout porter, weizen etc.) instead of one kind (like lager).

share has started to accelerate. The average chain index value for the above mentioned period is 113.9 %, which means it is very progressive sector, especially since domestic consumption of beer decreased over the 2006 – 2015 period. The index 2015/2006 is 790 %, so it means that in 2015 was the market share of microbreweries by 690 % higher than in 2006.

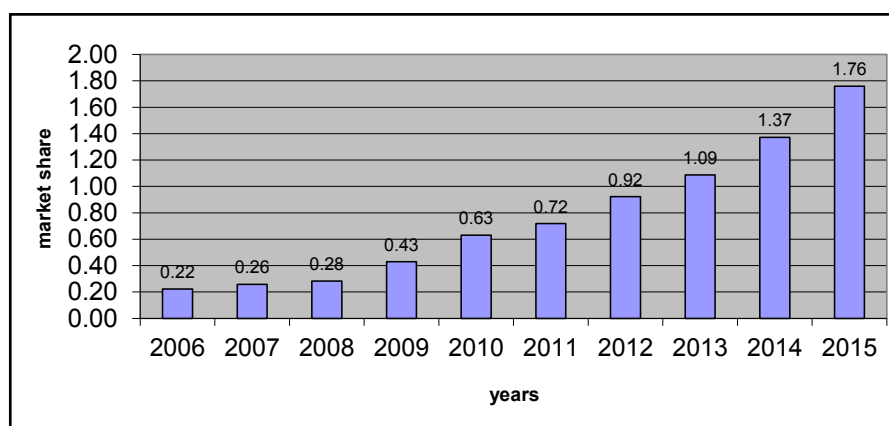
It is possible to make a comparison on the basis of the number of microbreweries per 1 mil. inhabitants indicator between various (selected) states. The results are given in Table 1. In 2014, the Czech Republic was in second position, with Switzerland in first position. In the Czech case, however, we can see a high acceleration in this indicator in the 2011 – 2014 period. All the values in the Table 1 are rather indicative however, because there are various definitions and various conditions pertinent to each of above mentioned states.

	2011	2012	2013	2014
USA	6.2	7.5	9.0	11.2
Czech Republic	11.4	13.6	18.2	22.0
Austria	11.4	10.8	12.8	12.8
Germany	8.1	8.2	6.9	8.4
United Kingdom	13.9	19.4	22.3	21.9
Switzerland	38.2	40.1	44.3	53.7
Spain	1.5	2.5	4.4	6.8
Italy	5.5	6.7	8.1	9.6
Ireland	-	3.2	5.0	6.9

Sources: Brewers Association, World Bank, Swiss Customs Administration and Brewers of Europe

Table 1: Number of microbreweries per 1 mil. inhabitants in selected states.

In the United States the term “craft brewery” is more frequently used, while the term “microbrewery” is more frequently used in the EU. In the United



Source: Customs Administration of the Czech Republic

Figure 1: Czech microbreweries market share development in 2006 – 2015 (%).

States, according to US Brewers Association, the category “craft brewery” consists of four groups:

1. Microbrewery: A brewery that produces less than 15,000 barrels (17,600 hectoliters) of beer per year with 75 percent or more of its beer sold off-site.
2. Brewpub: A restaurant-brewery that sells 25 percent or more of its beer on site. The beer is brewed primarily for sale in the restaurant and bar.
3. Contract Brewing Company: A business that hires another brewery to produce its beer. It can also be a brewery that hires another brewery to produce additional beer.
4. Regional Craft Brewery: An independent regional brewery with a majority of volume in “traditional” or “innovative” beer(s). (Brewers Association)

Wells (2016) noted in regard to this problem that the conflation of brewpubs and microbreweries reflects some ambiguities in the data and the definitions of these activities. Brewpubs are businesses that brew and sell their beer on the premises; microbreweries on the other hand are small-scale brewers (and scale here is open to some debate) that may sell on the premises but may also distribute their product to other retailers, sometimes over long distances. Both categories are sometimes also known as craft brewers or artisanal brewers. Bower & Cox (2012) and Sandberg (2010) add one aspect that is of interest is that beer can be made at almost any scale, from the household level through to huge multinational combines running vast centralised production complexes.

The fuzziest definition is that of “regional craft brewery”; this category can also cover big breweries like the Boston Beer Company. According to its Annual Report, this company produced 6 677 466 hl in the 2015 fiscal year, which represents one third of total annual beer production in the Czech Republic. In 1980s, the Boston Beer Company entered the sector like any typical small microbrewery, and boosted by the large US market it has grown very strongly. But for the category “craft brewery”, the number of regional craft breweries is not so important; in the USA a total of 4225 craft breweries were operating in 2015, including 178 regional craft breweries (Brewers Association), representing 4.2 % of the total.

In the EU, the regional craft breweries typical for the US are almost non-existent, there being two

reasons for this situation. In EU states, beer never changed into such an homogenous product as it did in the USA in the second half of 20th century. The second reason is that the national markets in EU are much smaller, such that regional craft breweries do not have such good conditions for growing, being more limited.

The most intensive microbrewery state in the whole world is Switzerland; according to Swiss Customs Administration, in 2014 there were 53.7 microbreweries operating per million inhabitants. This is more than 2.4 times the figure in the Czech Republic, which is in second position. According data from the Swiss Federal Customs Administration FCA, in Switzerland in 2014 there were 483 breweries and one year later there were 623 breweries. It can be supposed that these 140 new breweries over the course of 2015 are mainly (or only) microbreweries. The reasons for this situation can be historical, as Switzerland is a traditional beer-drinking country, and also that the purchasing power of Swiss consumers is one of the highest in the world. Meanwhile, Switzerland does not have a progressive excise tax system for beer. In Switzerland, compared to the Czech Republic, there are only three excise tax brackets which depend on ° Plato, while in the Czech Republic the amount of tax depends on each additional ° Plato. Let's give an example. A brewery with annual production of less than 10,000 hl pays excise tax of 8 EUR for 12 – 12.99° Plato in the Czech Republic, while in Switzerland it would pay 26.3 EUR. Both these values are calculated per 1 hl of beer. The excise taxes are additional costs for brewers, so it represents a restriction for them. On the other hand, taxes on alcohol contribute to the state's exchequer (Castiglione et al., 2011). Ellis, V. and Bosworth, G. (2015) indicate that the number of microbreweries in the UK has more than doubled since the start of the millennium. Compared to the United Kingdom, there has been more expansion in the Czech Republic.

The Czech excise beer tax is shown in Table 2. The progressive beer excise tax system was established in 1995 and was inspired by the German tax system. This system helps smaller producers to stay or to enter the market. In 1995, only approximately 20 microbreweries were operating in the Czech Republic, and as such the lobby comprised mainly smaller industrial breweries.

Another particular of the Czech beer market is that it is almost closed to imports. Czech consumers are very conservative and they do not usually prefer foreign brands. The figure 2 shows the share

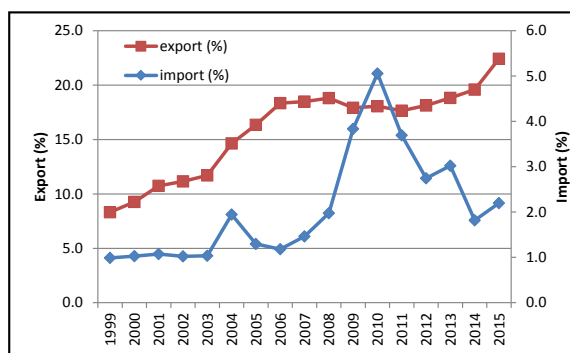
Year	Basic rate (EUR)	Reduced rate (EUR) for annual production up to				
		10,000	50,000	100,000	150,000	200,000
2009	0.907	0.453	0.544	0.635	0.725	0.816
2010 and further years	1.209	0.605	0.725	0.846	0.967	1.088

Note: Exchange rate of 31/12/2009

Source: Act No. 353/2003 of the Legal Code

Table 2: Beer excise tax rates in the Czech Republic.

of Czech beer import and export based on data from the Czech Statistical Office for the period 1999 – 2015. In the observed period we can see that export grew over almost the whole time, although in the economic crisis period one can detect stagnation or very slight decrease. 2015 shows historically the highest export, with more than 20% of domestic production exported for the first time in the Czech history.



Source: Czech Statistical Office, Customs Administration of the Czech Republic

Figure 2: Share of Czech beer import and export.

Import was very low compared to export, and lower than 2 % of domestic beer consumption until 2008. Then it started to increase, but the main reason here was a sudden change in consumer habits, with consumers starting to demand beer in plastic bottles, a technology which in 2009 was only used in one small Czech brewery, Nová Paka. As such, the large brewery companies imported beer in plastic bottles. Later, the breweries built their own technology for plastic bottles such that in 2014 import was once again less than 2 % of domestic consumption.

If we compare these indicators with the other selected EU countries (Table 3), we can see that all other states have higher values of import, the lowest being in Austria (6.9 %) and the highest in Ireland (49.8 %), but this value is decreasing.

A Relatively large change in terms of export is indicated in Slovakia from 2010 compared to the previous year. The export value went from 0.5 % to 8.7 %. The reason for this is

the abovementioned plastic bottles. In 2010, Heineken International (3rd position on the Czech beer market, leader in Slovakia) started with heavy exports of beer in plastic bottles from Slovakia to the Czech Republic, because in Slovakia this company had plastic beer bottle technology.

Another strong specific indicator compared to other well developed beer-drinking states is the Czech Republic's highest consumption per capita in the whole world. Within the Czechoslovak federation (before 1993) the Czech Republic reached the top global position in 1970, but in the past Czechoslovakia had a lower consumption than Western Germany. This has changed with the independence of the Czech Republic. But beer consumption volume is not mainly determined in accordance with particular states, but rather by habits within particular regions. The region with the highest beer consumption per capita is Bavaria excepting its southwest part, Bohemia except Prague and the western part of Austria. It can be supposed that in this region the per capita beer consumption may be around 170 liters. The per capita beer consumption for selected states is shown in Table 4.

In the Table 4 it is possible to detect the strong influence of the economic crisis on the Czech beer sector. Year-on-year (2010/2009) the per capita consumption decreased by 10 %, while in all the other states the affect of beer crisis was not so strong. Generally, we can make the statement that in all traditional beer-drinking states, per capita beer consumption has been decreasing.

From the above discussed, we can deduce that the microbrewery boom in the Czech Republic is a society-wide phenomenon, and thus we need to find the reasons behind this boom and in particular to find the sources of Czech microbrewery competitiveness. The aims of the paper are:

1. To quantify the number of all microbreweries over the period 1991 - 2015. Because there are no official statistics in the Czech Republic for this indicator

	2009	2010	2011	2012	2013	2014
Germany import	7.3	8.5	8.8	8.4	7.3	7.7
Germany export	14.3	15.8	16.7	16.6	16.0	16.2
Belgium import	10.3	11.0	12.8	14.1	12.7	13.7
Belgium export	56.8	58.5	59.7	62.3	61.1	61.6
Austria import	6.9	6.9	7.4	7.5	6.9	7.4
Austria export	7.7	8.0	8.0	7.9	9.1	9.9
Slovakia import	22.4	25.3	25.7	26.7	29.9	31.2
Slovakia export	0.5	8.7	4.3	5.3	10.1	6.5
United Kingdom import	16.5	17.6	18.7	20.5	20.7	19.5
United Kingdom export	10.5	10.2	9.9	13.9	15.6	12.7
Ireland import				34.3	29.2	29.8
Ireland Export				42.9	49.8	38.5

Sources: Brewers of Europe

Table 3: Share of import and export for selected EU countries.

State/Year	2009	2010	2011	2012	2013	2014
Czech Republic	159	143	142	147	144	144
Germany	110	107	107	108	107	107
Austria	107	106	108	108	106	104
Ireland	91	90	86	86	79	81
Belgium	81	78	78	74	72	72
United Kingdom	71	69	67	67	66	68
USA	-	78	77	78	76	76

Source: Statista, Inc., Brewers of Europe

Table 4: Per capita beer consumption (l).

and this variable is required to undertake the research further (aim), it is necessary first of all to quantify (or estimate) these values.

2. To determine main external reasons for microbrewery foundation.

In particular, the paper addresses following research questions:

- i. Is there any statistically significant relationship between number of microbreweries and selected demographical aspects? It can be supposed that the total population value can influence the number of microbreweries; and furthermore certain selected age bracket may also influence it. Microbreweries usually focus their production on (non-conservative) consumers, and thus this aspect may be a very important source of Czech microbrewery competitiveness.
- ii. Is there any statistical relationship between number of microbreweries and annual per capita consumption of beer? A negative dependency can be supposed; this is typical for Belgium. Belgium is typical beer country,

but the per capita consumption is half comparing to the Czech Republic (Table 4), because typical beer for Belgium – Belgian abbey – is high-strength beer. Microbreweries usually brew special and high-strength beers, meaning that consumers drink smaller volumes of beer. Beer produced by microbreweries usually has higher added value and the Czech Republic has been the state with highest beer consumption per capita for many years.

- iii. Is there any statistically significant relationship between number of microbreweries and beer market concentration? It can be supposed that the beer market operates in two ways; there is ever increasing market concentration in industrial breweries segment and this usually brings homogenization of the market, while on the other hand microbreweries bring heterogeneity. It can be supposed that generally high beer market concentration may be another source of Czech microbrewery competitiveness.
- iv. Is there any statistically significant relationship between number of microbreweries and various

beer market indicators (packaging, ° Plato). Increasing demand for stronger beer (higher degrees Plato) can have a positive impact on microbreweries competitiveness. The segment of microbreweries in the Czech Republic is still very tiny if it is measured by amount of produced beer (Figure 1). In last 10 years, the market share of microbreweries has increased 8 times, it can be supposed that the market indicator can be tightly linked with some other beer market indicators – variables. The problem is that there are not available data for the amount of top fermented beer – ale. In the Czech Republic many of microbreweries brew top fermented beer and some of them produce only top fermented beers.

- v. Can models be produced to simulate the market? And using these equations, can one determine the conditions which will result in 400, 500 and 1000 microbreweries? Some Czech beer experts have the opinions, that in the nearby future can be in the Czech Republic 1000 (micro)breweries, similar situation was in the end of 19th century.

Materials and methods

The aims and research questions are addressed using the derived econometric model. The model specification is based on the neoclassical consumer theory and new industrial organization theory. Thus, the model explains the the number of microbreweries based on the three groups of variables, namely: demographic aspects, market concentration aspects and six selected market indicators (see relation (7)).

The variable specification is as follows. Two variables were chosen in regard to the demographic aspects of the first research question:

- Total population in the Czech Republic.
- Population within the age range 25 – 39 years. We can suppose that these consumers are the most important consumers for microbreweries. Young consumers (younger than 25 years) do not normally earn so much and as such they don't usually buy more expensive beer from microbreweries, and old consumers (older than 39) can be more conservative. Microbreweries very often produce less traditional kinds of beer (such as ales etc.), and as such conservative consumers do not normally frequent such institutions.

Four indicators were chosen for market concentration as explanatory variable:

i. Herfindal-Hirshman index (*HHI*).

HHI is defined as the sum of the squared market shares of all the firms in the industry (Tremblay, V. J. et al., 2005). This indicator is very often used by various national and supranational authorities for solving mergers, acquisition etc.

The formula for its calculation is

$$HHI = \sum_1^i y_i^2, \quad (1)$$

where

$$i = 1, 2, \dots, n,$$

y_i states for the market share of i^{th} company (%),

n means number of operators in the sector.

ii. Concentration Coefficient *CC3*

The formula for its calculation is

$$CC3 = \sum_1^j y_j, \quad (2)$$

where

$$j = \langle 3 \rangle$$

y_j states for the market share of j^{th} company (%),

so this indicator describes market share of three biggest companies,

iii. Concentration Coefficient *CC5*

The formula for its calculation is

$$CC5 = \sum_1^k y_k, \quad (3)$$

where

$$k = \langle 5 \rangle$$

y_k states for the market share of k^{th} company (%),

so this indicator describes market share of three biggest companies,

iv. Gini Coefficient *GC*

The Gini Coefficient is calculated on the basis of a Lorenz Curve. This curve describes cumulative percentages of market shares dependency (in ascending order) and cumulative percentages, if every operator has the same market share. The border of ideal equality is an ideal situation where all the operators in the sector have the same market share. As such, the Gini coefficient is the surface between the border of ideal equity and the Lorenz Curve. If we have the general form

of the Lorenz Curve

$$y_l = a^{bx}. \quad (4)$$

So the surface between the Lorenz Curve and axis y in the interval (0 %; 100 %) is

$$B = \int_0^{100} ae^{bx} = \frac{a}{b}(e^{100b} - 1). \quad (5)$$

And finally the formula for Gini Coefficient is

$$GC = \frac{5000 + 100a - \frac{a}{b}(e^{100b} - 1)}{5000}. \quad (6)$$

Data in the form of time series is used for the modelling, with the data in annual sequences (1995 – 2015), meaning a total of 21 observations, see Table 5.

Thus the model is in this general form

$$y = f(x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{10}, x_{11}, x_{12}, x_{13}, x_{14}, x_{15}), \quad (7)$$

And the declaration of variables is

y number of operating microbreweries

x_2 population of 25 – 39 years age range (mil. inhabitants)

x_3 total population (mil. inhabitants)

x_4 beer consumption per capita (l/year)

x_5 HHI

x_6 CC3 (%)

x_7 CC5 (%)

x_8 GI

x_9 x_2/x_3

x_{10} proportion of domestic beer consumption in party barrels (%)

x_{11} proportion of domestic beer consumption in glasses (%)

x_{12} proportion of domestic beer consumption in plastic bottles (%)

x_{13} proportion of domestic beer consumption in cans (%)

x_{14} proportion of domestic beer consumption of beer 11 – 12.99 ° Plato

x_{15} proportion of domestic beer consumption in barrels (KEGs) and tanks (%)

We can suppose with a high level of probability that some variables from the economic model are not

year	y	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}
1995	20	2.07	10.33	157	733	34.58	48.43	0.74	0.20	0.00	52.32	0.00	0.92	30.39	45.89
1996	21	2.06	10.32	157	770	38.16	52.00	0.77	0.20	0.00	53.61	0.00	1.20	30.43	44.16
1997	23	2.06	10.31	161	861	43.19	57.03	0.77	0.20	0.00	50.45	0.00	1.37	31.10	46.75
1998	24	2.07	10.30	161	2374	58.55	68.10	0.69	0.20	0.00	48.98	0.00	1.63	29.98	48.09
1999	27	2.12	10.29	160	2222	58.39	68.32	0.72	0.21	0.00	47.67	0.00	1.79	29.24	50.54
2000	28	2.12	10.29	160	2176	58.03	67.89	0.69	0.21	0.06	45.67	0.00	1.89	29.27	50.32
2001	33	2.25	10.27	157	2428	60.83	70.04	0.69	0.22	0.01	44.90	0.00	1.92	28.06	53.16
2002	38	2.28	10.21	160	2588	62.45	71.24	0.80	0.22	0.02	43.54	0.48	1.94	28.45	54.01
2003	39	2.33	10.20	162	2662	63.49	72.19	0.80	0.23	0.02	43.29	0.27	2.02	28.08	54.39
2004	45	2.37	10.21	161	2616	63.37	71.96	0.80	0.23	0.02	43.72	0.34	2.16	28.14	53.76
2005	49	2.40	10.22	164	2645	63.74	72.36	0.80	0.23	0.03	44.10	0.29	2.26	27.86	53.33
2006	59	2.42	10.25	159	2723	64.72	73.29	0.78	0.24	0.02	44.89	0.05	2.60	29.15	52.44
2007	68	2.44	10.29	159	2760	65.09	73.78	0.76	0.24	0.01	45.87	0.14	2.61	29.82	51.37
2008	74	2.48	10.38	157	2790	72.06	81.15	0.78	0.24	0.03	46.58	0.05	2.78	31.10	50.57
2009	79	2.52	10.47	151	2710	71.48	79.85	0.75	0.24	0.11	53.56	1.31	3.01	32.61	49.39
2010	96	2.53	10.51	144	2420	68.84	77.48	0.79	0.24	0.12	46.00	2.80	3.14	36.76	47.94
2011	120	2.53	10.53	143	2400	70.93	80.71	0.80	0.24	0.12	44.31	5.78	3.63	37.71	46.14
2012	143	2.49	10.51	149	2410	69.86	79.76	0.88	0.24	0.10	41.98	10.25	4.19	38.05	43.48
2013	192	2.46	10.52	147	2450	65.25	74.34	0.89	0.23	0.08	41.91	11.24	3.86	38.86	42.91
2014	232	2.42	10.51	147	2475	67.73	76.98	0.90	0.23	0.08	40.96	12.35	4.41	41.49	42.20
2015	289	2.39	10.55	145	2352	69.84	80.08	0.91	0.23	0.08	40.86	11.99	5.62	43.24	41.45

Sources: Czech Statistical Office, Czech Beer and Malt Association, Customs Administration of the Czech Republic

Table 5: Data set used for the estimation.

statistically significant, including multicollinearity etc. This aspect is discussed and dealt with in the next chapter.

The regression dependency is calculated for linear function and power function and the Gretl SW was used for the estimation.

Results and discussion

The only microbrewery which survived the communist era and was founded before 1991 is Microbrewery U Fleků in Prague. This brewery is historically an old brewing privilege holder. This law was introduced by King Wenceslas II. (1278 – 1305), and their old brewing privilege has never been officially canceled.

Figure 3 shows the evolution of microbreweries in the Czech Republic since 1991. In order to create the graph, various information (mainly from the internet) was used. In the Czech Republic, there is no official database of microbreweries which is managed by any state authority.

The very first microbrewery in the Czech Republic was Meloun (named after founder Milan Meloun), which opened in 1991. It was a family business. Production ceased in 1998, because of the sudden death of Meloun (personal interview with his granddaughter). He was the only one who was involved in beer distribution and nobody else in the family knew the distribution channels. This microbrewery was not a typical microbrewery, because more than half of production was consumed beyond its own restaurant.

The oldest microbrewery which has survived

to the present (except U Fleků) is Pivovarský dvůr Chýně near Prague, which was founded in 1992. In Figure 3, we can see that the number of breweries operating has grown exponentially.

Many of the 15 explanatory variables are redundant, so they should be reduced. The highest pair correlation was detected between the variables x_6 ($CC3$ (%)) and x_7 ($CC5$ (%)). For linear dependency, the correlation is 0.9955, for power function the value is 0.9948. As such we should choose only one variable for describing market concentration. The situation is very similar for the variables which describe the types of packages.

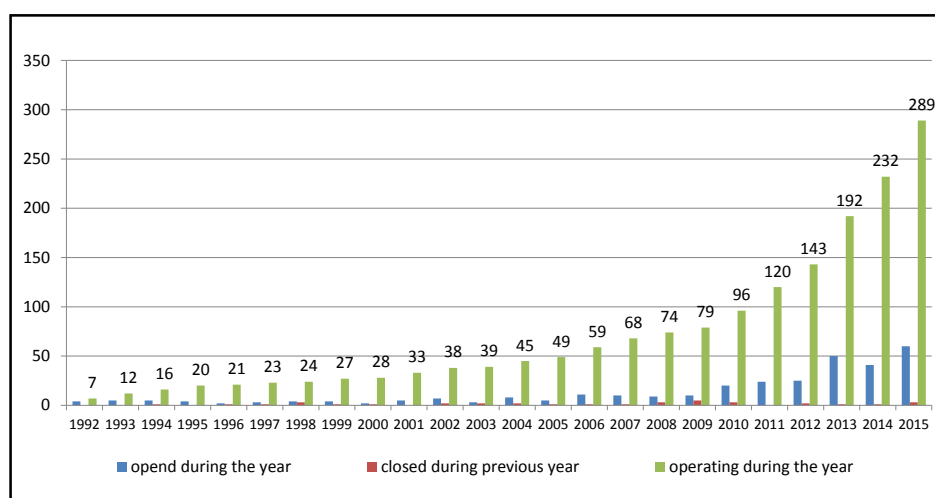
So by the gradual eliminations of (redundant) explanatory variables we estimated the two models. The criteria for elimination is a statistical significance of every particular variable and multicollinearity. Model 1 is a linear model and Model 2 is a model in nonlinear (power) form.

Econometric verification

- We can exclude the problem with autocorrelation for both regressions because the DW-values are in the range $(1.40823^2; 2)$, or more specifically we can say that there is not a statistically significant autorrelation.

- According to the White and Breusch–Pagan tests, heteroscedasticity was not detected for linear regression nor for power regression.
- According to the Jarque-Bera test the residuas have normal distribution.

A very strong relationship between all the chosen phenomena is confirmed. Thus according to both



Source: Own calculations, <http://pivni.info/>, <http://pivovary.info/>, <http://www.pividky.cz/> and <http://www.minipivo.cz/>

Figure 3: Microbrewery evolution in the Czech Republic.

	Coefficient	Std. Error	t-ratio	p-value	
const	-1.217	81.2976	-0.0150	0.98823	
x_8	254.26	84.9976	2.9914	0.00820	***
x_9	-1219.51	280.075	-4.3542	0.00043	***
x_{13}	59.6018	5.25418	11.3437	<0.00001	***
Mean dependent var	80.90476		S.D. dependent var	75.02593	
Sum squared resid	3845.814		S.E. of regression	15.04076	
R-squared	0.965839		Adjusted R-squared	0.959810	
F(3, 17)	160.2126		P-value(F)	1.16e-12	
Log-likelihood	-84.50500		Akaike criterion	177.0100	
Schwarz criterion	181.1881		Hannan-Quinn	177.9168	
rho	-0.054036		Durbin-Watson	1.979351	
p-value White	0.090682		p-value Jargue – Bera	0.01309	

Source: Own calculation in Gretl

Model 1 (linear): OLS, using observations 1995-2015 (T = 21).

	Coefficient	Std. Error	t-ratio	p-value	
const	13.2349	1.92937	6.8597	<0.00001	
x_6	-1.94305	0.286841	-6.7740	<0.00001	***
x_9	2.09279	0.703408	2.9752	0.00849	***
x_{13}	2.21634	0.113257	19.5691	<0.00001	***
Mean dependent var	4.053994		S.D. dependent var	0.817689	
Sum squared resid	0.251542		S.E. of regression	0.121641	
R-squared	0.981189		Adjusted R-squared	0.977870	
F(3, 17)	295.5808		P-value(F)	7.32e-15	
Log-likelihood	16.66129		Akaike criterion	-25.32258	
Schwarz criterion	-21.14449		Hannan-Quinn	-24.41583	
rho	-0.063016		Durbin-Watson	1.982014	
p-value White	0.141034		p-value Jargue – Bera	0.57705	

Source: Own calculation in Gretl

Model 2 (power): OLS, using observations 1995-2015 (T = 21).

models the number of operating companies depends on

- i. Market concentration;
- ii. Proportion of 25 – 39 year olds in the total Czech population;
- iii. Proportion of domestic beer consumption in cans (%).

So the analytical forms of the equations are:

Linear:

$$y = -1.217 + 254.26x_8 - 1219.51x_9 + 59.6018x_{13} + u \quad (8)$$

Power:

$$y = 559556.6205x_6^{-1.94305}x_9^{2.09279}x_{13}^{2.21634} + u \quad (9)$$

In this form, a comparison of both results is not possible, instead one has to count the values of elasticities for the linear equation. The elasticities

for both models are clearly given in Table 6.

	Linear dependency		Power dependency	
	variable	elasticity	variable	elasticity
Market concentration	x_8	2.47	x_6	-1.94
Population rate	x_9	-3.38	x_9	2.09
Consumption in cans	x_{13}	1.93	x_{13}	2.22

Source: Own calculation

Table 6: Values of elasticities for linear and power dependency.

The results show that all the values of elasticities (in absolute value) are considerably high. The primary assumptions are valid for both equations only for the variable x_{13} , i.e. the rate of beer consumed in cans. A particularly surprising result is that the market concentration indicator (x_6) has negative elasticity for the power function, and an economic interpretation of this is that

if the market concentration (indicator $CC3$) increases by 1 %, then the number of microbreweries decreases by 1.94 %. The reason for this value may be the decrease in market concentration since 2008. In this year, the three most powerful companies controlled 72.06 % of the Czech beer market, while two years later this figure was only 68 % and the number of microbreweries had increased by 30 %. But we should highlight that two different variables were used for the market concentration indicator; GC was used for linear dependency, and $CC3$ was used for power dependency (according to the statistical characteristics and verification of both models).

The condition for the primary assumption about demography was met only for a power function, where the influence is positive. For a linear function, the condition is negative. The demography indicator is the proportion of 25 – 39 years old in the total Czech population. The influence is ambiguous; while the number of microbreweries increased in the whole period (1995 – 2015), the value of the demographic indicator increased in the period 1995 – 2010, but decreased from 2011. The maximum rate was in 2011 at 24.1 %.

The only assumption which is in agreement with the results is beer consumption in cans (x_{13}). The elasticities are pretty similar for both equations, for a linear function it is 1.93 % and for a power function it is 2.22 %.

We can do a simulation for both regressions. The endogenous variable (number of microbreweries) does not influence exogenous variables. The microbreweries do not produce beer in cans, the microbreweries cannot influence the population rate and because they had in the year 2015 total market share 1.7 % (289 companies), so they cannot influence the beer market concentration. The results are given in the Table 7.

The simulations were calculated for 400, 500 and 1000 microbreweries, ceteris paribus. Some results are not in line with assumptions according to the previous analysis. The problem may be that

the microbrewery sector in the Czech Republic is very young and the microbrewery boom (wave) is very strong, such that it is very difficult to do any simulation in these conditions.

The simulation results for market concentration for linear dependency do not make any sense, as the market concentration (GC) can't be higher than 1. The population rate (for 1 000 microbreweries) does not make any sense either, because it is a negative number.

The only acceptable results of the simulation are population rate for the power function, and share of beer consumed in cans for both functions.

Conclusion

Development of the Czech microbrewery sector is very similar to that in western states, except with a 10 – 15 years delay because of the communist regime. While the first microbrewery in USA was opened in 1976, in the Czech Republic (specifically in Czechoslovakia) the first microbrewery was opened in 1991. To understand the microbrewery boom in the Czech Republic one must go back to the situation after the Second World War, specifically the situation in 1948, when the communists carried out their coup d'état. The number of Czech breweries at the time was very similar to that in neighbouring Bavaria. Both beer markets were heterogeneous (there was no homogenous beer product) and both markets were fragmented, with very low market concentration. But subsequent to 1948, a forced concentration process was started, mainly involving small industrial breweries with annual production of less than 10 000 hl, which were closed by the communists. Product homogenization processes also took place. Development in Bavaria from 1948 was completely different; product homogeneity was kept at a similar level and the HH index is still very low. The HH index is no more than 800 points for the whole of Germany (Adams, 2006). This is also very important for the successful microbrewery boom in the Czech Republic. Over

indicator	linear				power			
	variable	no. of microbreweries (y)			variable	no. of microbreweries (y)		
		400	500	1000		400	500	1000
Market concentration	x_8	1.35	1.74	3.71	x_6	60.18	53.65	37.55
Population rate	x_9	0.14	0.05	-0.36	x_9	0.26	0.29	0.40
Consumption in cans	x_{13}	7.48	9.16	17.55	x_{13}	6.40	7.08	9.68

Source: Own calculation of the basis of equations

Table 7: Results of the simulations.

the period 1991 – 2015, the Czech Republic started slowly but surely to return to the previous situation and tradition which had been interrupted in the 1948 – 1989 period.

The answers to the all five research questions are mostly difficult and mostly ambiguous. The statistical significance between beer market concentration and number of microbreweries was strongly proven. But the direction of influence is very ambiguous; on the basis of both above mentioned models it is not possible to make unequivocal results. The reason for this may be that with the economic crisis (2008/2009) the fall in the market share of the Czech beer market's leading company was of greatest importance. The market share of this company decreased from 49 % to 43 %. A fairly similar process was characteristic of almost all major Czech brewing companies. While before 2008 the number of microbreweries had increased fairly slowly, since 2009 the number of microbreweries has been growing exponentially. Danson et al. (2015) came to the conclusion in the UK context that, while there are particular challenges to starting a microbrewery, barriers to entry are lower than for many other sectors. In terms of the food and beverage industry, different conditions can be seen for example in sugar beet processing. New processors have no chance of penetrating the EU market (Rezbová et al., 2014). We can suppose that conditions in the Czech Republic may be similar to those for microbreweries like in UK. The microbrewery boom in the 21st century in the Czech Republic is more a question of the demand side than the supply side. Technical efficiency in the food processing industry did not change significantly within the period from 2000 to 2007 (Čechura, 2009).

Similarly controversial is the influence of demographic aspects – the proportion of the population 25 – 39 years of age. It can be supposed that this generation have enough money for more expensive beer from microbreweries compared to younger consumers, and on the other hand this generation is not as conservative as older generations. In the above mentioned part of this text we state that in general Czech beer consumers are very conservative. For a linear dependency the influence is negative, while for power function it is positive. Similarly to the case of market share concentration, there is a critical point in this case too. The proportion of above mentioned generation in the whole population grew until 2010, but since 2011 the proportion of this generation has been decreasing. We can make the statement that

before reaching this demographical peak (a similar period to the growth of beer market concentration) this variable had influenced the number of microbreweries in an unequivocally positive manner. Since reaching this peak, the microbrewery boom has become a society-wide phenomenon.

The influence of per capita beer consumption for both models is not statistically significant. As in the case of the above mentioned variables, per capita beer consumption until 2008 was extremely stable. In the period 1995 – 2008 the differences between annual values and mean value (159.55) was no higher than 2.5 % (this was the value in 2005). With the economic crisis, a beer consumption decrease was identified. The average value for the period 2009 -2015 is 8.2 % lower than the period 1995 – 2008.

There is not more statistical data on the production volume of various kinds of beer, because the beer microbreweries very often focus on is not mainstream beer. It would be very interesting to analyze the relationship between the microbrewery boom and the production of non-filtrated beer, ales etc. According to the available data, there is no relation between beer original gravity and number of microbreweries; for describing beer original gravity, the proportion of 11 – 12.99 ° Plato beer compared to total production was used. The only statistically significant variable which influenced the number of microbreweries is the share of beer sold in metal cans. This is related to market change, with consumers visiting ordinary pubs and restaurants less, and considering more deeply the decision about which restaurant (or brewpub) to visit, and they buy more beer in cans. The same development was seen in the US market.

Furthermore, it is indisputable that a very significant source of the Czech microbrewery boom and competitiveness is the economic crisis and the limited ability of industrial breweries to respond to consumer demand adequately and in time. Negative aspects can also be seen, however. Operations which offer only in-house brewed beers and ales can fall victim to the same market trap of limited variety of offerings that has troubled the large brewers (Murray and O'Neill 2012).

Acknowledgements

The findings presented in this paper have arisen from research enabled by the grant of the Internal Grant Agency provided

by the Faculty of Economics and Management,
Czech University of Life Sciences in Prague
– no. 20151049.

This article is dedicated to Milan Meloun (1951
- 1998), who founded the first microbrewery
in the Czech Republic after the communist era.

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