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Price Transmission for Beer Sector in Covid Era: Case of Czechia

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Abstract: The paper examines (in covid era) the extent to which the beer market has been affected and also the consequences it has in the phase of the strictest measures due to the Covid-19 in the years 2019-2020. The analysis examines the difference between the development of consumer beer prices and the trend development and qualifies this difference. Due to differences in the cost of production of beer with lower and higher degrees of Plato, so for each type (light beer, lager) the analysis is performed separately. Based on at least 132 price observations (monthly data 2010-2020, or 2021) obtained from the Czech Statistical Office, trend functions are compiled, as well as forecasts for the years that were most affected by the Covid-19. Furthermore, after a suitable adjustment of the data for ADL-modeling in SW Gretl for lager and light beer, the expected (theoretical) and actual price differences are compared and evaluated. The results show that the Covid-19 pandemic did have a negative impact on the market and a certain hypothesis was confirmed that this impact was smaller for light beers, where there is a presumption of higher competition in the market and relatively higher price influence by retail chains.

Keywords: beer; Covid-19 impact; consumer price; producer price, price transmission

JEL Classification: C01; C22; L66

1. Introduction

It was very difficult in the Czech Republic to look for any branch of the agri-food sector that brought the Czechia such a higher opinion than in the case of brewing. The most widespread style of beer in the world is essentially connected with the Czech Republic, which is Czech lager, sometimes called pils or pilsner, which was so successful that especially in the second half of the 19th century in most countries it pushed older beer styles to the margins of the market. And it was this Czech lager that was born in 1842 in Pilsen, when Bavarian brewer Josef Groll used the Bavarian advanced bottom fermentation technology, but using purely Czech raw materials (Basařová et al., 2011).

At the beginning of the new millennium, not only the Czech brewing industry had to face two significant structural shocks. The first was the financial crisis, which erupted at the turn of 2008/2009. However, this event was not significantly unprecedented in human history. The brewing sector is coping with economic crises in its own way.

However, the Covid pandemic is a completely new phenomenon, precisely because it is global; all previous epidemics were only local, such as the Spanish flu epidemic.

Wardell et al. (2020) examined several hypothesized coping motive path-ways to alcohol use and problems from various factors that were thought to be relevant for drinking to cope early in the pandemic. One of them is that it's closely related with lower social connectedness.

The impact of Covid-19 on natural indicators of the brewing industry was huge, while on others it was marginal or completely insignificant. One of them was the value of exports and imports, respectively, according to organization Brewers of Europe (2021), total EU27 imports in 2020 were 43.005 million hl, which was a year-on-year decrease of only less than 6% and was even higher than in 2017, when it amounted to 41.050 million hl. The situation was similar for exports. In 2020, EU27 exports amounted to 83.639 million hl of beer, the YoY decrease was recorded only at 2.2% and was even higher than in 2018, when it amounted to 83.435 million hl. The explanation is quite simple, the vast majority of the on-trade channel consumes local production for many reasons, and draft or tank beer is exported very limited. Czechia exported 5.317 million hl of beer in 2019, compared to 4.936 in 2020, a decrease of less than 7%. It is interesting that the Czechia recorded a slight increase in exports outside the EU countries, so the decline is clearly only due to beer transported only to other EU countries.

The consumer is a social creature and is therefore very close to consuming alcohol in the company of other people, mostly in restaurants, i.e., in the on-trade distribution channel. And since all Covid-19 measures were primarily intended to prevent or limit people contacts, the amount of beer flowing through this distribution channel was shock-greatly reduced.

As Covid-19 restrictions have directly affected on-trade channel, Table 1 clearly shows, in selected EU countries, movements (in chosen years) in relative beer sales through the on-trade and off-trade channels, i.e. beer that is consumed at the point of sale (restaurants and pubs) and beer that is consumes outside the point of sale. However, the pandemic does not have the same impact on the decline in on-trade, because Vandenberg, Livingston and O'Brien (2021) shows that in countries with no so strong beer traditionals (Australia), after the abolition of the restrictive the level of on-trade beer consumption has significant immediate increase, but no changes on off-trade consumption. Pitts and Witrick (2021) state, that in another country (US) beer sales and production have been down and this drop in sales has been majorly felt by brewers, especially small breweries, by 80% in extreme cases.

In Baltics countries (Estonia, Lithuania, and Latvia), the on-trade consumption of beer is traditionally low, usually below 10%. Descriptive statistics show that the Iberian states have relatively surprisingly high on-trade values, followed by Ireland and the lowest in Estonia. Spanish participants indicated more frequent beer consumption (almost at least once a week) than wine (more than at least once a month). The decrease of drinking with friends and family was greater for them. Interestingly, a new social context for drinking flourished during lockdown: virtual meetings, which were more relevant (Rodrigues et al., 2021). Beer has become popular especially among younger people, mostly drunk in bars, at leisure events. (Osterberg & Karlsson, 2003).

The analysis was performed for a change in the sales channel on-trade due to the economic crisis, this is indicated by the index 2010/2008, then the index 2019/2008 shows us a permanent change in the sales channel on trade and finally the index 2020/2019 shows us the power of the Covid pandemic.

Table 1: On-trade values, in % from total sales, Brewers of Europe

	2008	2009	2010	2019	2020	2010/2008	2019/2008	2020/2019
PT	70	70	69	70	60	99	100	86
ES	69	67	66	68	44	96	99	65
IE	69	71	66	63	30	96	91	48
BE	51	49	48	42	27	94	82	64
CZ	*51*	*50*	*48*	*35*	*26*	*94*	*69*	*74*
FR	24	25	24	35	35	100	146	100
PL	20	15	15	11	8	75	55	73
SK	40	40	40	29	20	100	73	69
AT	34	34	33	27	17	97	79	63
DE	29	27	22	18	18	76	62	100
EE	5	8	9	7	5	180	140	71

In other countries (e.g., the United Kingdom, although not part of the EU) beer purchases have fallen slightly but preferences have changed – confinement was associated with a shift in purchases from lower to higher strength beers (Anderson et al., 2020).

The economic crisis caused the greatest damage to the on-trade distribution channel in the case of Germany, which fell by 24% (over two years in period 2008-2010), and in Poland, where it fell by a quarter in the same period. In the Czech Republic, the impact was not so significant, there was a decline of only 6%, much larger declines were recorded later. On the contrary, somewhat surprisingly, they increased by 80% during the economic crisis in Estonia, but there was an increase of only a few percentage points. In the long run (but not yet influenced by the Covid pandemic), the biggest declines in the on-trade sales channel were recorded in Poland (45%), Germany (38%), and the Czechia, where the decline was 31%. Table 1 shows the impact of the Covid pandemic, which represents the 2020/2019 index. Pandemic Covid-19 didn't move with France and Germany, where there had been a big drop before. Czechia recorded a decline of 26%, which can be considered a slightly better result than in most countries.

The organization Brewers of Europe (2021) explains, that this suggests some of the lost consumption in on-trade shifted to the retail sector. The impact of this can be seen in the change in the split of consumption between markets: whilst on-trade used to account for around one third of the volumes consumed in Europe (against two thirds for off-trade), the situation is starkly different in 2020, with only 22% of the volumes being consumed in the on-trade.

The paper aims to find out if the pandemic Covid-19 has had an impact on beer price transmission in Czechia, where this sector plays an important economic and social role. If it had, the paper aims to quantity this impact.

2. Methodology

The analysis is performed using the data from the Czech Statistical Office (CZSO, 2021). This institution keeps statistics on average consumer and producer beer prices since 1994 on an annual basis and since 2010 on a monthly basis. The data are aggregated; the development of consumer prices is monitored on consumer baskets based on a set of selected types of goods and services paid by the population. After 2021, the methodology changed

(reassessment of the consumer basket) and therefore monthly data on the consumer price of lager are not available.

There is the hypothesis:

H0: The Covid-19 pandemic has a negative effect on beer prices.

H1: The Covid-19 pandemic has no effect on beer prices.

The research uses an ex-post forecast to compare estimated and real prices. Hušek (2009) explains that by comparing the ex post forecast with the actual value of the predicted variable, it is possible to determine the prediction error, which can be used to verify the strength between estimated and real prices. An adjusted time series is needed for the forecast, ie without the seasonal component, because seasonal changes are caused, among other things, by human habits institutionalized in economic activity. Adjustment is performed by additive decomposition.

Dynamic models of economic time series are assumed to be constructed from observed economic variables that meet the requirement of stationarity. Since the augmented Dickey-Fuller test established nonstationarity of both time series, it was transformed to stationary using the first differences. The model works with first-order integrated series. Dickey-Fuller's test statistics are derived from a regression relationship including constant and trend (Cipra, 2008).

In the paper, there is used the ADL model. The ADL (4; 4) model is a multidimensional time series model and is derived from two stationary adjusted time series with 132 (for lager) and 144 (for light beer) observations. Monthly data are in the years 2010-2020, resp. 2010-2021, so those data were user for estimation.

Lag effects can be assessed by deriving a backward shifted variable and including this along with the original version in the model. This would specify the associations between past values of x and current values of y plus current values of x and current values of y, while adjusting for each other (Beard, 2019).

In addition to its error-correction form, ADL models in general may have complex dynamic specifications, including multiple lags, first differences, and lagged first differences (Jordan & Philips, 2018).

Statistical procedures which yield exact finite-sample inference in simple linear models have an indeterminate distribution in more general models, due to the effects of unknown nuisance parameters. In the context of dynamic models, such problems do not occur when the relationship can be modeled according to the normal classical linear model with finite distributed lags (Dufour & Kiviet, 1998).

Two unrelated one-equation models for each type of beer describe a one-way relationship between variables. The model is estimated using the ordinary least squares method. After ADL models estimation, the predicted values are calculated manually in MS Excel.

Both models are econometrically verified, namely the Jarque Bera test for normality of residues testing, the White test for heteroskedasticity testing, and the Breusch-Godfrey test for autocorrelation testing. Based on the p-values of all tests, the models were econometrically verified.

As an endogenous variable (y) in both models is chosen the consumer price of beer, as exogenous (x) – producer prices, also in previous periods. The models also have predetermined variables - consumer prices in previous periods. Prices are in CZK per hl.

In this research, beers are divided into lager (11 – 12.99% extract of original wort) and light beer (7 – 10.99% extract of original wort), according to the regulation of the Ministry of Agriculture. This difference gives rise to different characteristics, buyer preferences, excise duty and production costs.

The program Gretl was used for estimations and for testing of models.

3. Results

The difference between the real and estimated consumer price of beer varies according to the degrees of Plato. The impact of the economic shock caused by Covid-19 is obvious and most affected lager, because it's beer with higher production costs. Figure 1 and Figure 2 show the estimated results by forecast and the real consumer price of beer.

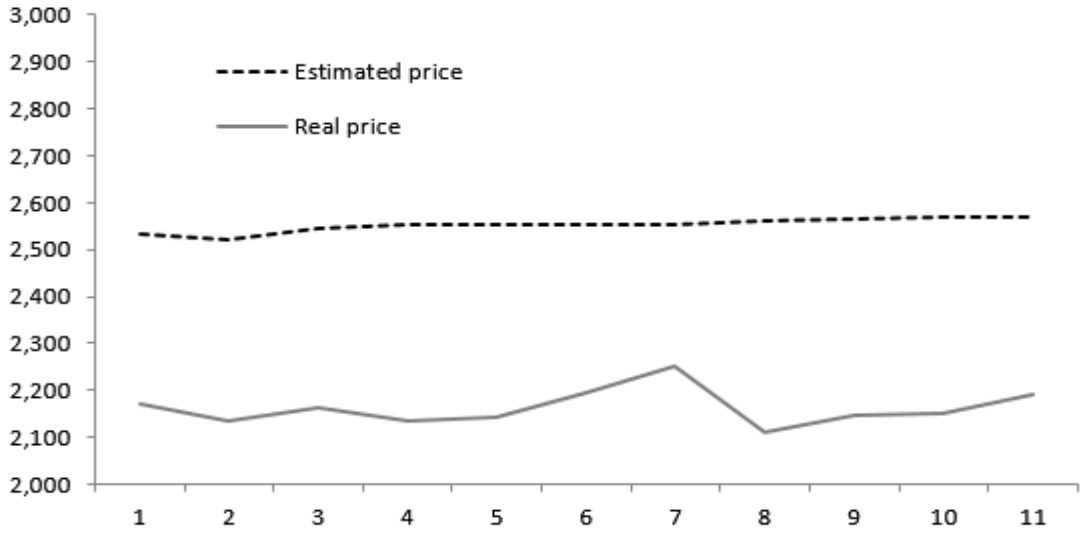

Figure 1. Estimated and real price of the light beer. CZK per hl. Jan 2021 – Nov 2021 (CZSO, 2021).

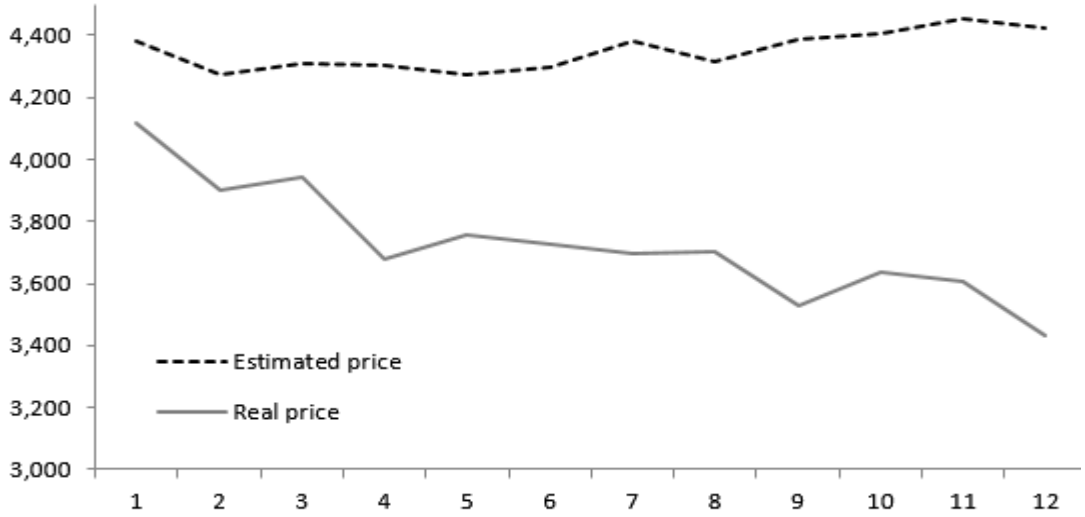

Figure 2. Estimated and real price of the lager. CZK per hl. Jan 2020 – Dec 2020 (CZSO, 2021).

It is clear that the real price for both types of beer is lower than expected, but the biggest difference is in case of lager. While the price of light beer does not fluctuate, it is underestimated but stagnant, the price of lager shows a markedly declining trend, the opposite direction of price development than it should (according to expectations). Table 2 shows the absolute difference between lager prices in 2020. For light beer the table is not in the paper, because the difference between estimated and real price it is not so important and considerable, we focus on lager.

Table 2. Estimated and real price of lager and its difference, CZK per hl

	Estimated price (CZK/hl)	Real price (CZK/hl)	Absolute difference
Jan 2020	4,379	4,116	-263
Feb 2020	4,275	3,900	-375
Mar 2020	4,312	3,944	-368
Apr 2020	4,303	3,680	-623
May 2020	4,275	3,758	-517
Jun 2020	4,300	3,726	-574
Jul 2020	4,384	3,696	-688
Aug 2020	4,318	3,704	-614
Sept 2020	4,386	3,526	-860
Oct 2020	4,407	3,634	-773
Nov 2020	4,456	3,608	-848
Dec 2020	4,425	3,434	*-991*

The key figure is for December, when the largest absolute difference is observed, namely 991 CZK per hl less than forecast, i.e., 22.4%. The real value of light beer is 17% lower than expected.

From the figures it can be deduced that the price of lager is more sensitive to shocks than the price of light beer. This is also due to the fact that light beers are cheaper for production and at the final (consumer) price. The consumer prefers to buy it due to its lower degrees of Plato and for everyday consumption. In the case of lager, on the contrary, it is consumed more on-trade, and so at the time of the pandemic, for many breweries, due to the excise tax, it was cheaper to throw the beer out, than to sell it, even at a discount.

Although beer prices have been seasonally adjusted, the seasonal price increase (July) for the light beer can still be seen in Figure 1. However, in the following months, the price returns to its original state. Lager does not show this seasonality.

Two unrelated equations for the ADL model (4; 4) for the forecast of beer prices are compiled in the form:

for light beer:

$$y_t = 6.33 - 0.57y_{t-1} - 0.36y_{t-2} + 0.31y_{t-3} - 0.2y_{t-4} - 0.14x_{t-1} + 0.2x_{t-2} - 0.18x_{t-3} + 0.02x_{t-4} + u_t \quad (1)$$

for lager:

$$y_t = 6.33 - 0.57y_{t-1} - 0.36y_{t-2} + 0.31y_{t-3} - 0.2y_{t-4} - 0.14x_{t-1} + 0.2x_{t-2} - 0.18x_{t-3} + 0.02x_{t-4} + u_t \quad (2)$$

where the consumer price of beer is explained by its development in previous periods (y) and the development of the producer price (i.e. breweries) in previous periods (x). Since the

original time series did not show stationarity, the model applies to the first differences of the variables. The model only examines the relations between the producer price and the consumer price.

Although the BIC recommendation was the best for ADL (6; 6), ADL (4; 4) showed better significant relations and better statistical significance of the variables. The same procedure applies to lager price modeling.

Table 3 shows only the individual statistically significant variables for the light beer price forecasting model:

Table 3. Statistical values of chosen variables. The model for the light beer

Variable	p-value	Alfa
CP-1	<0.001	0.01
CP-2	0.001	0.01
CP-3	0.004	0.01
CP-4	0.039	0.05

The coefficient of determination is 0.27. The model is econometrically verified.

The economic assumption is that the consumer price is affected by the producer price. However, the results of the analysis show that the consumer price of light beer is not affected by the price of producers at all, but is dependent on its development in previous periods. In practice, this means that there is a different pricing and price transmission mechanism for light beer. The interlink plays a major role in determining the prices of these beers - retail chains that have bargaining power and market position, so they can use final margins, for example, to set final beer prices. This displaces the breweries from determining the final price of the light beer.

This is not the case with lager (see Table 4), because it has higher production costs and is more expensive in itself, and the average consumer in Czechia is not repelled by a higher price when buying it, because he is aware of the worth of lager. Therefore, the producer has more scope in determining the final price, respectively, retail chains do not interfere so much.

Table 4. Statistical values of chosen variables. The model for the lager

Variable	p-value	Alfa
PP-3	<0.001	0.01
CP-1	<0.001	0.01
CP-2	<0.001	0.01
CP-3	0.03	0.05
CP-4	<0.001	0.01

The coefficient of determination is 0.33. The model is econometrically verified.

The analysis performed for the series of lags 4, 5 and 6 showed that the final price of lager is always dependent on the development of the consumer price in previous periods, but also on the production price before 3, respectively, 4 periods. After adding the dummy variable to indicate the Covid years, the level of statistical significance of the variables improved, but

no other significant variables were added, so it follows that the consumer price of lager is affected more by its development over time but also by the producer price in the previous periods, inertia is present.

It follows from the analysis that for both types of beer, the impact of the Covid-19 pandemic on the beer market and beer prices is negative, especially for Czech lager.

4. Discussion and Conclusion

The main goal of this paper was to find out whether the Covid-19 pandemic affected beer prices in the Czech Republic and, if so, to quantify this effect. Using a forecast based on ADL models, the estimated beer prices were determined and compared with the actual ones. The significant difference was explained not only from an economic point of view, but also from a social point of view. The analysis included 132, resp. 144 observations. These were time series with a monthly periodicity from 2010 to 2020, or 2021. The only limitation was the incomplete length of the lager time series, which was associated with the fact that lager was no longer included in the consumer basket in 2021. However, this did not significantly disrupt the analysis.

In the paper it proved that the pandemic did hit the beer market in the Czech Republic and a more significant impact was observed for Czech lager – traditional Czech beer. Lager here means the classification of beer according to its degrees of Plato, not according to the method of fermentation. It can be supposed that there was not influence of the inflation on the consumer price, because the prices of inputs had not increased in the significant period and the competition among the retail chains is too significant. There is a correlation between the impact on beer prices, especially lager, and the decline in on-trade sales, which is explained not only by the economic relations between these phenomena but also by the social aspect both in distant cultures (McAllister, 2003; Kirkby, 2003) and in the Czech Republic, where beer traditions are strong. It was the reduction in contact between people and the associated lockdown that led to the disappearance of the social context of beer consumption. Fleissig (2021) states that beer has the most inelastic demands, which confirms that beer is the most popular type of spirit.

The case of the Czech Republic can be compared with the case of the USA (Pitts & Witrick, 2021), where the decline in sales and prices was felt for the beer sector. In contrast, the situation is quite different from other EU countries; for example, in Spain, where beer consumption increased during a pandemic, despite the fact that the Iberian states consider themselves like wine countries (Rodrigues et al., 2021). Among other things, beer consumption per capita in the Czech Republic has decreased over the last two years, from 141 l / person per year to 135 l / person (Brewers of Europe, 2021).

In conclusion, however, it must be stated that the current partial or comprehensive analyzes of Covid's impact on the brewing industry in the Czech Republic are not yet effective in general, it is a completely new phenomenon, which also has not only its economic aspect, but perhaps even more cultural or social. Consumers are not much affected by the price of beer, but by its qualitative properties, as well as the environment of consumption - Czech consumers prefer the presence of a social element, which greatly reduced the Covid-19

pandemic. (Svatošová et al., 2021). The fact is that the pandemic certainly had a negative effect on the development of beer prices. Another problem is the complete heterogeneity of consumer channels in individual countries (not only the EU), which is due not only to different consumer preferences, but perhaps most of all the share of the ot-trade and of-trade channels. It is difficult to compare countries as diverse as Ireland and Estonia.

One of the directions of further research may be the search for the most important factors influencing the decline in beer consumption in the Czech Republic, apart from the pandemic, because the decline in on-trade consumption began before it.

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