Czech University of Life Sciences in Prague

Faculty of Economics and Management

Department of Statistics

BACHELOR THESIS

Statistical analysis of beer consumption

Julius Fördöš

Supervisor: Ing. Tomáš Hlavsa, Ph.D.

Study programme: Economics and Management

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Department of Statistics

Faculty of Economics and Management

BACHELOR THESIS ASSIGNMENT

Fördöš Julius

Economics and Management

Thesis title

Statistical analysis of beer consumption

Objectives of thesis

Bachelor thesis deals with assessment of beer consumption. The main goal is to find out and assess possible factors which affect consumer behaviour and final consumption.

Methodology

The assessment of factors influencing consumer behaviour and final consumption will be carried out by questionnaire survey and analysis of hard data . The dataset based on survey will by analysed using categorical data analysis. Hard data will be assessed by regression analysis.

Schedule for processing

Formulation of thesis aims and of the thesis structure: 01/2013 – 03/2013
Preparation of materials for research: 04/2013 – 07/2013
Theoretical part and methodology: 08/2013 – 11/2013
Data collection: 10/2013 – 11/2013
Statistical data analysis: 12/2013 – 01/2014
Conclusions, corrections, graphical elaboration, final revision: 02/2014 – 03/2014

The proposed extent of the thesis

30 - 40 pages

Keywords

Consumption, preference, survey, beer, statistical analysis, hypothesis

Recommended information sources

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The Bachelor Thesis Supervisor

Hlavsa Tomáš, Ing., Ph.D.

Last date for the submission

March 2014

Kába

doc. RNDr. Bohumil Kába, CSc.
Head of the Department

prof. Ing. Jan Hron, DrSc., dr. h. c.
Dean

Prague November 5. 2013

I would like to thank my supervisor, Ing. Tomáš Hlavsa, Ph.D., for his guidance and patience during the writing of this thesis. Also I would like to thank my whole family for supporting my studies.

I hereby declare that I wrote this thesis myself using the referenced sources only. I also agree with lending and publishing of this thesis.

Prague, March 5, 2014 Julius Fördöš

Název práce: Statistická analýza konzumace piva
Autor: Julius Fördöš
Katedra: Katedra statistiky
Vedoucí bakalářské práce: Ing. Tomáš Hlavsa, Ph.D.
E-mail vedoucího: hlavsa@pef.czu.cz

Abstrakt:

Průměrná spotřeba piva na osobu v České republice je nejvyšší na světě (následují Německo a Rakousko) a to je zajímavý fakt, který je hodný analýzy. Česká republika není číslo jedna v celkové konzumaci piva z důvodu své malé rozlohy a nízkého počtu obyvatel. Fakta, týkající se spotřeby piva, jsou důležitá pro podniky jak v České republice, tak i pro zahraniční dovozce, které ji zásobují různými druhy piva jako třeba známé značky Plzeň, Gambrinus, Kozel, Staropramen, atd. Taková informace může být brána v potaz při rozhodování o zásobování pivem Českou republiku. Na druhou stranu, pokud je zásoba piva dostatečná, zbytek produkce může být exportován do zahraničí. Analýza konzumace piva v minulosti a současnosti je důležitá a prognóza konzumace piva by mohla být použita při rozhodování o potřebném množství piva v České republice.

Bakalářská práce pojednává o konzumaci piva v České republice. Hlavním cílem práce je najít a vyhodnotit možné faktory ovlivňující spotřebitele ohledně konzumace piva v České republice. Vyhodnocení faktorů je provedeno za pomocí modelu, který pomáhá určit, zdali proměnné, které byly pečlivě vybrány, ovlivňují závislou neznámou v rovnici modelu. Následně je vypracována prognóza budoucího růstu nebo propadu spotřeby piva na osobu v České republice a ostatních proměnných.

Výsledky ukazují, že dva statisticky významné faktory (průměrný český příjem a počet obyvatel v České republice) ovlivňují celkovou spotřebu piva v České republice. Prognóza spotřeby piva má podle výpočtu klesat.

Klíčová slova: konzumace, preference, výzkum, pivo, statistická analýza, hypotéza

Title: Statistical analysis of beer consumption
Author: Julius Fördöš
Department: Department of Statistics
Supervisor: Ing. Tomáš Hlavsa, Ph.D.
E-mail of supervisor: hlavsa@pef.czu.cz

Abstract:

The average consumption of beer per capita in the Czech Republic is the highest in the world (following Germany and Austria) and that is an interesting fact worth of analysing. The Czech Republic is not the number one total consumer of beer due to its size and population. Nevertheless, the fact of the average consumption of beer per capita is important information for businesses within the borders but also outside of the borders of the Czech Republic which supply the Czech Republic with different kinds of beer, e.g. Pilsner, Gambrinus, Kozel, Staropramen, etc. Such information could be taken into account when deciding supply of beer needed in the Czech Republic. On the other hand, if supply is sufficient the rest of total production of beer can be exported abroad. Analysis of the past and present consumption of beer is therefore important fact and prognosis of beer consumption could be used in decision making about the volume of beer needed to produce.

Bachelor thesis deals with the assessment of beer consumption in the Czech Republic. The main goal is to find out and to assess possible factors which affect consumer behaviour and final consumption of beer in the Czech Republic. The assessment is made by estimation model which helps to prove whether explanatory variables, which were carefully selected, influence dependent variable or not. Also prognoses of the future increase or decrease of the average consumption of beer per capita in the Czech Republic and prognoses of explanatory variables is elaborated.

The results show that two statistically significant factors (the average income of Czech citizens and the number of people older than 15 years in the Czech Republic) influence the total beer consumption per capita in the Czech Republic. Prognosis of the total beer consumption is predicted to decrease.

Keywords: consumption, preferences, survey, beer, statistical analysis, hypothesis

Content

Introduction

The topic of this bachelor thesis was chosen because the average consumption of beer per capita in the Czech Republic is the highest in the world (following Germany and Austria) and that is an interesting fact worth of analysing. The Czech Republic is not the number one total consumer of beer due to its size and population. Nevertheless, the fact of the average consumption of beer per capita is important information for businesses within the borders but also outside of the borders of the Czech Republic which supply the Czech Republic with different kinds of beer, e.g. Pilsner, Gambrinus, Kozel, Staropramen, etc. Such information could be taken into account when deciding supply of beer needed in the Czech Republic. On the other hand, if supply is sufficient the rest of total production of beer can be exported abroad. Analysis of the past and present consumption of beer is therefore important fact and prognosis of beer consumption could be used in decision making about the volume of beer needed to produce.

Objectives

Bachelor thesis deals with the assessment of beer consumption in the Czech Republic. The main goal is to find out and to assess possible factors which affect consumer behaviour and final consumption.

Another aim is to prove whether explanatory variables (factors affecting beer consumption), which were carefully selected (the average income of Czech citizens, the average price of beer in the Czech Republic, number of people older than 15 in the Czech Republic and the average consumption of wine per capita in the Czech Republic) influence dependent variable (the average consumption of beer per capita in the Czech Republic) or not. If explanatory variables are proved to be statistically significant, the next goal is to reveal to which extent explanatory variables influence the average consumption of beer per capita in the Czech Republic. Also prognoses of the future increase or decrease of the average consumption of beer per capita in the Czech Republic and prognoses of explanatory variables will be elaborated.

Price elasticity of demand will be calculated and compared to the different studies which have elaborated their own price elasticity of demand for beer before.

It is assumed that two explanatory variables (the average income of Czech citizens and number of people older than 15 years in the Czech Republic) will have positive direction of effect on dependent variable, e.i. as each of those two explanatory variables increases, dependent variable will increase too. On the other hand, if each of those two explanatory variables decreases, dependent variable will decrease too. The other two explanatory variables (the average price of beer in the Czech Republic and the average consumption of wine per capita in the Czech Republic) will have negative direction of effect on dependent variable according to the assumptions.

Methodology

Classical assumptions of model

The classical assumptions must be met in order for OLS estimators to be the best available. There are seven classical assumptions. The regression model is linear, is correctly specified, and has an additive error term. The error term has a zero population mean. All explanatory variables are uncorrelated with the error term. Observations of the error term are uncorrelated with each other (no serial correlation). The error term has a constant variance (no heteroskedasticity). No explanatory variable is a perfect linear function of any other explanatory variable(s) (no perfect multi-collinearity). The error term is normally distributed (this assumption is optional but usually is invoked).

The assessment of factors influencing consumer behaviour and final consumption will be carried out by analysis of hard data. Hard data will be assessed by regression analysis. Price elasticity of demand will be calculated according to formulas and the data collected. The conditions for research are that it is not supposed that tourists come seasonally to the Czech Republic in order to drink alcohol. Therefore this fact is omitted and only the population of the Czech Republic is taken into account.

Price Elasticity of Demand (PEoD)

The price elasticity of demand measures the rate of response of quantity demanded due to a price change. The formula for the price elasticity of demand (PEoD) is:

PEoD = (% change in quantity demanded)/(% change in price) ***[1]***

PEoD = [(new price – old price)/old price]/[(new quantity – old quantity)/old quantity]

Regression analysis

With GRETL estimation of regression model (multiple linear regression model) will be made, which will help to determine the relationship between dependent and explanatory variables (using ordinary least square method (OLS) to estimate parameters). GRETL will help to determine statistical significance of parameters (hypothesis testing: p-value was chosen) and to measure goodness-of-fit.

General model

$$y = \gamma_0 + \gamma_1 x_1 + \gamma_2 x_2 + \ldots + \gamma_n x_n + \varepsilon$$

To obtain data, quantitative data collection method was used in order to test hypothesis, and to look at cause and effect and to make predictions. Data are secondary data and time series data. Each explanatory variable was taken for the whole year. To obtain the most current possible results we took quarterly data from year 2001 to year 2011.

Hypothesis testing: p-value

H_0: $\gamma_i = 0$ parameter is not statistically significant

H_1: $\gamma_i \neq 0$ parameter is statistically significant

H_0 (null hypothesis) is accepted if: p-value > α

H_1 (alternative hypothesis) is accepted when H_0 is rejected: p-value ≤ α

Goodness-of-fit

Coefficient of determination (R^2) shows in percentage how much of variance of dependent variable (y) was explained by the model.

$$R^2 = \frac{SSR}{SST} = 1 - \frac{SSE}{SST}$$

[2]

SST (total sum of squares)

$$SST = \sum_{i=1}^{n} (y_i - \bar{y})^2$$

[3]

SSR (sum of squares due to regression)

$$SSR = \sum(\hat{y} - \bar{y})^2$$

[4]

SSE (sum of squares due to error)

$$SSE = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2 = \sum_{i=1}^{n} \hat{e}_i^2$$

[5]

MO Excel was used to create tables and graphs (linear graphs, prognosis graph) with data collected, to calculate descriptive statistics of the data (number of observations, mean, median, minimum, maximum, variance, standard deviation and coefficient of variation) and to predict the future values of dependent variable (trend analysis).

Descriptive statistics

Arithmetic mean: statistics measuring central tendency

$$\bar{y} = \frac{\sum_{i=1}^{n} x_i}{n}$$

[6]

Median: middle value in ordered set of values according to their sizes, 50 % values are lower than median, 50 % values are higher than median

$$\tilde{y}$$

[7]

Variance: statistics measuring variability of data set, the average of the squared differences from the mean

$$s_y^2 = \sum_{i=1}^{n}(y - \bar{y})^2$$

[8]

Standard deviation (square root of the variance): statistics measuring variability of data set, it is a measure of how numbers in data set are spread out

$$s_y = \sqrt{s_y^2}$$

[9]

Coefficient of variation: relative measure of variability, describes homogeneity/heterogeneity of the data set in percentage (measures the differences or similarities of the data)

$$CV = \frac{s_y}{\bar{y}}$$

[10]

Maximum: maximum value of the data set

Minimum: minimum value of the data set

Trend analysis

Three graphs of dependent variable will be conducted and then trend will be analysed with linear, quadratic and cubic function. The same process is applied to all explanatory variables. Exponential smoothing will be used if necessary to predict future development of variables (in programme STATISTICA). In case of seasonality in variable, there must be calculated seasonality index as follows.

$$Y = T_t + \varepsilon$$

[11]

Trend function above will be elaborated from the data collected and estimated value (Y) will be obtained from the result of trend function. Division of actual value with weighted value will be seasonality index.

$$s_i = \frac{y_i}{y'_i}$$

[12]

Where s_i is seasonality index, y_i actual value of variable and y'_i is estimated value.

Average seasonality index will be calculated for each quarterly data. Inserting number representing certain period of time into the trend function will result in number which by multiplication with seasonality index will provide estimated value for the point of time in the future.

1 History of Beer

Ethanol, as a type of alcohol naturally found in wild nature, has been used in many ways by many fruit-eaters (frugivorous) for ages. Hornsey (2003) speaks about fruit-eaters and how they have used ethanol as a locator of ripe fruit. When ethanol is present it is a sign that the fruit is ripe which means that it has the highest possible value in calories which is very beneficial for fruit-eaters. Ripening is very complex biochemical process. When fruit is ripe and ready to disperse its seeds it also has its defence mechanisms at the lowest point which means that any micro-organism can take advantage of it. Since on the surface of fruits it is common for yeast to be present there fermentation is naturally next biochemical process that takes place. This fermentation leads to creation of various alcohols (ethanol being the most dominant type) in order to prevent non-dispersing vertebrates from eating that specific fruit.

Since the very beginning people were driven by their instincts. According to Maslow's hierarchy (pyramid) of needs the first things a human being needs are physiological needs as the air to breathe, water to drink, food to eat, sleep etc. Along with new experiments people discovered different tastes due to variety of food combined with water. But even before that nomadic people probably discovered fermented beverage by an accident. According to Hornsey (2003) nomads found most likely rainwater which was combined with stored rotten fruits, grain or stale honey. These coincidences could have led to discovery of beverages with alcohol. People discovered many ways how to intoxicate themselves, e.g. poppy seeds, fungi. Hornsey cites opinion of Rudgeley (1993) which is that in Palaeolithic era people were unoccupied and therefore they had time for experimenting with "magic mushrooms" and a ritual usage could have developed that way. Intoxication was closely linked with the way of living. When people had a lot of free time boredom was inevitable and therefore ways to pleasure themselves were searched for. Cultivation of mood-altering plants was regular practice. Euphoria from mood-alteration created need for more. Change of lifestyle from nomadic to more settle life aimed at farming helped to cultivate raw materials and to supply others. Nevertheless scarcity of raw materials was often and therefore it became prestigious commodity reserved for nobles. Intentional fermentation of fruits and cereal grains is a relatively recent practice. Hornsey cites work of Joffe (1998) who states that the knowledge how to brew helped prehistoric man to settle down from nomadic way of living and to live agricultural life. But

that was not the biggest changed. Joffe (1998) speaks in his work about how brewing wine and beer was fundamental in development of socio-economics in the world and that beer and wine was used in many ways, e.g. the main nutritional source; the reorganisation of production of agriculture; labour mobilisation; a sign of civilised behaviour of nation; expression of allegiance between people; and as an alternative to water which could have been polluted in bigger cities due to increasing population. The origin of intentional fermentation is unclear. Hornsey (2003) speculates about the origin of fermentation. He says that raw material for fermentation, different sources of sugar (wild berries, tree sap, honey, etc.) were available only in different seasons and locations and they were extremely difficult to store in that time for pre-Neolithic peoples. Even water was not easy to obtain. Therefore the sources of raw materials for making alcoholic drinks varied due to location in the world. Hornsey mentions facts from work of Vencl (1991) that in Eastern Europe (more temperate zone) tree sap from birch and maple was used as the main source of sugar for making alcoholic beverages. According to Vencl (1991) some predecessors of beer might have been *braga* (common mostly all over the Europe) which was made by soaking millet in water, heating the mixture and then it was set aside to ferment for twenty-four hours. Another predecessor could have been *kvass*. Also new discoveries were made that helped to form present beer, e.g. if germinated grains were used as a raw material then drinks tasted better and maltose became the main fermentable sugar.

The beginning of civilisation is linked with the start of living agricultural way, growing crops and with settlement of people. From the facts mentioned above it is obvious that there must be also some link between settlement, civilisation and alcoholic beverages. In order to have a steady supply of beer and other alcoholic beverages agriculture was crucial. Once the way of living changed the civilization was just a stone's throw away, and so was brewing. Therefore estimated time of the beginning of intentional brewing is around 8,000 BC. At that time also bread baking started. It is closely linked with brewing because the process of making is similar. "… b*rewing and baking leavened bread are related processes, relying as they do on the ability of a unicellular fungus, the yeast, a member of the genus, Saccharomyces, to convert sugars, such as glucose, fructose and maltose, into ethyl alcohol (ethanol) and carbon dioxide (CO_2), in the absence of oxygen (i. e. under anaerobic conditions); a process referred to as alcoholic fermentation"* (Hornsey, 2003, p. 29). Invention of beer happened most likely in different regions in the

world independently and with different ingredients. Brewing of beer became popular and known around the world through the centuries and it evolved even into science nowadays. Since the ancient times to the present day, beer has been an important part of celebrations, rituals, good fellowship and throughout the time it became also important economic commodity that is very important even in recent days.

2 History of Economics of Beer

Women were always the ones who took care of the process of making beer. It was considered a domestic task and not suitable for men. In the Early Middle Ages the centres of brewing were established in monasteries and therefore there was a shift in the economy of beer. Brewing became more popular and more of the science. Men took over the control of the process of brewing as they were considered more suitable for such a task (Rabin and Forget 2008 in Swinnen 2011). Monasteries were centres for brewing wine mainly in the south and in the north monks in monasteries focused more on beer due to its geological position and climate. The rulers often had big influence on what their brewing was focused on. At first, monasteries produced only to satisfy their needs and the needs of the poor (Bickerdyke 1889 in Swinnen 2011). It was not until twelfth and thirteenth century that brewing emerged as commercial business and spread outside of the walls of monasteries. Until this time (probably around 800 AD) hops were not part of the brewing process. This innovation brought big changes to the brewing industry. Hops were added by Germans to preserve their beer for longer period (Behre 1983 and 1999 in Swinnen 2011).

First taxes on beer appeared in a way of licence of the taste of the beer. Brewers had to buy grut, which was a combination of allowed additive to beer to change taste of the beer, from the local authority. Brewing without grut was not allowed (Mosher 2009 in Swinnen 2011). The tax delayed adding hops to the beer. In some regions it was even forbidden. It was said to spoil the taste of the real beer. Although the reason was quite different – with addition of hops brewers no longer needed that amount of grut and that lead to lower revenues for tax collectors and authorities (Unger 2004 in Swinnen 2011).

Early Modern Times brought about a new change regarding beer industry. In the fourteenth century, several factors influenced such a change. Beer was not only beverage to drink during fests anymore because it became wide spread among people and throughout countries, demand for beer increased with the increase of income, water was

more or less polluted at that time and therefore beer was preferred as beverage (as it was made from boiling water which meant that many diseases were avoided), travelling became more frequent along with transportation which lead to increase in demand for facilities for lodging for travellers and also higher demand for beer in such facilities (Clark 1983 in Swinnen 2011).

The beer industry became widely appreciated and many governments sought to take advantage of it. Regulations and taxes were implemented on beer and brewing process (duration of brewing process, composition of beer, price of beer, etc.). The most known law was enacted in Munich, 1487. It was called Reinheitsgebot which stated that beverage can only be called beer if for its production clean water, hops and barley was used (Hackel-Stehr 1987 in Swinnen 2011).

Competition between brewers emerged which contributed to increased quality of beer, increase in transportation and distribution of beer and appearance of new kind of beers. Permanent centres of beer production were established (Antwerps, Munich, London) (Unger 2004 in Swinnen 2011).

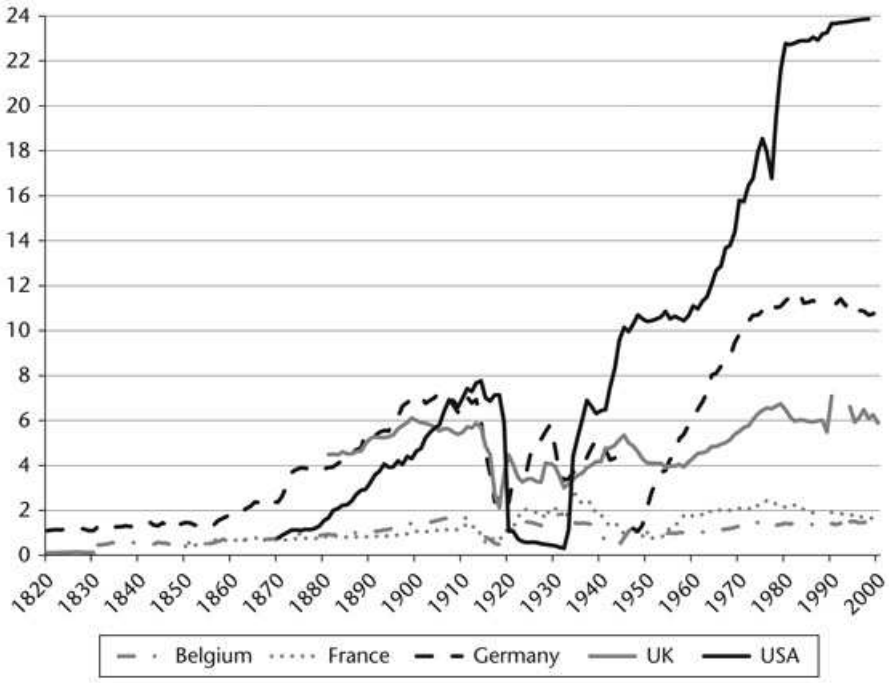
With the exploration of the New World and settlement in new territories demand for beer kept increasing. Brewing was introduced in places where it was unknown. Ships transported beer as a precious cargo in bulk. Beer was used as precaution. It was better to drink beer than waters which might have parasites or diseases. Globalisation helped to discover new business opportunities and new markets in which beer could be sold. The only negative impact of new markets for beer was that there were new products competing with beer – coffee, tea, coca, wine and other spirits (vodka, rum, etc.) which were frequently traded (Aerts and Unger 1990 in Swinnen). Wine was highly produced in Europe and due to increasing income of people and development of transport it started to be more available and better competitor to beer. Many governments tried to protect their markets and they implemented high taxes on imported wine as this was an example in UK. Therefore most of the people started to drink beer instead of wine. Discovery of soda had also influence on beer regarding beer and its competitive products. In 1886, the American John S. Pemberton invented carbonated drink which is world-wide known as Coca-cola. Other soda drinks from that time became popular and their consumption kept increasing.

With the start of eighteenth century, many new discoveries helped market of beer to grow. Better knowledge of brewing process and all its ingredients, also steam engine was

discovered, refrigerator and also very important were new types of beer bottles with unique sealing. Steam engine was useful because the transportation of beer world-wide became cheaper. Also steam engines were used in machines which helped during brewing process. Refrigerator, on the other hand, helped during the fermentation process of lager as cooling was necessary part of the process of brewing. As beer was transported to different destinations refrigerator was quite useful invention because beer is better preserved in cool. Cask storage of beer was not very convenient. Industrialization helped to produce mass of glass bottles for cheap and beer was from then transported in glass bottles. With glass bottles it was necessary to close them the best possible way. Henry Barrett in 1872 invented screw stopper which sealed glass bottles from then on. All these inventions contributed to brewing and preserving beer. Until mid-nineteenth century, yeast was rarely used during the process of brewing. It was discovered by Louis Pasteur (1822-1895) that yeast is the main source of fermentation (Barnett 2000 in Swinnen 2011). The most common type of fermentation was top-fermentation. Some beers produced with top-fermented yeast are weissbeer and rye beer (roggenbier). Fermentation takes place at about 15 to 20 degrees Celsius. The yeast cells rise to the surface of the beer after fermentation. Unlike bottom-fermentation which must take place at temperatures of 4 to 9 degrees Celsius. During the year, it was rather difficult to proceed with bottom-fermentation until the invention of the refrigeration machine (1876). Brewing with the bottom-fermentation was restricted and could take place throughout the year. Only in winter and cooler months of the year it was possible. Example of bottom-fermented beer is Pilsner, for example. In 1880s transition from top to bottom-fermentation took place and industrialization impacted on brewing industry (Teich 1990 in Swinnen 2011).

In the nineteenth century, beer production was increasing rapidly along with consumption of beer. Nevertheless World War I had impact on the beer markets. The biggest players in beer markets of that time were Germany, the UK and the USA. The following Figure 1 shows the beer production in the nineteenth and twentieth centuries for Belgium, France, Germany, the UK and the USA.

Figure 1: Beer production in 19th and 20th centuries in Europe (billion litres)



Source: Swinnen (2011) – The Economics of Beer, Figure 1

It is obvious that the USA was the least affected by the world wars. Materials were scarce during world wars and therefore expensive. It was expensive to sustain breweries. Many had to be closed. On the other hand, the USA faced prohibition in years 1919 to 1933 which resulted in rapid decrease in production of alcoholic beverages (more than 0.5 alcoholic beverages were banned). Fourteen years period of not permitted brewing forced many breweries go out of business. After repealed prohibition, it was stated that about 50 percent of breweries had been forced to close (Stack 2003 in Swinnen 2011). *"The 1950 – 1980 period was characterized by strong growth in beer production and consumption, both in Europe and in the USA. Technological innovations and increasing incomes lowered real prices and increased demand, causing growth in beer consumption"* (Swinnen, 2011). After the world wars, there had been some significant changes in Europe. Many breweries were damaged and needed to be repaired. It was difficult to raise capital in order to start new brewery or repair the old one. Therefore many breweries merged together. Another

strategy was diversification which helped breweries with economies of scale because they started to produce some types of non-alcoholic drinks such as mineral water and lemonade. Many breweries disappeared but many of them grew in size and in production. Globalisation and its impacts were especially strong by the end of the twentieth century. Many breweries intensified their production abroad. Starting up breweries outside of the countries of origin became common practice. Licensing deals emerged and many breweries started their business in different countries or even continents. For example, Budweiser from the USA started their business in the UK and in China (Stack 2003 in Swinnen 2011). The trends in tastes of beer had been changing throughout the years - from ale to lager to beer with special flavours. The USA regulations in twentieth century forced brewers to come up with substitutes added to beer and also to lower the percentage of alcohol in beer. Demand for low calorie drinks and food was another impact on beer industry. Drinking light lager became really popular especially in the North America by the end of twentieth century (Tremblay and Tremblay 2005 in Swinnen 2011). Although light lager celebrated great success especially around the year 2005 people started to demand variety and they started seeking the old styles of beer. In 1990s, new movement started. This movement was called microbrewery movement. The goal was to bring new breweries and new tastes of beer to the market in order to satisfy different wants and needs of customers. This movement unconditionally led to emergence of many small microbreweries. Some of them eventually became bigger than microbrewery due to its popularity. Microbreweries significantly contributed to the beer market especially by consolidations with other breweries and by increasing popularity and desire created in people.

3 Beer Consumption

The consumption of beer and other alcoholic beverages is influenced by many factors. From the psychological point of view for example, theories suggest that alcohol consumption increases as a response to stress, economic downfalls and unemployment (Brenner and Mooney 1983 in Swinnen 2011). *"Tremblay and Tremblay (2005), in a comprehensive study of the beer industry, summarize eight studies of demand, with six finding beer to be a normal good and two finding beer to be inferior, with an average income elasticity of about + 0.2."* (Swinnen, 2011). Dee (2001) in his study talks about an increase in drinking alcohol beverages during recession due to stress of people. He says

that recession and its influence on income is not as strong as the stress from the actual economic situation. There are also different studies. One very interesting study was done by Freeman (2001). He fallowed patterns like previous researchers but Freeman focused on beer consumption per month and over long period (about thirty-nine years). Evidence of long-run relationship between beer consumption, the unemployment rate, personal income and beer excise tax was found. On the other hand, beer was not found to be influenced in short-run changes by economic variables. It was thought that alcohol and specifically beer is immune to recession. Further studies to examine beer cyclicality consumption focused more on state-level shipment data in the USA between years 1970 to 2007. These studies were more precise due to concentration on smaller areas supported by data and therefore the data was easier to analyse. Pesaran (2006) and his approach was that the estimation model used cross-section data and controlled unobserved common factors. It is also known as the common correlated effects (CCE) estimator. Results showed that beer is cyclical, normal good. The unemployment rate has negative effect on beer consumption and income has positive effect. Meaning that people drink less beer during recession although the estimated effect is small and therefore the beer consumption is practically not influenced. Demography influences beer consumption positively and significantly. The more young adults are present the higher beer consumption per capita is. Excise tax has negative effect on beer consumption but its effect is relatively small. Swinnen (2011) talks about survey in which time period examined is thirty-one years long with data for 50 states of the USA. For the measures of economic activity were chosen the unemployment rate, employed/working age population ration, disposable income per capita, excise tax per gallon and population between 20 to 35 in percentage. The results showed that states with relatively young population (between 20 to 35 years) and large tourist sector have high beer consumption, for example Nevada. Unlike regions or states where there is large share of people with denomination. There was beer consumption the lowest, e. g. Utah. Swinnen (2011) is aware of much unobserved factors and heterogeneity in the estimation model. This might be due to different state laws regarding sale of alcohol, also different fiscal policies and interest rate changes are not taken into account in the model. Also social perception of alcohol consumption has evolved over the years which influenced beer and alcohol consumption too. Swinnens´ (2011) estimation models are designed to control the unobserved factors. Swinnen (2011) talks about four different models. "*Model 3 introduces*

the main innovation in this chapter, the use of the CCE estimator. We replace the time fixed effects with a two-step procedure, first regressing each cross-section unit on an intercept and the cross-section averages of the set (yit, xit), then pooling and regressing the residuals eyit on the exit. We find that the CCE estimator produces significant changes in the responses of beer consumption to the regressors." (Swinnen, 2011). This model clearly indicates that beer is pro-cyclical which means that quantity of beer has positive correlation with the overall state of the economy. It also shows that beer is negatively influenced by the unemployment rate but the employment ration has no influence on beer consumption anymore. The income was proved to be significant variable with negative effect and therefore beer can be considered normal good according to the model 3. Tax variable resulted as insignificant factor influencing beer consumption. Then another model was put in use. The difference between model 3 and model 4 was that to the model 4 lagged dependant variable was added to the CCE model. Again, model 4 interprets strong effect of economic variables and indicates beer as pro-cyclical normal good. On the other hand, it shows sensitivity to tax and therefore to the price of beer. Nevertheless, the price elasticity is small (– 0.045) along with small elasticity of income (+ 0.041) (Swinnen 2011). Unfortunately, using different models during research led to different conclusions and different results regarding beer consumption. The main difference is between the CCE estimator and the traditional two-way fixed effects estimator. The CCE suggests that beer is pro-cyclical and normal good. Also people drink less beer during recession but beer consumption increases with the high share of young adults in the population. Unlike the traditional two-way fixed effects model estimates which suggests that beer is non-cyclical and inferior good with relatively small tendency to react to the age distribution in the country. Therefore there are several results and no one can say that some of the model is wrong or right. All the models represent reality in some way. The models just differ in computations, variables and procedures (Swinnen 2011).

4 Determinants of Beer Consumption

"*When one thinks of the favourite alcoholic drinks of people in Italy, Spain and France, one thinks of wine; when one thinks of Russia one thinks of vodka; when one thinks of countries like Belgium, Germany, Czech Republic or Britain, one thinks of beer. The question then arises: what makes a country a "beer (or wine) drinking nation"?"*

(Colen and Swinnen, 2010, page 2). The answer to this question is not very difficult. There have been several factors affecting alcohol consumption.

It goes back to the history. Different locations, where people settled down, had different climates and therefore conditions regarding what could be grown in region. Usually, warmer climate favoured growing grapes for wine. Region around the Mediterranean is warm enough for growing grapes. Throughout the history it has always been a “cradle” of wine and viticulture. Unlike Northern Europe, which is generally colder region and not very suitable for growing grapes. Barley is more immune to harsh weather and climate conditions. It can thrive in cooler temperatures and that is the reason why barley is common cereal crop in Northern Europe and because beer is made from barley it is obvious that northern regions are more or less beer drinking regions. In the USA, the best location for growing barley is around the Great Lakes. On the other hand, grapes thrive in warmer regions like California. Of course that trading and development of transportation has helped to get beer to the regions where grapes have been grown and the opposite - to transport wine to the beer regions. It used to be expensive to transport any beverages but throughout the time development of road systems has helped to reduce the cost of transportation. Inventions have helped to speed up the transportation and delivery of different goods to the various destinations around the world.

Ruling forces like the Roman Empire helped to spread viticulture through Europe. The Romans and the Greeks despised beer and its drinkers. Unlike Celts which were more of beer drinkers.

Another factor influencing alcohol consumption, which has always been present, was and even now is religion. It strongly influences consumption of alcohol. People of various denominations consume usually less alcohol. For example, Islam, Mormon and Hindu absolutely forbid alcohol consumption.

Government regulations are another factor which influences consumption of alcoholic beverages. One great example is Prohibition in the USA in years 1920 to 1933 which was total failure. Eighteenth Amendment to the U.S. Constitution, which is the prohibition of alcoholic beverages in the USA (the production, transport and sale of alcohol declared as illegal), led only to the increase of criminal organizations. The Prohibition ended by repealing the Eighteenth Amendment by the ratification of the

Twenty-first Amendment, in 1933. Government also imposes taxes on alcoholic beverages in order to receive revenue (Colen and Swinnen 2010).

Factors mentioned above are probably factors which everyone can think of. But there is more to the alcohol consumption than a few factors, which as a matter of fact do not have to be statistically significant (estimation model shows significance of factors). In order to obtain the most precise factors, it is important to conduct analysis of the consumption of beer throughout the history and compare it to the beer consumption nowadays. Swinnen (2011) talks about economic theory which suggests that demand for beer of a consumer is influenced by the price of beer, prices of substitutes and complements, individual´s income, characteristics of the product, also addiction to the beer is important and influencing factor, and peer pressure along with advertising contribute to the increase of beer consumption too.

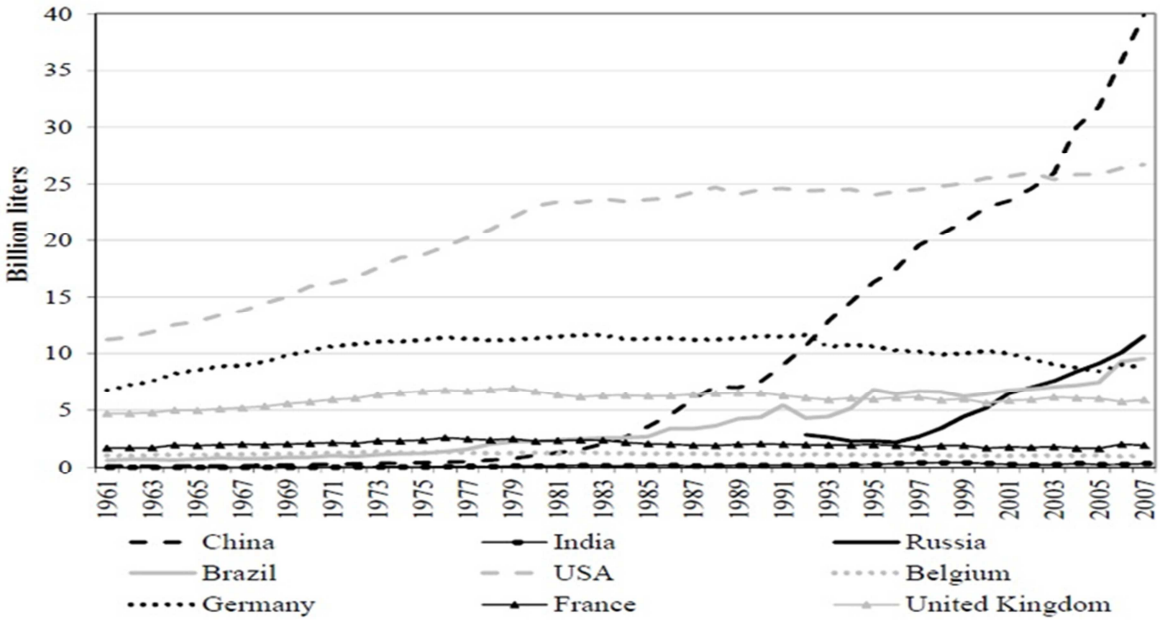
Tremblay and Tremblay (2005) and Fogarty (2008) summarized many studies (around 150 studies) regarding beer demand elasticity. Their summary suggests that beer is quite inelastic. The mean estimate of price elasticity of beer for countries like the USA, the UK and Ireland and it is said to be about – 0.5. This means that if the price of beer increases by 50% then the quantity of beer demanded decreases by 25%. Swinnen (2011) discusses mean income elasticity of beer which is positive and for most of the countries it is between 0.35 and 0.90. Therefore it has positive effect on beer consumption.

Demographics play its role in beer consumption too. Usually, men tend to drink more of beer than women. As mentioned in previous chapters, young adults are the main contributors to the beer consumption as it was proven by studies and estimation models. The peak of drinking age in demography is approximately between years 18 and 44.

In last 50 years, there was an evolution of production of beer all over the world. According to Colen and Swinnen (2010) beer consumption is approximately six times bigger than it is consumption of wine nowadays. About fifty years ago this was not true. The beer consumption was only about twice bigger than wine consumption which might indicate that beer has grown in popularity over the globe. This reality makes beer more important than wine or other alcoholic beverages. It is true that wine has been usually more expensive than beer which more or less had made up for the mass production of beer and its global value. But as the time passed, value of beer has kept increasing unlike other alcoholic beverages.

In the following Figure 2, it is obvious that emerging countries (those with growing economies, recent liberalization of economies, increasing individual income) led those countries to better conditions which go along with the increase of alcohol consumption, especially beer.

Figure 2: Beer consumption in the world (1961 – 2007)



Source: Colen and Swinnen (2010) - Beer Drinking Nations: The Determinants of Global Beer Consumption

The biggest increase in past years has been in China. In the Figure 2, it is easy to see that radical increase in China started around 1980 and even surpassed the USA in beer consumption around 2003. In other emerging countries, in which beer consumption has increased radically (Russia, Brazil), beer market has grown and it even has outgrown the German beer market in size. All the data are for relatively big countries with enormous population. The more suitable indicator to determine beer drinking nations would be consumption per capita. Per capita consumption clearly states how many litres of the beverage have been drunk during period of time per person. Table 1 below shows the list of thirty countries with the highest beer consumption per capita. The three top drinking nations are the Czech Republic, Germany and Austria. The leaders in the countries with the most beer per capita is the Czech Republic with 131.7 litres but it used to be more than 160 litres per capita and Ireland used to be ranked as the second most drinking country per person. Other non-European countries which consume huge amount of beer are Australia, Venezuela and the USA. In all named countries consumption is around 100 litres per

capita. There has been one substantial trend for decades now and that is that beer consumption is declining steadily and continuously.

Table 1: Per Capita Beer Consumption by Country (2010)

2010 Ranking	2009 Ranking	Country	Per-Capita Beer Consumption				Total Volume of Consumption (thousand kiloliters)
			Volume of Consumption (liters)	633-ml Bottle Equivalent (bottles)	Change from 2009 (bottles)	Ratio to Volume in Japan (set as 1.0)	
1	1	Czech Republic	131.7	208.1	-21.1	2.9	1,708
2	2	Germany	106.8	168.7	-3.7	2.4	8,787
3	3	Austria	105.8	167.1	-1.0	2.3	888
4	4	Ireland	103.7	163.9	-2.8	2.3	479
5	5	Estonia	90.6	143.2	-8.8	2.0	117
6	15	Lithuania	85.7	135.5	12.7	1.9	304
7	10	Poland	83.6	132.1	-0.3	1.8	3,215
8	6	Australia	83.4	131.7	-7.2	1.8	1,794
9	9	Venezuela	83.0	131.1	-4.7	1.8	2,259
10	7	Finland	82.7	130.6	-8.2	1.8	435
11	8	Slovenia	82.7	130.6	-6.2	1.8	165
12	14	United States	78.2	123.5	-2.5	1.7	24,138
13	12	Belgium	78.0	123.2	-4.7	1.7	844
14	11	Croatia	77.8	123.0	-7.6	1.7	350
15	13	Romania	77.4	122.3	-4.0	1.7	1,700
16	18	Panama	75.0	118.5	1.0	1.7	256
17	21	Holland	73.9	116.7	1.4	1.6	1,224
18	16	United Kingdom	73.7	116.4	-3.4	1.6	4,587
19	20	Bulgaria	72.8	115.0	-0.6	1.6	521
20	22	New Zealand	70.5	111.3	-3.6	1.6	300
21	17	Hungary	70.0	110.6	-7.1	1.5	700
22	24	Spain	69.9	110.4	-1.1	1.5	3,251
23	26	Canada	68.4	108.1	-1.9	1.5	2,311
24	19	Denmark	67.4	106.5	-10.2	1.5	372
25	27	Latvia	67.2	106.2	5.4	1.5	149
26	25	Russia	66.2	104.6	-6.8	1.5	9,389
27	29	Brazil	65.3	103.2	10.0	1.4	12,170
28	23	Slovakia	64.3	101.5	-11.5	1.4	352
29	28	South Africa	63.0	99.6	4.4	1.4	3,095
30	31	Switzerland	57.3	90.5	0.0	1.3	453

Source: Per Capita Beer Consumption by Country (2010), Kirin Holdings Company, Table 3

Maximums or the peaks of the beer consumption had already been reached in some countries of the Western Europe like Belgium, the UK, France, Germany, and even in non-European country like the USA.

Colen and Swinnen (2010) mention fact that there has been decrease in beer consumption in last years in traditional beer-drinking nations. They talk about shift which has happened recently and that is the shift of the share of wine consumption in traditional beer-drinking nations increased unlike the beer consumption which decreased. On the other hand, the opposite effect took place in wine-drinking nations where share of wine consumption decreased while share of beer consumption increased. It seems as if the alcohol consumption is trying to balance itself throughout the countries. Of course that inventions, new technology, transportation, new producers and globalisation helps with balancing the shares of consumption of alcohol beverages but it is an interesting fact. Another reason why traditional drinking nations have been changing their traditional drinks might be due to migration and change in population. Different nation has different

tastes and if minority increases in size of different nation then it might have influence on the consumption of preferred beverages.

Facts mentioned above lead to a conclusion which can be presented in a way that income has non-linear relationship with beer consumption. Therefore it suggests that emerging countries with lower income tend to drink beer unlike richer countries which tend to switch to “more sophisticated” alcohol beverages like wine and spirits. Theoretical conclusion should be further tested by estimation model in order to receive appropriate results which will suit the reality.

5 Relationship of Demand for Beer and Advertising

Analysis of many goods in the market can be crucial for many reasons and for many “players” in the market. The analysis can be used by companies to decide the supply of the good needed in the market, government can decide to which extent it will want to regulate that good in the market and also how much it contributes to the GDP, for example.

According to Castiglione, Grochová, Infante and Smirnova (2012) economic analysis of beer consumption is important mainly from two reasons and that is that beer might have negative effect on society and the other reason is that economic performance of beer which increased with the development of the new technology and generally with the advance in brewing industry. It is always a contribution to the field of science or research when the determinants of goods are known because if particular matter is understood then it is easier to predict its behaviour and it is easier for people to influence it in any way. There have been many studies which tried to explain dependence of beer consumption on advertising of beer. Some studies suggest that advertising of beer has statistically significant and positive effect on beer consumption (McGuiness 1980, Walsh 1982). Unlike studies of Duffy (1982) and Lee and Tremblay (1992) which state that there is no empirical evidence of the relationship of advertising of beer and its consumption. Studies differ due to different influence of variables. To be precise, income variable was found to be crucial in Duffy´s (1982) study, not the price of substitutes. The exact opposite was found in Lee and Tremblay (1992) study.

In consumption and advertising theory there are different attitudes towards this matter throughout the history. In the past, knowledge was always handed down from generation to generation and within family. This means that family created a habit which

then was inherited. This created a tradition on how the word was spread and advertised about certain goods in the market, for example. Experience with good was shared and spread among peers and friends. Nowadays, consumer chooses according to his or her income, prices, preferences and experience with the particular good (Castiglione, Grochová, Infante and Smirnova 2012). Consumption with the relation of history suggests that if the consumption of particular good was high at that time, it will be most likely high at the present and in the future, too. Addiction to alcohol beverages can play important role. Advertisements are intended to increase consumption of good and to make people buy that good. It is rather difficult for people to resist the temptation to buy goods when they have it every day in front of their eyes. For some people, it is really difficult to avoid being influenced by advertisements but it is even more difficult for people addicted to some good, in our case – beer. Imperfect information is another factor which leads to greater inelasticity of demand for good. Advertising, on the other hand, eliminates such phenomenon and informed consumer tends to demand more of particular good because he or she is informed and know where to go in order to buy good, how much it costs and other details.

Advertising has positive and negative effects on consumers. Companies via advertising might create needs in consumers, change their preferences, etc. These changes can be done by offering consumers benefits which might or might not be real (imagined). Therefore advertising can either turn the demand curve to make it more elastic or more inelastic. It is difficult to predict the effect of advertising on consumers.

In order to obtain demand for beer, the demand for substitutes has to be analysed too (with regard to advertising). Johnson and Myatt (2006) conducted a study about this issue. They found out that advertisements are about the content. *"If it promotes characteristics that differentiate the product, demand elasticity for all price levels declines; if it highlights its substitutability, then demand elasticity increases."* (Castiglione, Grochová, Infante and Smirnova, 2012, page 592). Advertisements can present the product in many ways and the way they want. As it is with kids, when they see something on TV they think it is real and normal to do. Adults know the difference but commercials can change their attitudes, desires and make them want that product. People tend to buy things in order to fit and be "normal" in their closest society – peers, friends, colleagues. If people think about something that it is normal then they will do it or buys it.

If on TV is presented drinking as normal or even traditional then it is more likely that it will increase the demand for product.

Castiglione, Grochová, Infante and Smirnova (2012) in their work conducted estimation of the model that would explain the demand for beer. They aimed to discover determinants of the demand for beer in the Czech Republic, to determine the effect of advertisements and the effect of past consumption on the demand of beer. They modelled the beer consumption by a double-log function. The results were that the most significant determinants of the beer demand are the price of beer, individual income and past consumption. Advertising proved to have immediate effect on beer demand, unlike on spirits which are not strongly affected.

Price elasticity varied with the country. In the USA and the UK price elasticity was more or less inelastic (value was - 0.4). In the Czech Republic it was quite different. Results showed that the Czech Republic is more price-sensitive (price elasticity varied from – 2.4 to – 3.8). Nevertheless, model was fixed by SUR approach, which basically took into account the interaction of substitutes for beer, and it brought the values almost to the zero (- 0.2). This value is similar to the studies which suggest that price is inelastic.

Similar pattern followed in relation of income elasticity. In the UK and the USA elasticity was estimated between 0.5 – 0.7 and 0.12 – 0.25. In the Czech Republic it was again different. In all estimations of Castiglione, Grochová, Infante and Smirnova (2012) increase in income had negative effect on beer demand and spirits were preferred over beer. Therefore beer was proved to be locally inferior good.

Advertising elasticity (both direct and indirect advertising included) was proved to be significantly greater than zero. Therefore it can be said that advertising increases demand for product, which is beer in this case. In the Czech Republic advertising elasticity had stronger effect than in other countries. This phenomena could be explained in a way that advertising of specific alcohol beverage leads to an increase in consumption of any alcohol beverage in the market.

Another factor significantly influencing current consumption was the past consumption. It proved that beer along with spirit consumption depends on the past consumption because the consumption of alcohol beverages is addictive behaviour.

At the end of work of Castiglione, Grochová, Infante and Smirnova (2012) they summarize the results and discuss the negative effects of beer drinking and its possible

preventions. They suggest that “optimum” tax could be implemented but it is rather difficult to find that tax which could prevent at least some proportion of people from drinking or to make up for the cost of medical help caused by drinking alcohol beverages. Another suggestion is ban on alcohol advertising since the advertising has positive significant effect on demand for product and permanent increase in prices of alcohol beverages. Explanation for it is that it might change the habit of drinking throughout the time which is basically past consumption factor which is strongly influencing factor of demand for product. If the habit changes also other externality connected with drinking alcohol might change and improve society (Castiglione, Grochová, Infante and Smirnova 2012).

6 Drinkability of Beer

The best beer is hard to define. Every person in the world is different and with this difference comes also different taste. One kind of beer can be delicious for one individual, but it does not have to be for the other one. Professionals would define the best beer most likely differently than regular consumer, or what is preferred by the mass. The goal of every brewery is to sell the highest amount of beer possible in order to earn money. Therefore it is crucial for breweries to produce kind of beer that is popular and therefore demanded and consumed the most at the time. According to Čejka, Dvořák, Kellner, Čulík and Olšovská (2011) beer evaluation depends on many factors. At first the product presentation can create anticipation in the consumer which could be caused by advertising or the way of packaging and design. Information is another factor that can influence consumers. If people know some specific information about beer from reliable source or professional then it might influence their preference quite significantly. In the last two years the term “drinkability” appeared and became an important attribute in the sensory evaluation of beer quality (Čejka, Dvořák, Kellner, Čulík and Olšovská 2011).

It is not easy to define the term drinkability. For this term there are many definitions. All the definitions generally state that beer should not prevent consumer from drinking another beer. Some example of the definition is: *“The beer must be tasty for the consumer and he must be looking forward to drinking another glass”* (Čejka, Dvořák, Kellner, Čulík and Olšovská, 2011, page 407).

Beer can be evaluated in many ways. Sensory evaluation, for example, is designed to specify beer and its sensory properties. This evaluation is conducted usually by professionals. Their goal is to evaluate organoleptic properties of beer sample and then to compare it to previously stated standard. Unlike the evaluation of drinkability which can be carried out by members of public.

First approaches to evaluation of drinkability were by Ferkl and Cuřín (1979). Evaluation method involved drinking 0.5 litres of beer and 1.5 litres of beer. After drinking of both volumes of beer, drinkers were asked to judge how they felt about the desire of drinking more of beer. Another approach was different. Beer was served to the judges every fifteen minutes and meanwhile judges were provided by water. The volume of water drunk after each beer was desired drinkability.

There are many factors influencing beer drinkability. Factors could be divided into two groups – controlled and non-controlled. Obviously, controlled factors are such factors which can be affected and specified. Unlike non-controlled factors which are given by external factors (e.g. atmosphere). The following are listed factors and they are divided into various groups: *"Specific features of the consumer (age, sex, social position, thirst, satiation, physical condition and so on) and his beer drinking habits. Sensory factors (kind of beer, harmony of the individual components, off-flavour, foreign odour or stale taste). Cognitive factors (information, experience, memories, conviction and expectations regarding the beer). External factors (daily time of consumption, atmosphere, meal consumed). Physiological factors (built by the absorption effects coupled with biochemical reactions after the food components such as amino acids and sugars have reached the digestive tract and the post digestive effects associated with the digestion of food and drinks)."* (Čejka, Dvořák, Kellner, Čulík and Olšovská, 2011, page 408).

In order to define standard approach for evaluation of drinkability of beer, the objectivity is crucial. Comparisons of any kind of beer should be possible. Factors influencing evaluation should be randomized as much as possible according to (Čejka, Dvořák, Kellner, Čulík and Olšovská 2011). Appropriate approach should be suitable for experts as well as for public panel of evaluators. Nevertheless, rules need to apply for evaluators. Some of the rules are: evaluators have reached the alcohol drinking age, or half of the evaluators should by product regularly, the other half occasionally. Technique must be precise in order to receive the best possible results. But evaluators should have enough

space and time. Taste neutraliser should be provided, samples must be tested anonymously and testing should be conducted in a room where free conversation is not a problem. It is utmost important to grasp and to highlight the factors which are subconsciously forcing consumer to drink another beer. Drinkability, in different words, means taking another sip and drinking another beer even though the body is already full and satisfied with water supply. Its drinkability what makes people to drink more beer. Therefore it must be subconsciousness what is the important factor that needs to be measured. Many factors influencing the evaluation can me neutralized by certain steps. In order to catch the subconscious reactions of consumers there must be monitored their drinking behaviour. Nevertheless, collection of data, data evaluation, and statistical methods of evaluation was too complicated and therefore not suitable for common use as a method of drinkability evaluation.

At the end of study of Čejka, Dvořák, Kellner, Čulík and Olšovská (2011) they summarize the facts about new techniques of evaluating drinkability. One of the facts discovered was that beer drinkability is correlated with the volume of beer drunk within a certain amount of time. As mentioned above, getting rid of misleading factors is crucial in order to receive objective results. Two most popular techniques are a pair comparison test and Monadic research design. Results should bring new information which can be helpful and valuable information for breweries. Results proved that producers can influence consumers in many ways if they know how. According to the techniques and their results producer might evaluate their approach to consumers and change whichever sphere of their production in order to sell the highest amount of beer possible. The beer drinkability can be used as an indicator of how the beer brand is doing among its competitors and therefore it is highly valuable information. It can provide information about other competitors which can be as motivator for other breweries or businesses, or brand new businesses which are planning to start in the field of brewery.

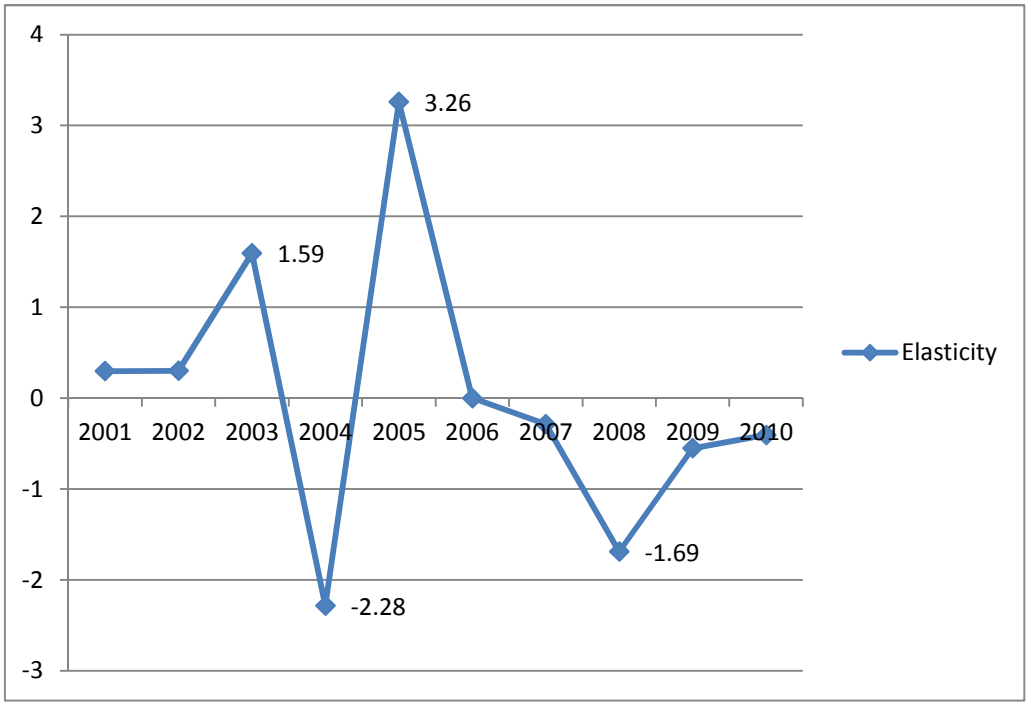
7 Price Elasticity of Demand (PEoD)

The Price Elasticity of Demand (also known as price elasticity) measures the rate of response of quantity demanded due to a price change. According to different studies there are different opinions about price elasticity of beer. No results can be said that they have

wrong results because they differ in procedures. Following text is about procedure in this work.

At first, percentage change in the average price of beer and then percentage change in quantity of beer demanded (consumed) was calculated for each year. These values were divided and put into graph in Figure 3 below.

Figure 3: Price Elasticity of Demand for Beer



Source: ČSÚ, Excel

Only absolute value of elasticity is important therefore the negative values can be omitted. All the values with price elasticity above 1 indicate that demand for beer is sensitive to price changes. Therefore in years 2003, 2004, 2005 and 2008 the demand for beer was sensitive to changes in price of beer. The highest value was in 2003 which states that demand for beer was strongly influenced by changes in price of beer.

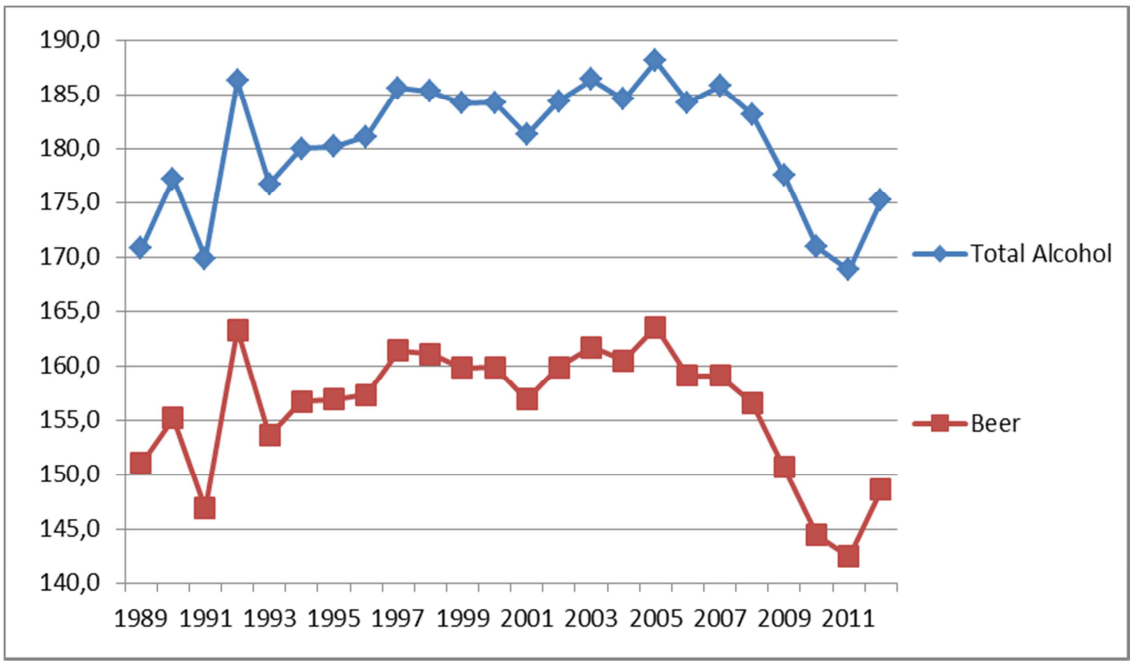
In the remaining years, absolute value of price elasticity was below 1 and therefore it can be said that in those years demand was inelastic.

Also price elasticity was calculated for the whole period (2001 to 2010). The average price of beer increased from 7.78 to 10.2. The value of price elasticity was 0.29567024 which states that throughout the years demand for beer was price inelastic and insensitive to the price of beer.

8 Total Alcohol, Beer and Wine Consumption per capita in the Czech Republic

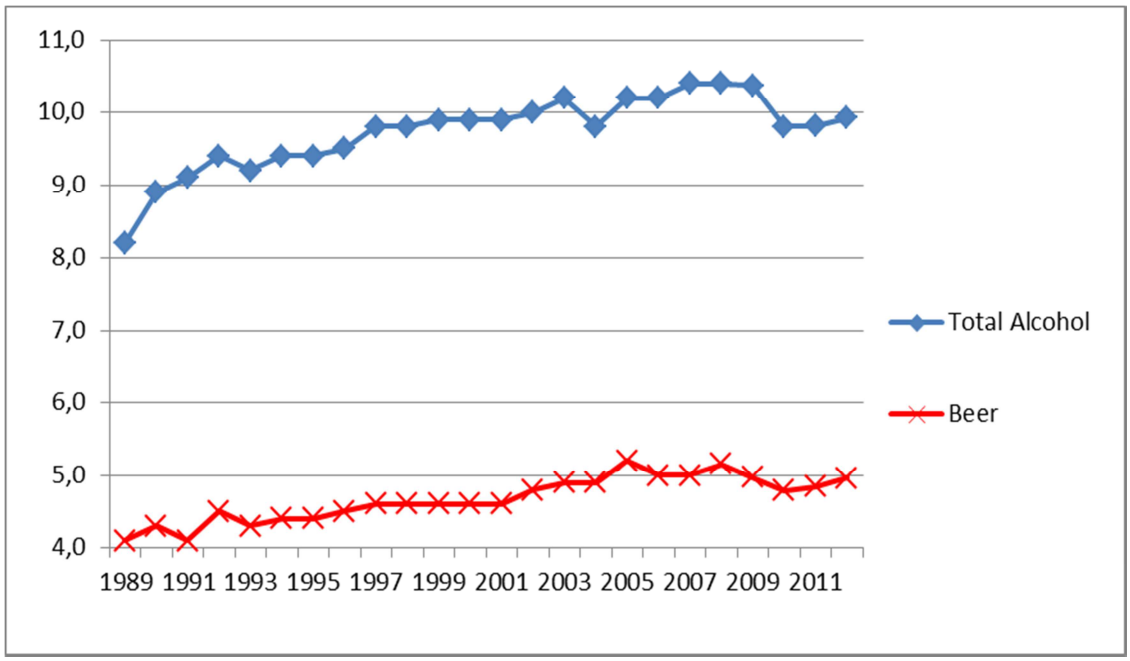
In this chapter, there are comparisons made between total alcohol consumption and total beer consumption in the Czech Republic depicted in figures below. Also chosen substitute, which in this case is wine, is compared to beer and total alcohol consumption in the Czech Republic. Always two figures are presented – one is in the volume of litres of each commodity, the other one is in volume of pure alcohol. All the data refer to the Czech Republic only.

Figure 4: Total Alcohol and Beer Consumption (litres/per capita)



Source: ČSÚ, Excel

Figure 5: Total Alcohol and Beer Consumption in pure alcohol (litres/per capita)



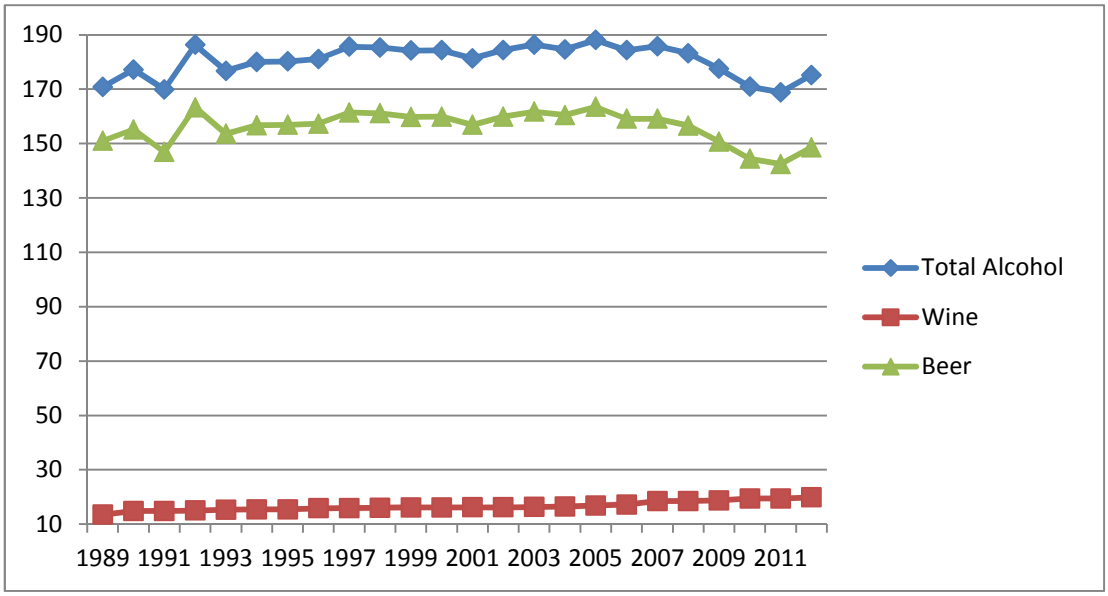
Source: ČSÚ, Excel

From the figures above it is possible to see that in the time span of twenty-three years (from 1989 to 2012), per capita consumption of beer fluctuated along with the total consumption of alcohol.

The line depicting the beer consumption per capita follows the pattern of the total alcohol consumption which could be described in a way that beer consumption strongly influences total alcohol consumption. The pattern can be seen especially in Figure 3. When beer consumption increases, total alcohol consumption increases too and vice versa. This could be due to high beer consumption in the Czech Republic unlike consumption of other alcohol beverages. Nevertheless, in Figure 5 there can be seen little difference due to more detailed look (pure litres of alcohol). From years 2004 to 2005 beer consumption in pure litres increased (4.9 to 5.2) and from 2005 to 2006 decreased (5.2 to 5). Unlike the total alcohol consumption which in years from 2004 to 2005 dropped (from 10.2 to 9.8) and in years 2005 to 2006 total alcohol consumption increased again (from 9.8 to 10.2). This inverse relation of beer and total alcohol consumption could be caused by the decrease of consumption of other alcohol beverages (wine, spirits).

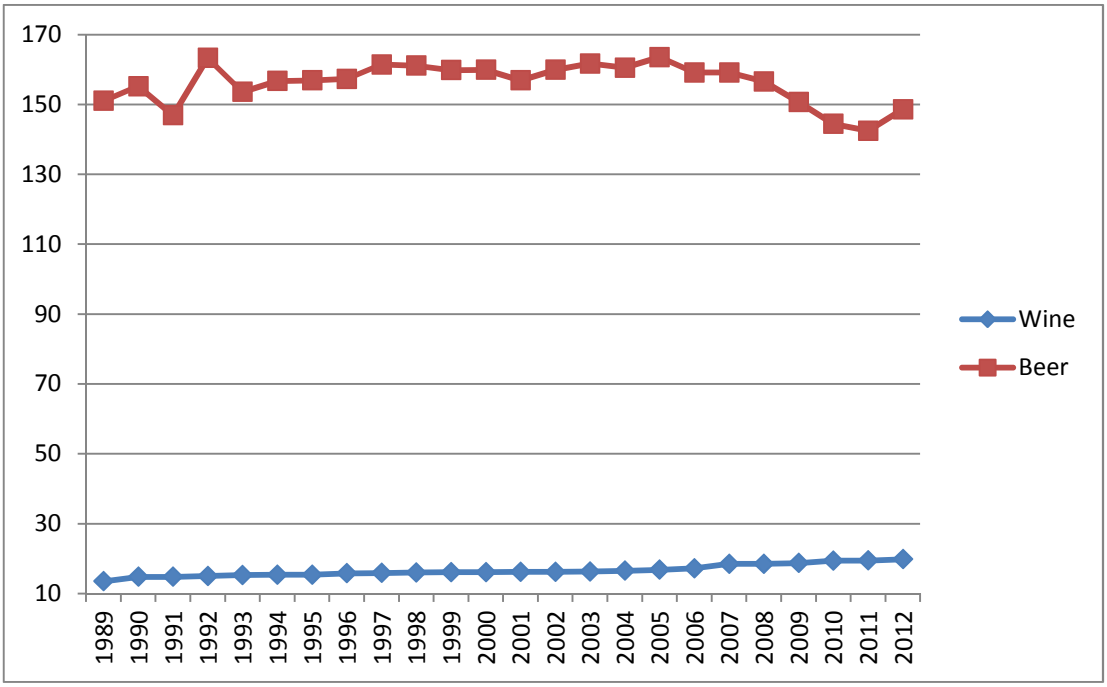
In the following figures, there is depicted wine consumption compared to beer and total alcohol consumption per capita in the Czech Republic.

Figure 6: Total Alcohol, Beer and Wine Consumption per capita (in litres)



Source: ČSÚ, Excel

Figure 7: Total Alcohol, Beer and Wine Consumption per capita (pure alcohol in litres)



Source: ČSÚ, Excel

In Figure 6, there can be seen how little influence wine has on the total alcohol consumption. The trend in wine drinking suggests that wine consumption per capita is steadily increasing year by year. The volume of beer drunk per person is much bigger then

wine consumption each year and therefore it influences the whole volume of total alcohol consumption per person the most. In Figure 7 there is a comparison of beer consumption and wine consumption per capita which simply presents how big difference is even in case of pure alcohol of these two beverages.

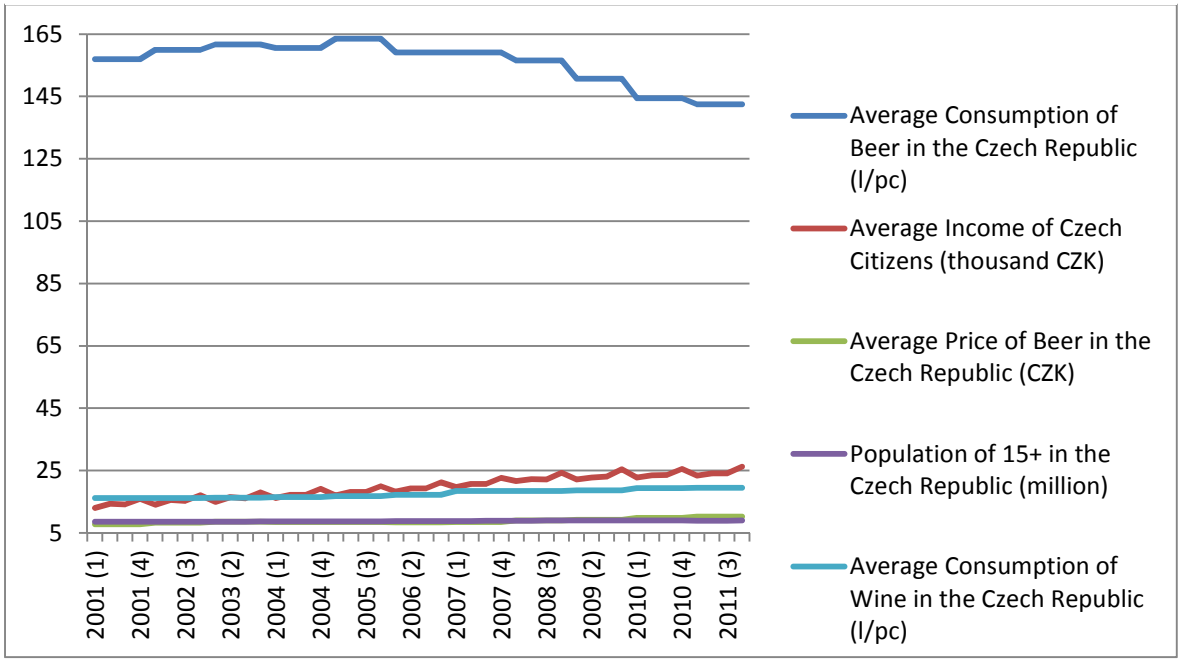
9 Analysis

9.1 Formulation of the model

The average consumption of beer per capita in the Czech Republic might be influenced by the average income of Czech citizens, the average price of beer in the Czech Republic, number of people older than 15 in the Czech Republic and the average consumption of wine per capita in the Czech Republic. Therefore the average consumption of beer per capita in the Czech Republic is dependent variable in the model and the others are explanatory variables.

9.2 Elementary analysis

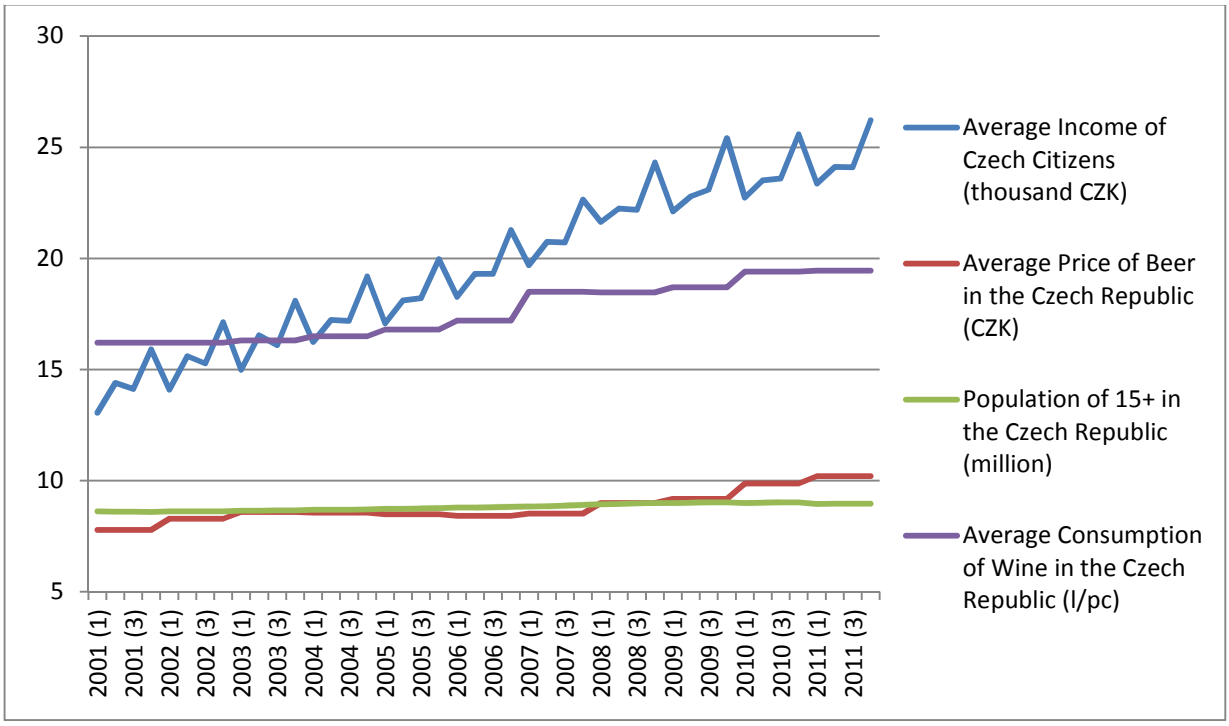
Figure 8: All variables



Source: ČSÚ, Excel

In the Figure 8 it is difficult to read precisely the data due to enormous amount of average beer consumption per capita. The blue line is slightly increasing from years 2001 to 2005 when it reaches its highest point (163.5). Since then the beer consumption per capita is decreasing. Following Figure 8 is provided without average beer consumption per person in order to present all explanatory variables.

Figure 9: Explanatory variables of the model



Source: ČSÚ, Excel

In Figure 9 there are four different explanatory variables. Number of people older than 15 years in the Czech Republic (green line) changes the least of them all. That is due to units of green line which are in millions. We can see that green line is continuously increasing but in years 2010 and 2011 it decreases slightly.

Rapidly increasing variable is the average income of Czech citizens (blue line). The average price of beer (red line) is slowly increasing. Only between years 2005 and 2006 there was a slight decrease in the average price of beer. The average consumption of wine per capita in the Czech Republic is steadily increasing (purple line).

Table 2: Descriptive statistics

	Average Consumption of Beer in the Czech Republic (l/pc)	Average Income of Czech Citizens (thousand CZK)	Average Price of Beer in the Czech Republic (CZK)	Population of 15+ in the Czech Republic (million)	Average Consumption of Wine in the Czech Republic (l/pc)
Number of observations	44	44	44	44	44
Mean	155.90	19.71	8.80	8.81	17.61
Median	159.10	19.50	8.55	8.79	17.20
Minimum	142.47	13.05	7.78	8.58	16.20
Maximum	163.50	26.21	10.20	9.01	19.44
Variance	44.515	12.685	0.458	0.023	1.551
Standard deviation	6.749	3.603	0.659	0.154	1.260
Coefficient of variation	0.043292	0.182758	0.075032	0.017453	0.071527

Source: ČSÚ, Excel

In Table 2 there are presented descriptive statistics values. The highest variance value is of the average consumption of beer. Therefore it has also the highest standard deviation which tells us that on average the data are spread 6.7 (litres) from each other. The second highest value of variance and standard deviation is of the income of Czech citizens. Therefore the data are on average spread 3.6 (thousand) from each other. From the Table 1 it is obvious that the most homogenous data are for explanatory variable - number of people older than 15 years in the Czech Republic, based on low coefficient of variation (0.017453 = 1.7% of homogeneity). On the other hand the most heterogeneous data are for explanatory variable – the average income of Czech citizens (0.182758 = 18.28%).

9.3 Regression model

Declaration of variables

y_t - Average Consumption of Beer in the Czech Republic (litres/per capita)

x_1 - Average Income of Czech Citizens (thousands CZK)

x_2 - Average Price of Beer in the Czech Republic (CZK)

(Beer with 3.4 – 4.1% of alcohol, price is the average price of many brands of bottled beer from shops, not from restaurants)

x_3 - Population of 15+ in the Czech Republic (millions)

x_4 - Average Consumption of Wine in the Czech Republic (litres/per capita)

Multiple linear regression model (estimation result from GRETL)

Model 1: OLS, using observations 2001:1-2011:4 (T = 44)
Dependent variable: Average Consumption of Beer in the CR

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	78.6307	104.024	0.7559	0.45426	
x_1	0.39135	0.461346	0.8483	0.40146	
x_2	-6.10051	1.46848	-4.1543	0.00017	***
x_3	25.2724	14.1283	1.7888	0.08142	*
x_4	-5.64388	1.49139	-3.7843	0.00052	***

Mean dependent var	155.8955	S.D. dependent var	6.749077
Sum squared resid	386.0424	S.E. of regression	3.146192
R-squared	0.802904	Adjusted R-squared	0.782689
F(4, 39)	39.71828	P-value(F)	2.94e-13
Log-likelihood	-110.2120	Akaike criterion	230.4239
Schwarz criterion	239.3449	Hannan-Quinn	233.7322
rho	0.724273	Durbin-Watson	0.467298

Estimated function

$$y_t = 78.6307 + 0.39135x_{1t} - 6.10051x_{2t} + 25.2724x_{3t} - 5.64388x_{4t} + \varepsilon_t$$

The model 1 shows estimated model which has high multi-collinearity between variables and high autocorrelation. In order to find the best possible model, many different combinations were conducted (more in Appendix), data had to be transformed. The best suitable model was then chosen. The final estimated model (model 2) is presented below.

Model 2: OLS, using observations 2001:2-2011:4 (T = 43)
Dependent variable: Average Consumption of Beer in the CR

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	181.999	3.56676	51.0265	<0.00001	***
x_1	-1.37977	0.174854	-7.8910	<0.00001	***
d_ x_3	155.072	37.5334	4.1316	0.00018	***

Mean dependent var.	155.8721	S.D. dependent var.	6.827150
Sum squared resid.	621.9611	S.E. of regression	3.943225
R-squared	0.682287	Adjusted R-squared	0.666401
F(2, 40)	42.94989	P-value(F)	1.10e-10
Log-likelihood	-118.4554	Akaike criterion	242.9108
Schwarz criterion	248.1944	Hannan-Quinn	244.8593
rho	0.385263	Durbin-Watson	1.193518

Estimated function

$y_t = 181.999 - 1.37977x_{1t} + 155.072x_{2t} + \varepsilon_t$

Interpretation of the estimated model

If the average income of Czech citizens (in thousands CZK) increases by 1, the average consumption of beer per capita in the Czech Republic decreases by 1.37977 litres.

If the difference of population of 15+ in the Czech Republic (in millions) increases by 1, the average consumption of beer per capita in the Czech Republic increases by 155.072 litres.

Goodness-of-fit

Goodness-of-fit is determined by the coefficient of determination (R-squared). In the estimation of the model above, R-squared value is 0.682287. This value can be presented in percentage - 68.23% and it state that 68.23% of variance of dependent variable was explained by the model.

Hypothesis testing: p-value

$\alpha = 0.05$

$\gamma_{0:}$ 0.00001 < 0.05 H_0 is rejected therefore parameter is statistically significant.

$\gamma_{1:}$ 0.00018 < 0.05 H_0 is rejected therefore parameter is statistically significant.

$\gamma_{2:}$ 0.02413 < 0.05 H_0 is rejected therefore parameter is statistically significant.

Summary of results

All the assumptions were fulfilled in the first model. The average income of Czech citizens and the number of people older than 15 years in the Czech Republic have positive direction of effect on dependent variable and the average price of beer in the Czech Republic and the average consumption of wine in the Czech Republic have negative direction of effect on dependent variable.

Hypothesis testing proved that three parameters are statistically insignificant for the function because their null hypothesises were accepted and alternative hypothesises were rejected. Therefore only two parameters in the estimated function influence dependent variable and those parameters are - the average price of beer in the Czech Republic and the average consumption of wine per capita in the Czech Republic.

The first model was not good model in many aspects (high multi-collinearity, high autocorrelation, heteroskedasticity). Therefore many models were computed with different data values and the best suitable was chosen and that is model 2. Other models can be seen in Appendix – Extras for chapter 9.3 – Regression model.

In the second model (model 2) with transformed data of population of 15+ in the Czech Republic to difference values, one assumption was fulfilled - population of 15+ in the Czech has positive direction of effect on dependent variable. The other assumption was not fulfilled and that was that the average income of Czech citizens and the number of people older than 15 years in the Czech Republic will have positive direction of effect on dependent variable.

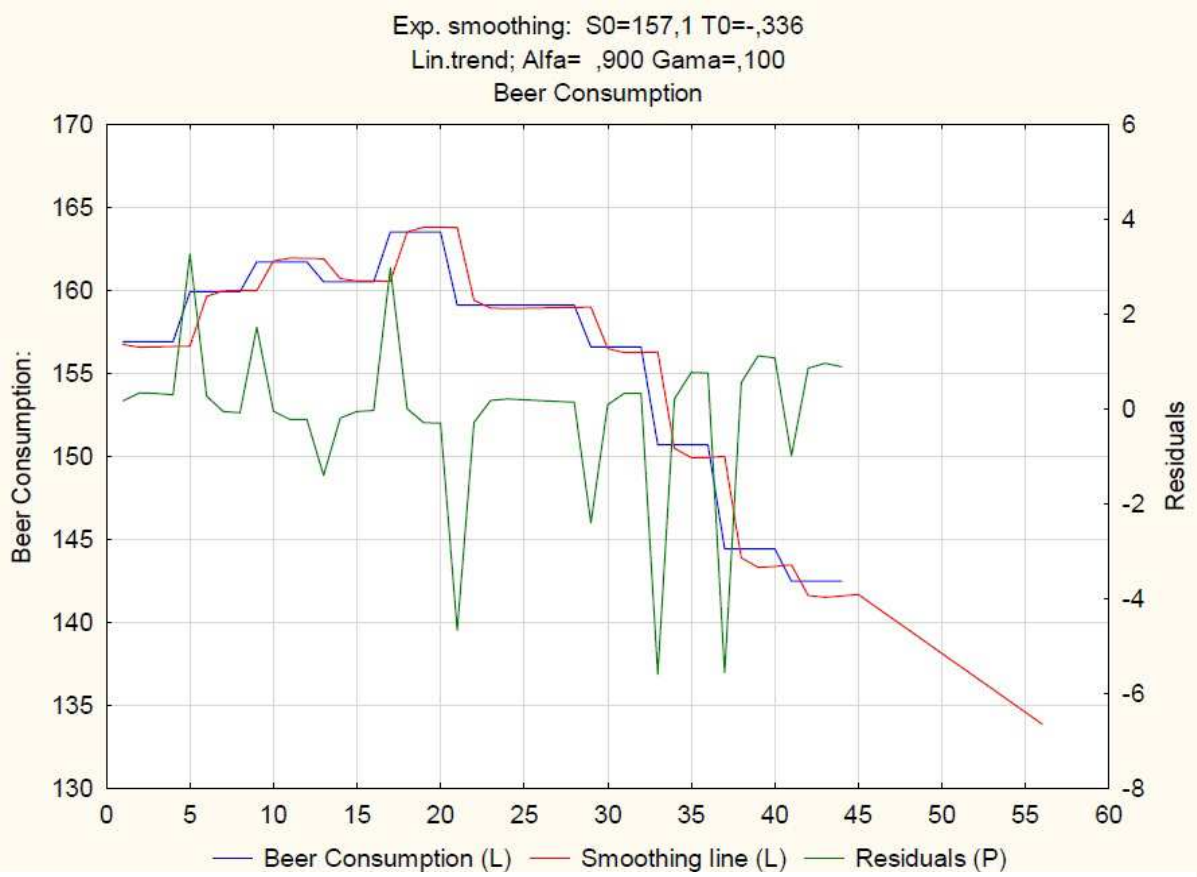
Hypothesis testing proved that three parameters are statistically significant for the function because their null hypothesises were rejected and alternative hypothesises were accepted. Therefore all parameters in the estimated function influence dependent variable.

If the average income of Czech citizens (x_1) increases by one then dependent variable (the average consumption of beer per capita in the Czech Republic) will decrease by parametric value of x_1 and vice versa.

9.4 *Trend analysis*

In order to predict the future values of the average beer consumption in the Czech Republic, three graphs were done with trend lines. Each trend line is represented by different function. The first one is linear function, the second one is quadratic and the third trend line is represented by cubic function. This process was repeated for each variable in order to predict their development till the year 2014. All graphs are shown in Appendix. Regarding the average beer consumption in the Czech Republic none of graphs represented realistic prediction of beer consumption. Therefore exponential smoothing had to be conducted, see Figure 10 below.

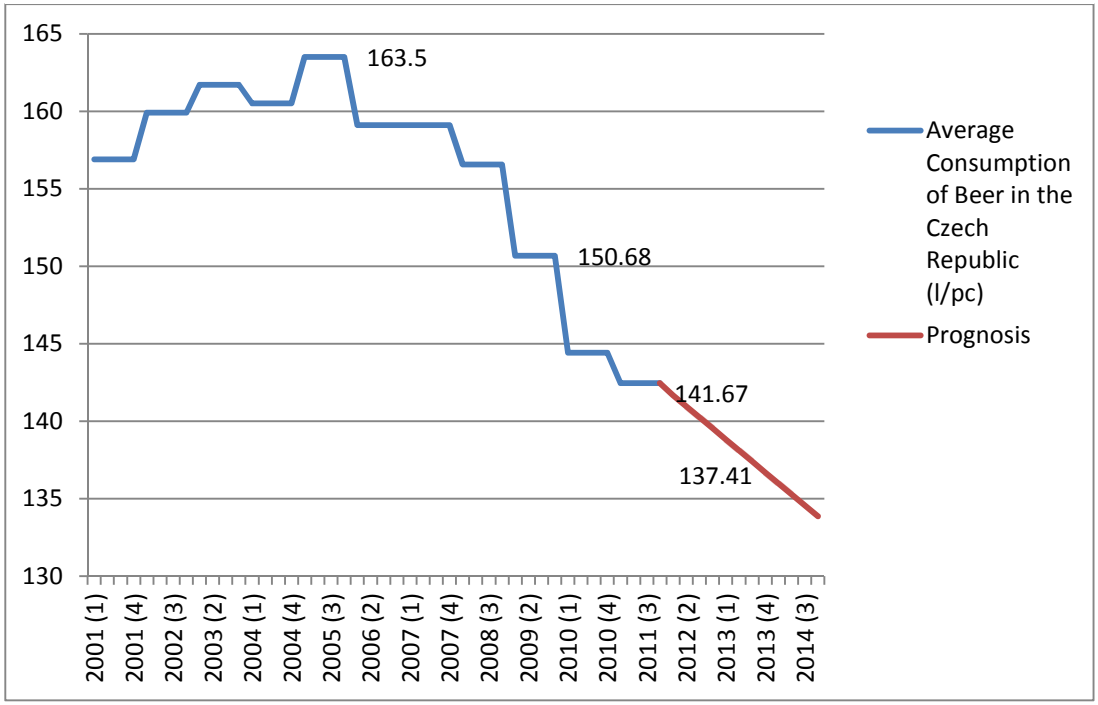
Figure 10: Exponential smoothing



Source: STATISTICA output

Exponential smoothing was conducted with linear trend with alpha value of 0.9 and gamma value of 0.1. The results for prognosis are shown below in Figure 11.

Figure 11: Prognosis - The average consumption of beer per capita in the Czech Republic



Source: Excel calculations

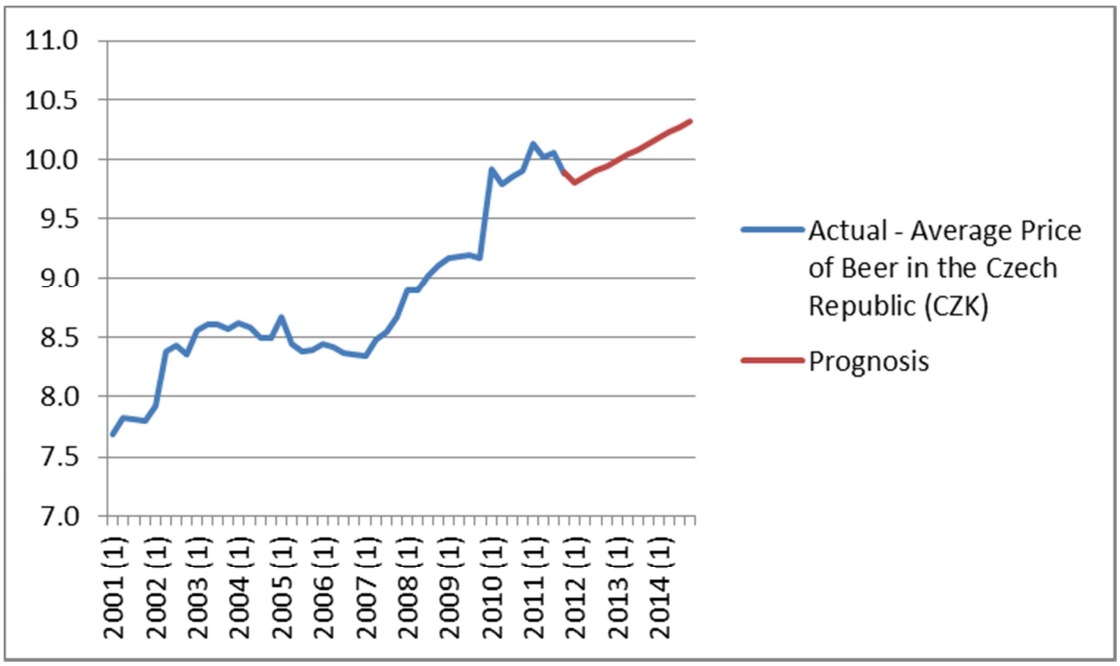
In Figure 11 there is prognosis for the average consumption of beer per capita in the Czech Republic. The prognosis suggests that the average beer consumption per capita will keep decreasing steadily until the end of prognosis, which is year 2014. Decrease is not radical and since the beer consumption is decreasing from 2005 it is more likely that this trend of beer consumption decrease will continue in following years.

It is rather difficult to say whether the prognosis will reflect reality or not. Nevertheless, one possible explanation for the decrease in beer consumption per person in the Czech Republic could be that wine and other substitutes will become preferred drinks and their consumption will increase unlike beer consumption. The decrease in overall beer consumption is more likely due to shift of the share of wine consumption since it is the strongest alcoholic substitute for beer.

To predict future values of explanatory variables linear function was chosen to interpret the average price of beer in the Czech Republic, for the number of people older than 15 years in the Czech Republic was chosen quadratic function and for the average consumption of wine per capita in the Czech Republic was chosen linear function. To predict explanatory variable the average income of Czech citizens, seasonality had to be taken into account and seasonal index had to be calculated to make prognosis (calculations

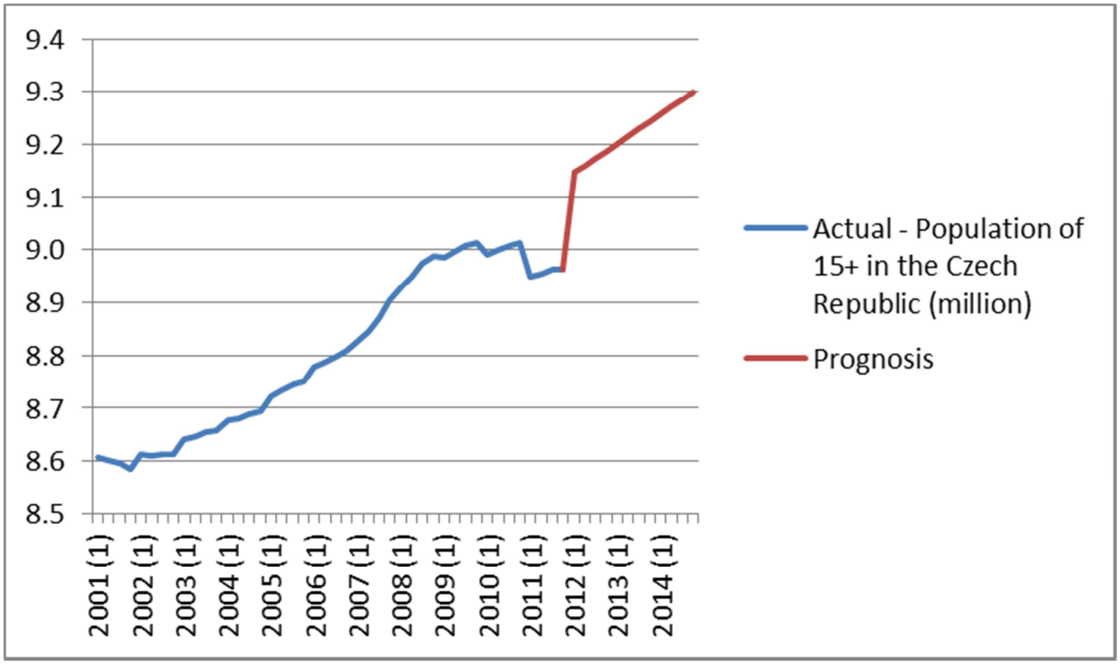
based on steps in methodology). Following are figures of prognoses of explanatory variables.

Figure 12: Prognosis - The average price of beer per capita in the Czech Republic



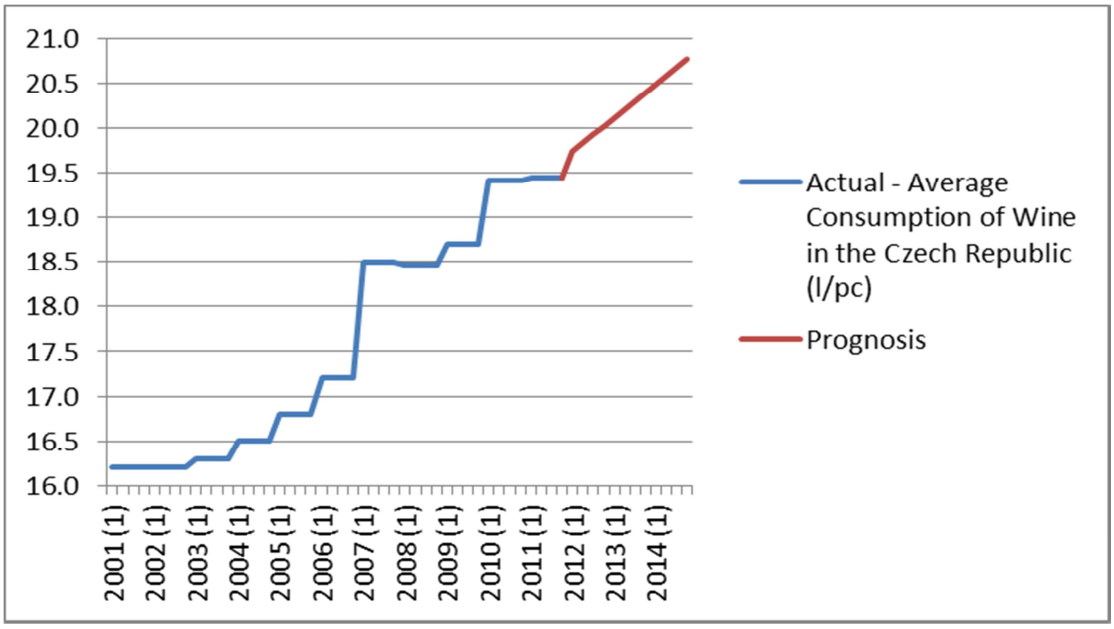
Source: Excel calculations

Figure 13: Prognosis - Population of 15+ in the Czech Republic



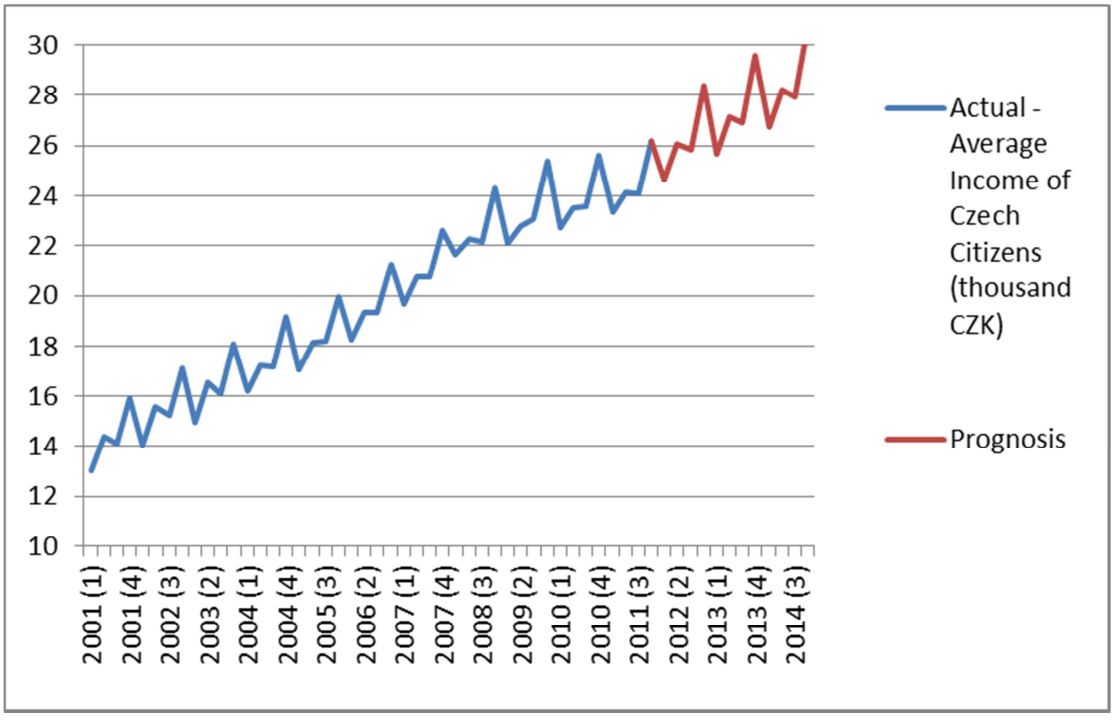
Source: Excel calculations

Figure 14: Prognosis – The average consumption of wine in the Czech Republic



Source: Excel calculations

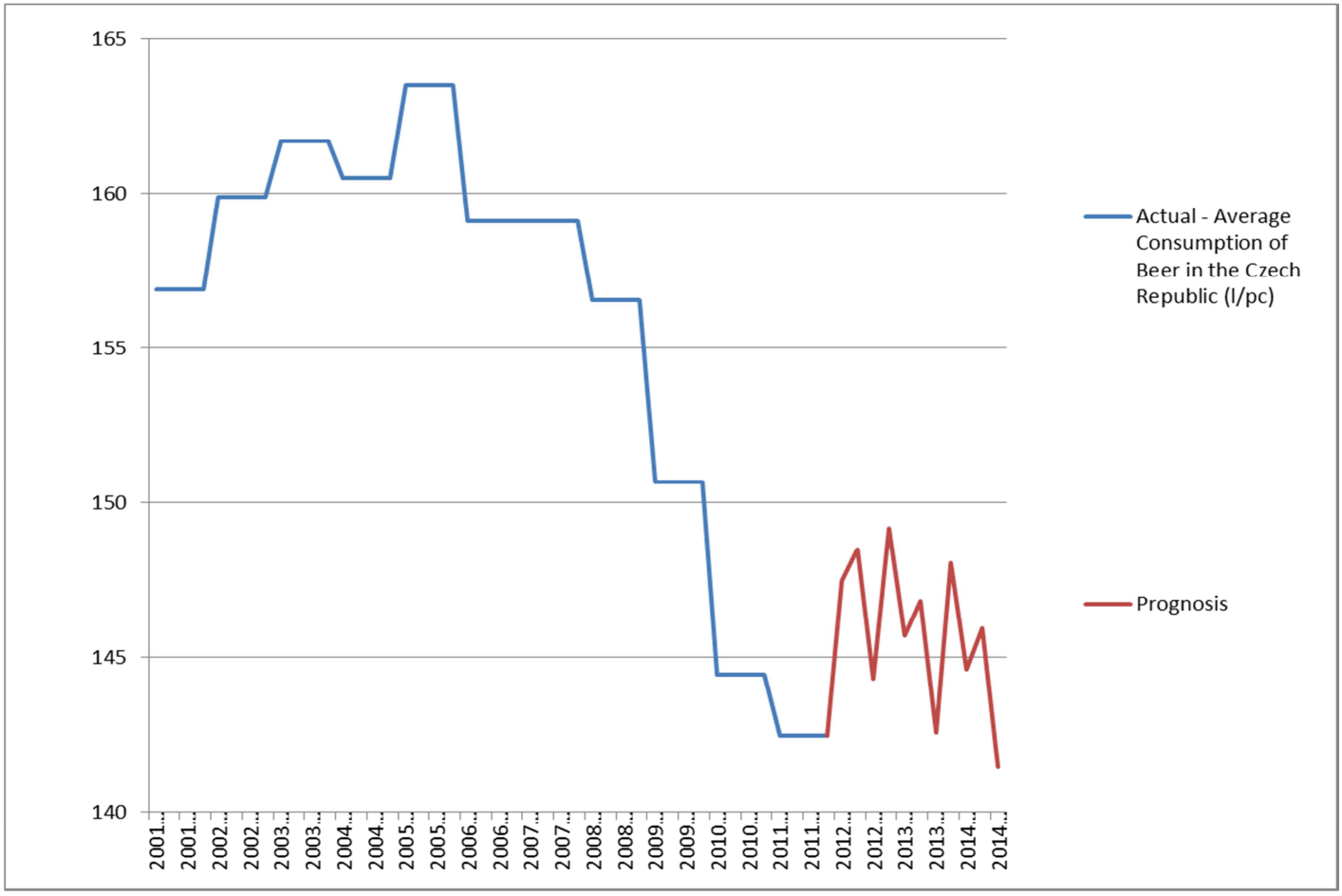
Figure 15: Prognosis – The average income of Czech citizens in the Czech Republic



Source: Excel calculations

According to prognoses made it is obvious that all explanatory variables will keep increasing.

Figure 16: Predicted average beer consumption per capita in the Czech Republic by the model



Source: Excel calculations

Figure 16 above shows predicted future values of average beer consumption per capita in the Czech Republic estimated by the estimated function from the model 2. It can be stated that beer consumption is fluctuating with tendency to decrease since the beginning of 2012 till the end of 2014.

10 Conclusion

Swinnen (2011) presents in his research many factors which influence beer consumption. The most influential factors according to Swinnen are price of beer, price of substitutes or complements, individual income, characteristics of the product, addiction to a product, peer pressure and advertisement. For the research of this bachelor thesis there were chosen four factors as explanatory variables for the model (the average price of beer in the Czech Republic, the average consumption of wine per capita in the Czech Republic, the average income of Czech citizens and the number of people older than 15 years in the Czech Republic).

From the results of the research can be concluded that only two explanatory variables (the average income of Czech citizens and the number of people older than 15 years in the Czech Republic) statistically influence the dependent variable (the average consumption of beer per capita in the Czech Republic). Explanatory variable the average income of Czech citizens has negative direction of effect on our dependent variable, which means that as the explanatory variable increases, the dependent variable will decrease. On the other hand, the number of people older than 15 years in the Czech Republic influences dependent variable in a positive direction of effect. Estimated model explains 68.23% of variance. Therefore it is relatively accurate and represents data by regression line in 68.23%.

Tremblay and Tremblay (2005) and Fogarty (2008) researched beer demand elasticity and their results can be concluded that demand for beer is inelastic. On the other hand, price elasticity researched in the USA and in the UK was – 0.5, therefore it proves that there is a non-linear relationship between price and quantity demanded, although the elasticity is quite inelastic due to its absolute value below 1. According to Swinnen (2011) the price elasticity of beer in most of the countries is positive and value is in range of 0.35 and 0.90, thus the relationship between price and quantity is linear but still the price elasticity is quite inelastic. In research of this thesis there was calculated price elasticity for each year and then for the whole time span of 10 years (from 2001 to 2011). In years 2003, 2004, 2005 and 2008 the demand for beer was sensitive to changes in price of beer. In the remaining years, absolute value of price elasticity was below 1 and therefore it can be said that in those years demand was inelastic. For the whole period (2001 to 2010) price elasticity was 0.29567024 which states that throughout the years demand for beer was inelastic, although the relationship of beer and price is positive.

Also prognoses were conducted based on the data collected. To predict future values of explanatory variables linear function was chosen to interpret the average price of beer in the Czech Republic, for the number of people older than 15 years in the Czech Republic was chosen quadratic function and for the average consumption of wine per capita in the Czech Republic was chosen linear function. To predict explanatory variable - the average income of Czech citizens, seasonality had to be taken into account and seasonal index had to be calculated to make prognosis (calculations based on steps in methodology). According to prognoses made all explanatory variables will keep increasing

since 2011 until 2014. Prediction of the average consumption of beer per capita in the Czech Republic was done with trend analysis but predictions were poor and not likely to happen with all trend line functions suggested. Therefore exponential smoothing had to be done. Using exponential smoothing prediction of average beer consumption per capita in the Czech Republic is predicted to decline. Predicted values of beer consumption (from the estimated function of the model) show fluctuation since 2012 with values rapidly increasing and then decreasing. Over all tendency of predicted beer consumption is declining. There is a similarity in predictions of beer consumption by exponential smoothing and by estimated function in tendency of decline. Exponential smoothing predicted straight decrease, but prediction by estimated function of the model 2 shows serious fluctuation since 2012. Estimated function might not be precise due to flaws in the model and that could be a reason why the values of beer consumption are fluctuating instead of decreasing steadily.

The decrease in overall beer consumption is more likely due to shift of the share of wine consumption. As wine is becoming more popular and preferred alcoholic beverage beer consumption naturally decreases because wine and beer are substitutes. Another reason for the decrease of beer consumption could be migration which might change the taste and preferences of population.

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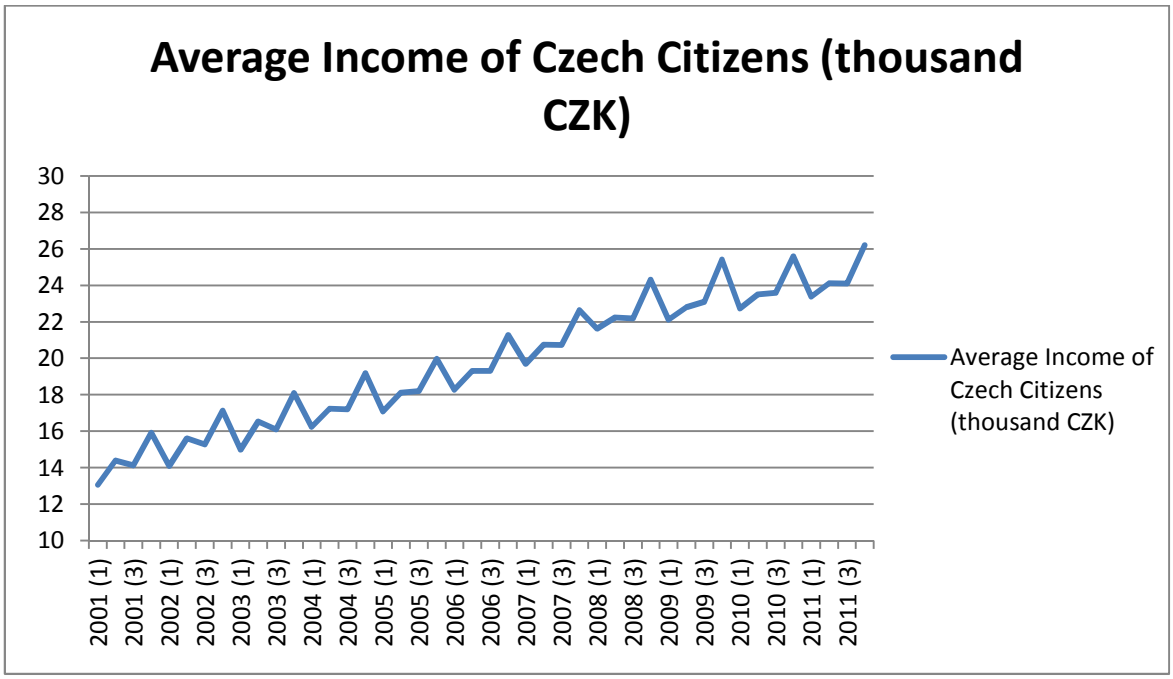
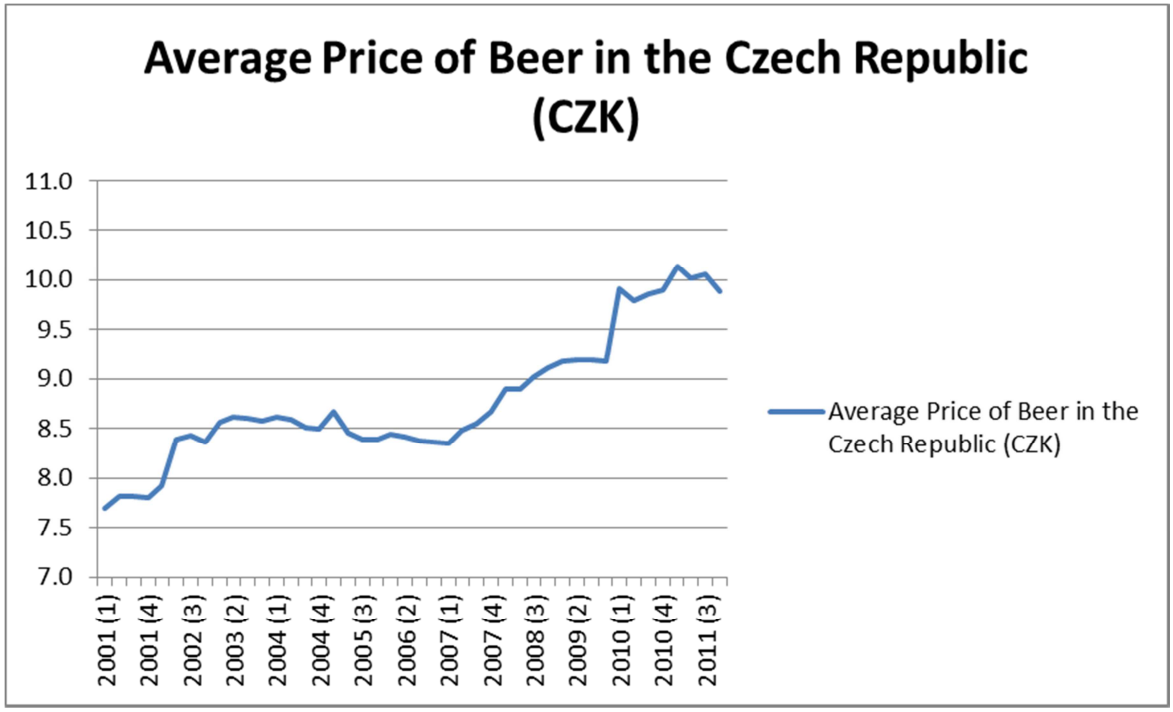
LIST OF FIGURES

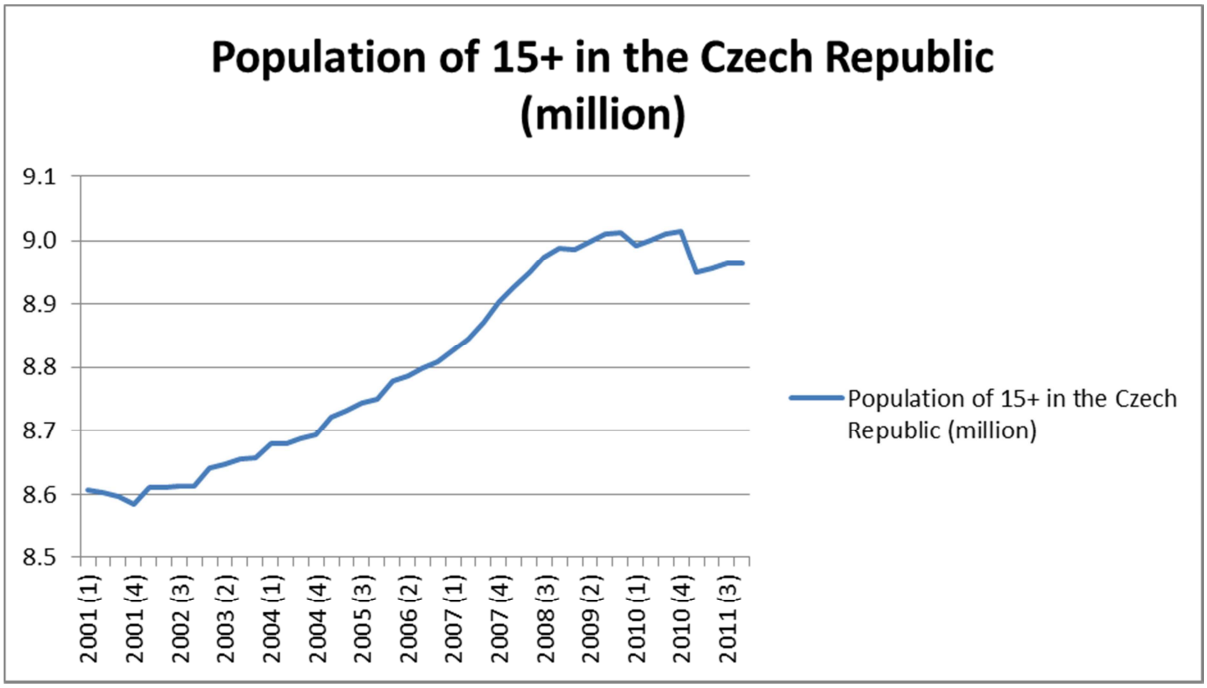
LIST OF TABLES

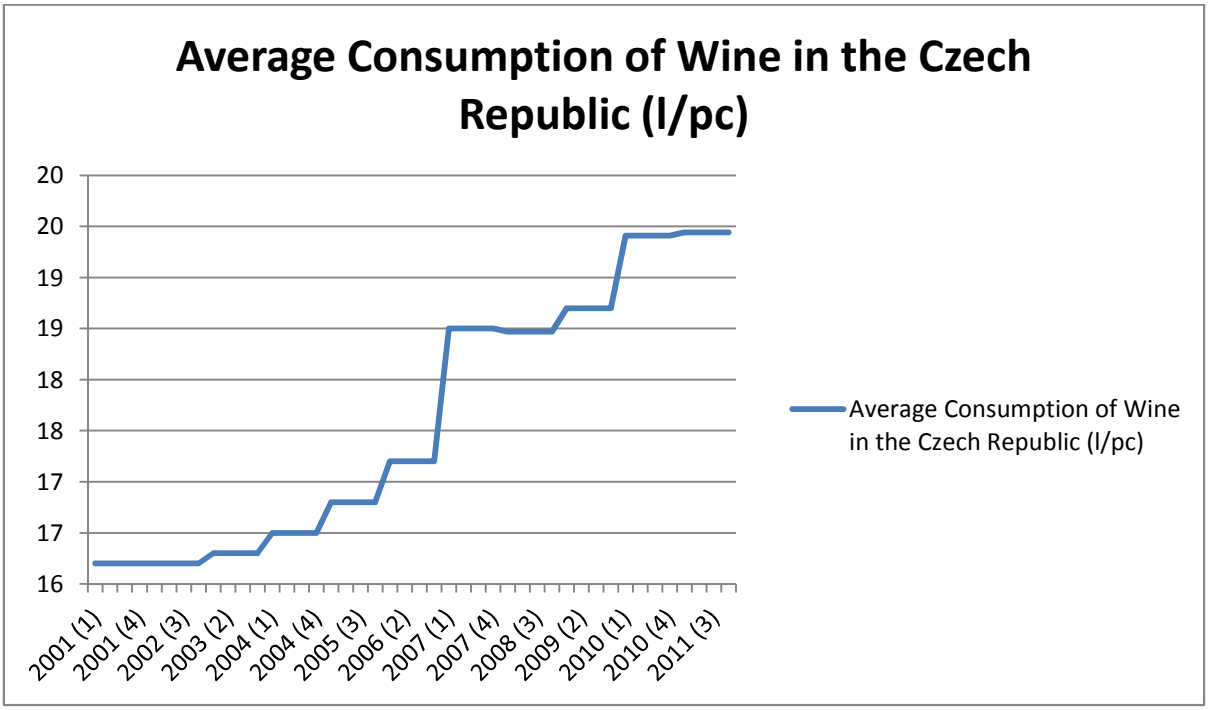
Appendix

Extra graphs for chapter 9.2 – Elementary analysis



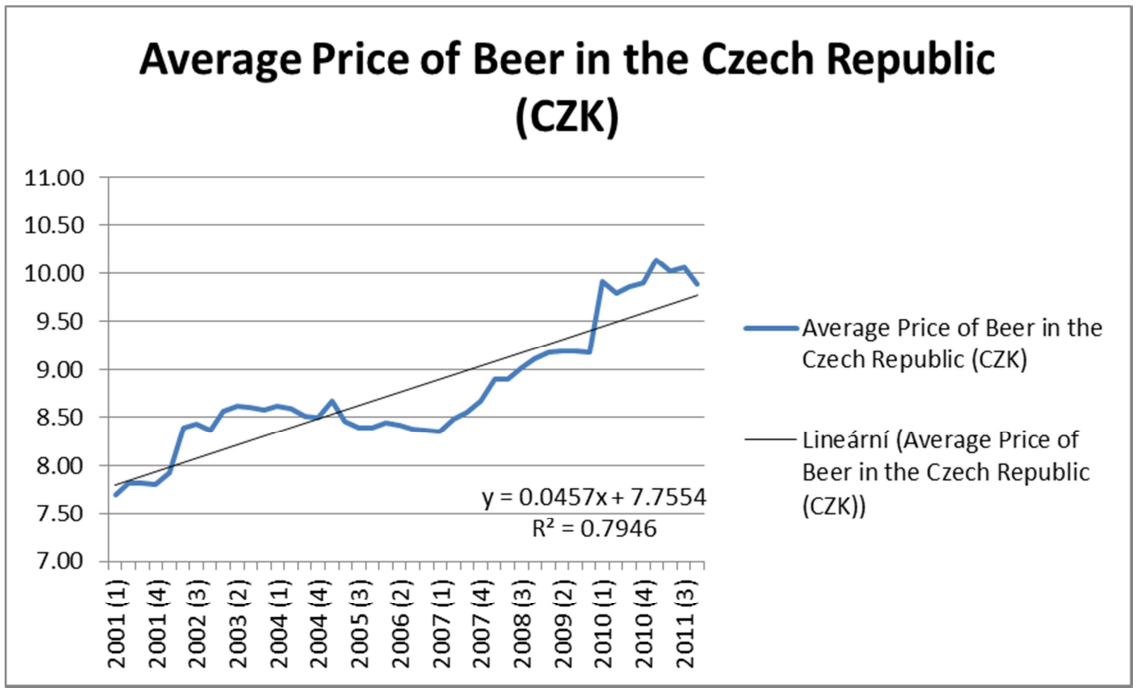



Population of 15+ in the Czech Republic (million)
9.1
9.0
8.9
8.8
8.7
8.6
8.5
2001 (1)
2001 (4)
2002 (3)
2003 (2)
2004 (1)
2004 (4)
2005 (3)
2006 (2)
2007 (1)
2007 (4)
2008 (3)
2009 (2)
2010 (1)
2010 (4)
2011 (3)
Population of 15+ in the Czech Republic (million)

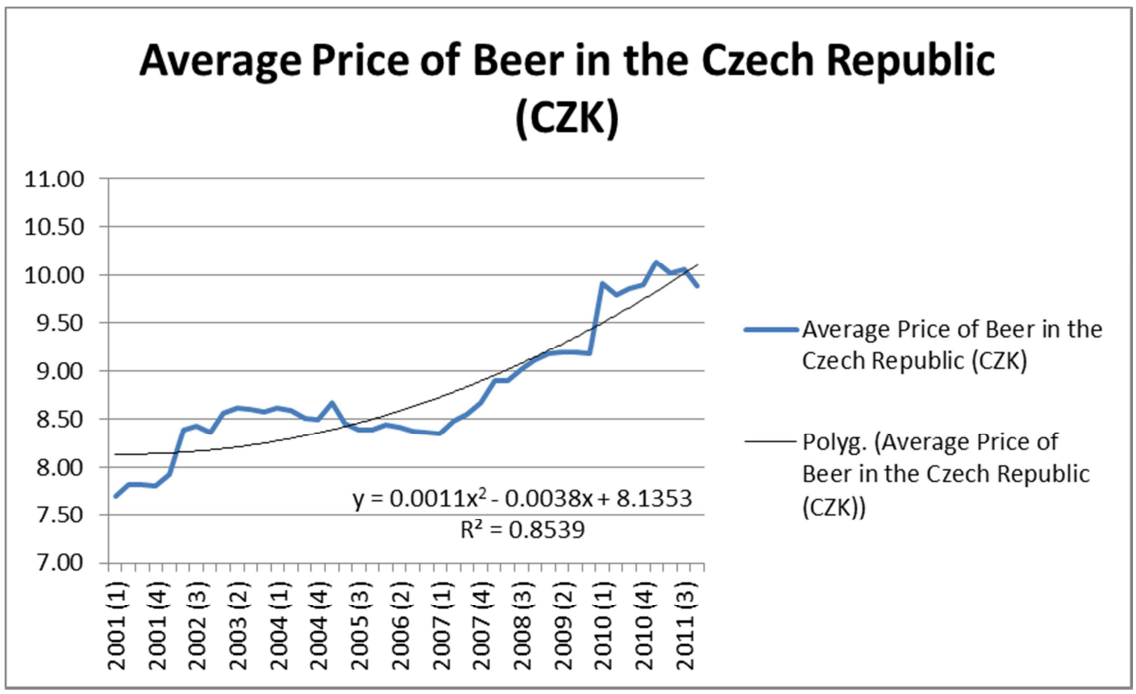

Average Consumption of Wine in the Czech Republic (l/pc)
20
20
19
19
18
18
17
17
16
2001 (1)
2001 (4)
2002 (3)
2003 (2)
2004 (1)
2004 (4)
2005 (3)
2006 (2)
2007 (1)
2007 (4)
2008 (3)
2009 (2)
2010 (1)
2010 (4)
2011 (3)
Average Consumption of Wine in the Czech Republic (l/pc)

Extra graphs for chapter 9.4 – Trend analysis

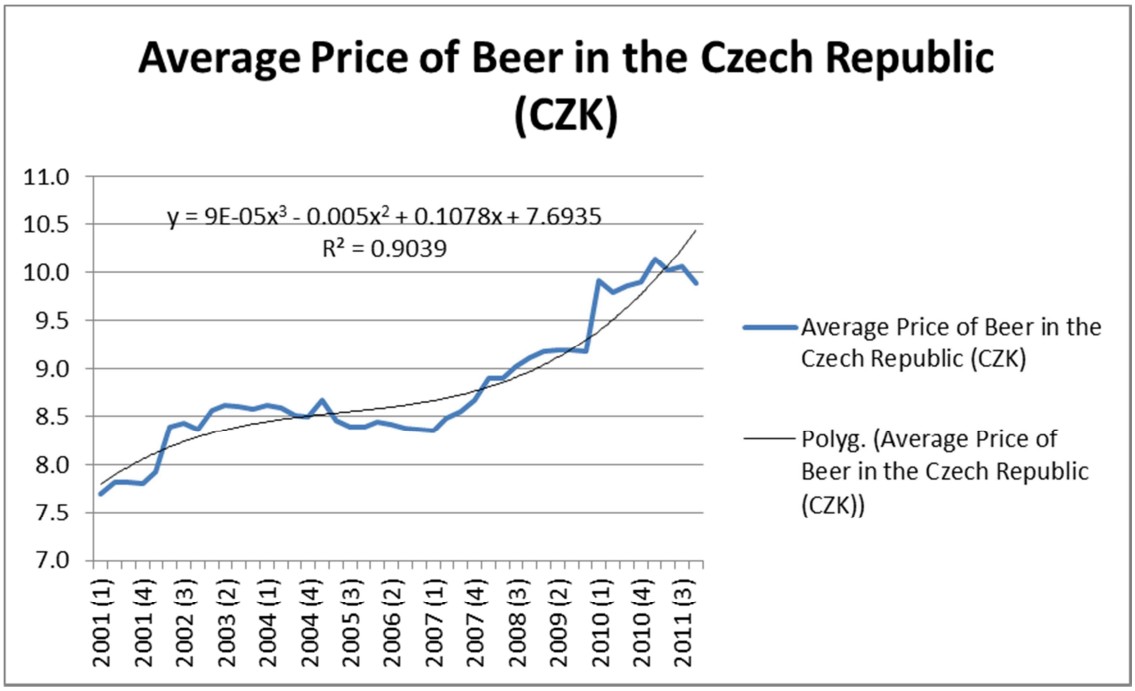
Linear function



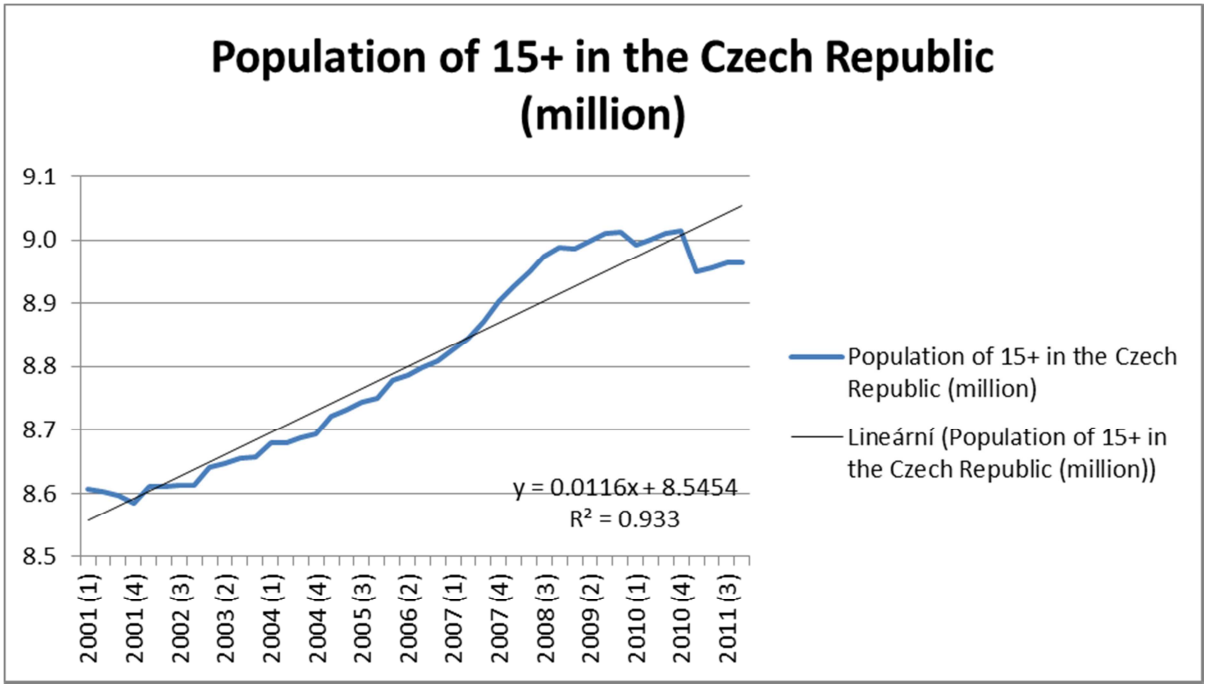
Quadratic function



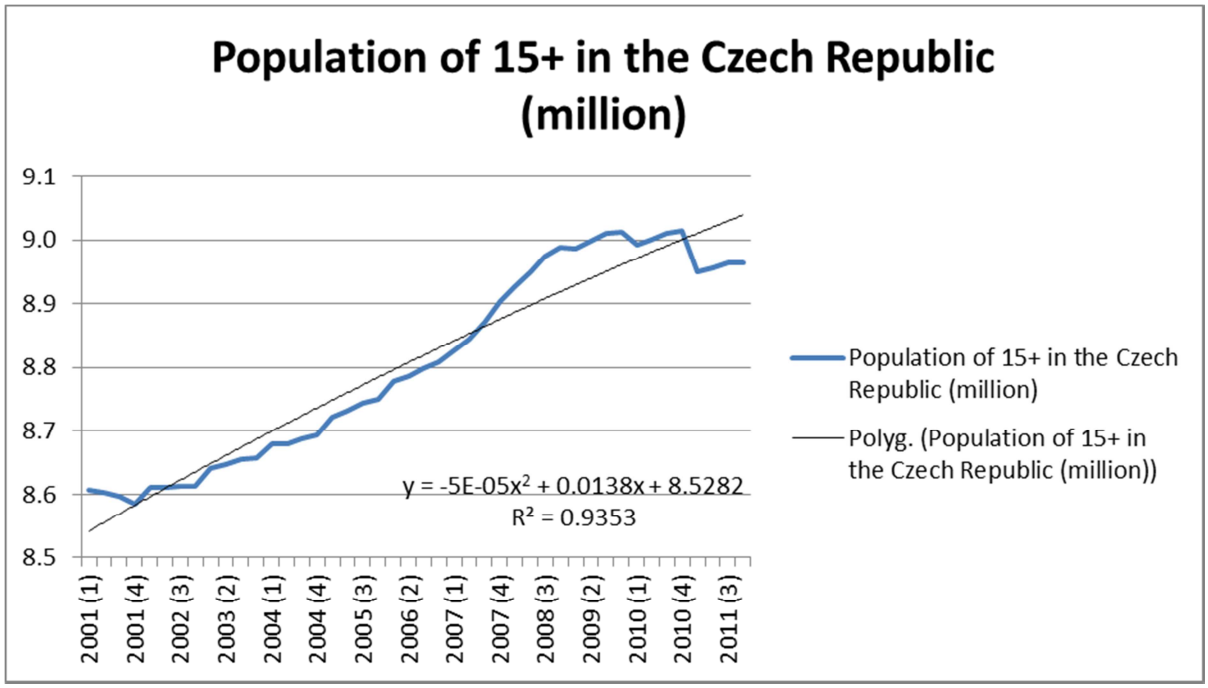
Cubic function



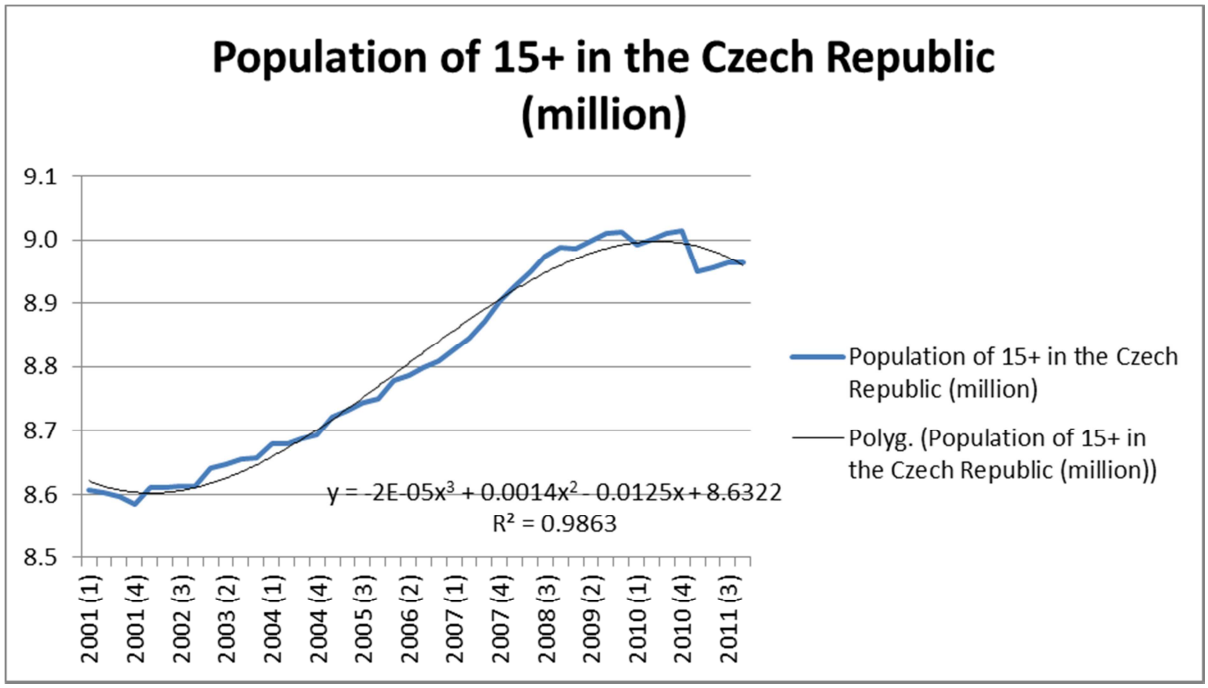
Linear function



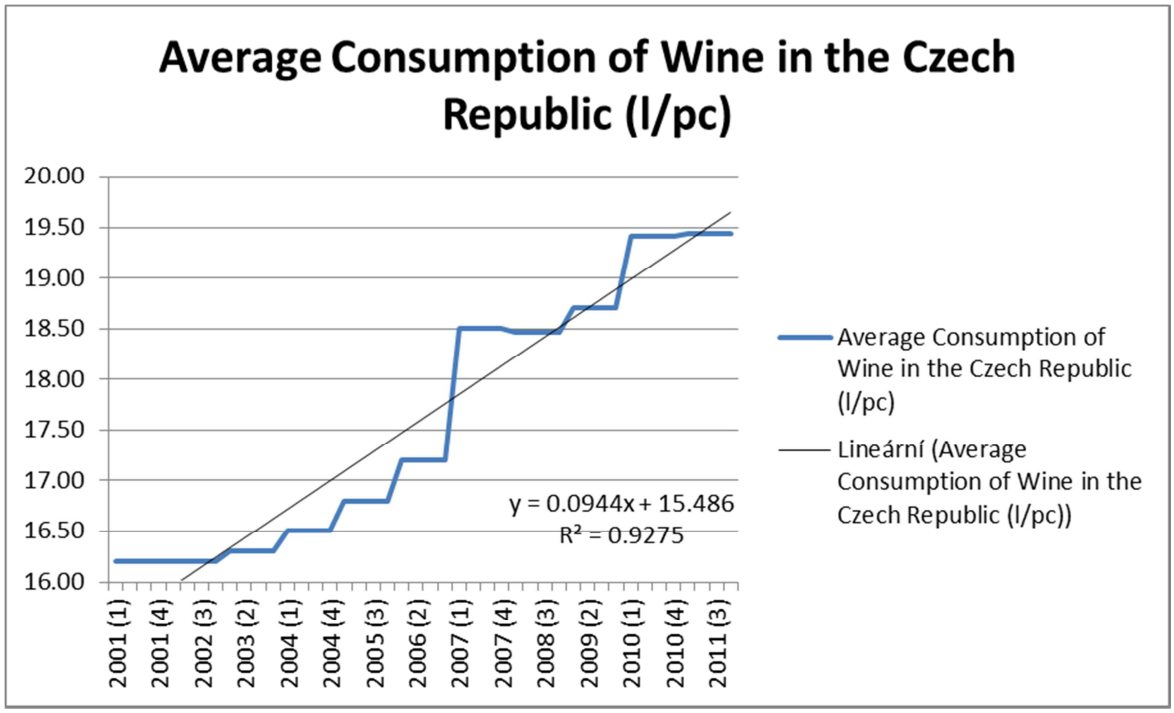
Quadratic function



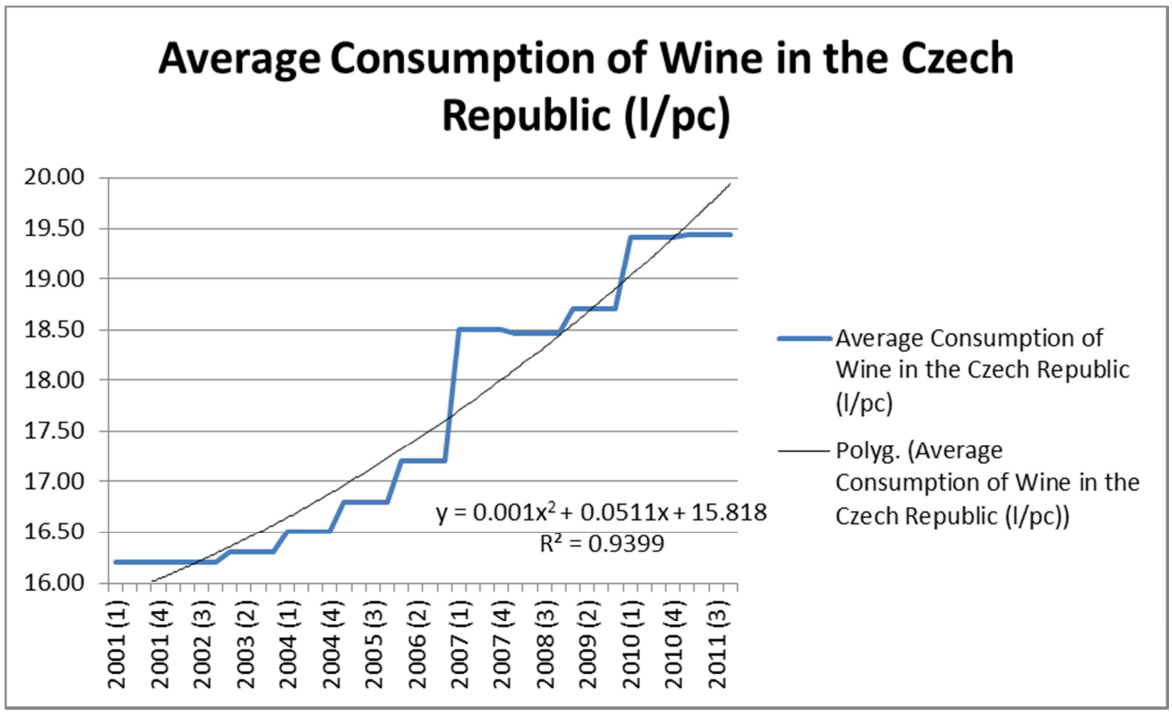
Cubic function



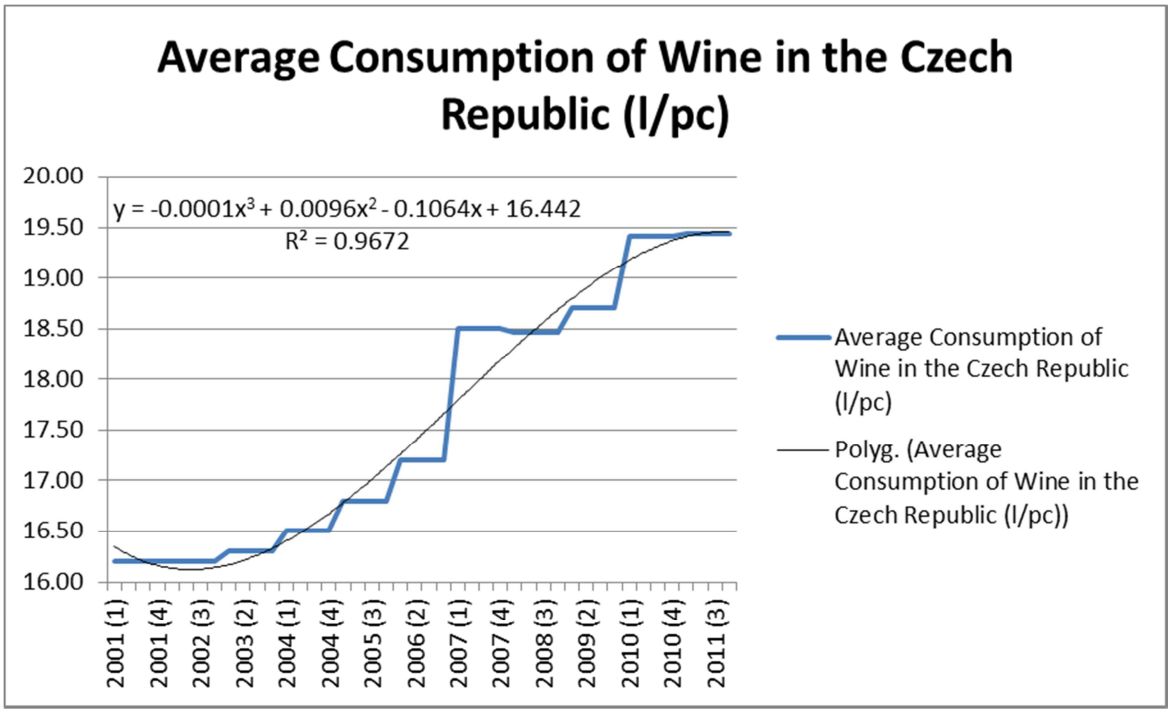
Linear function



Quadratic function



Cubic function



Extras for chapter 9.3 – Regression model

Model 14: OLS, using observations 2001:2-2011:4 (T = 43)
Dependent variable: Average_Consumption_of_Beer_in_

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	181.999	3.56676	51.0265	<0.00001	***
Average_Income_of_Czech_Citizend_Population_of_15__in_the_Cz	-1.37977	0.174854	-7.8910	<0.00001	***
	155.072	37.5334	4.1316	0.00018	***

Mean dependent var	155.8721	S.D. dependent var	6.827150
Sum squared resid	621.9611	S.E. of regression	3.943225
R-squared	0.682287	Adjusted R-squared	0.666401
F(2, 40)	42.94989	P-value(F)	1.10e-10
Log-likelihood	-118.4554	Akaike criterion	242.9108
Schwarz criterion	248.1944	Hannan-Quinn	244.8593
rho	0.385263	Durbin-Watson	1.193518

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 5.18718
with p-value = P(Chi-square(5) > 5.18718) = 0.393466

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 10.0348
with p-value = P(F(4,36) > 10.0348) = 1.46299e-005

Model 38: OLS, using observations 2001:2-2011:4 (T = 43)
Dependent variable: d_Average_Consumption_of_Beer

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	4.9204	3.43022	1.4344	0.15963	
d_Average_Income_of_Czech_Cit	0.374068	0.155613	2.4038	0.02121	**
Average_Price_of_Beer_in_the_Cz	0.600336	0.739466	0.8119	0.42193	
d_Population_of_15__in_the_Cz	37.0376	15.4266	2.4009	0.02136	**
Average_Consumption_of_Wine_in_	-0.621557	0.36401	-1.7075	0.09588	*

Mean dependent var	-0.335581	S.D. dependent var	1.698702
Sum squared resid	83.94445	S.E. of regression	1.486292
R-squared	0.307359	Adjusted R-squared	0.234449
F(4, 38)	4.215610	P-value(F)	0.006378
Log-likelihood	-75.39689	Akaike criterion	160.7938
Schwarz criterion	169.5998	Hannan-Quinn	164.0412
rho	-0.029624	Durbin-Watson	2.056815

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 34.246
with p-value = P(Chi-square(14) > 34.246) = 0.00189832

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 0.0759117
with p-value = P(F(4,34) > 0.0759117) = 0.989089

Model 40: OLS, using observations 2001:2-2011:4 (T = 43)
Dependent variable: d_Average_Consumption_of_Beer

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	1.85979	4.31107	0.4314	0.66862	
Average_Income_of_Czech_Citizen	-0.115239	0.121932	-0.9451	0.35057	
Average_Price_of_Beer_in_the_Cz	0.000251241	0.689101	0.0004	0.99971	
d_Population_of_15__in_the_Cz	34.3281	15.5856	2.2026	0.03377	**
d_Average_Consumption_of_Wine	-2.55744	0.993067	-2.5753	0.01403	**

Mean dependent var	-0.335581	S.D. dependent var	1.698702
Sum squared resid	85.96953	S.E. of regression	1.504113
R-squared	0.290649	Adjusted R-squared	0.215981
F(4, 38)	3.892527	P-value(F)	0.009567
Log-likelihood	-75.90940	Akaike criterion	161.8188
Schwarz criterion	170.6248	Hannan-Quinn	165.0662
rho	-0.040356	Durbin-Watson	2.064522

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 37.6896
with p-value = P(Chi-square(14) > 37.6896) = 0.000579588

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 0.460414
with p-value = P(F(4,34) > 0.460414) = 0.76419

Model 47: OLS, using observations 2001:2-2011:4 (T = 43)
Dependent variable: d_Average_Consumption_of_Beer

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-0.743712	0.267885	-2.7762	0.00833	***
d_Average_Income_of_Czech_Cit	0.38274	0.159906	2.3935	0.02147	**
d_Population_of_15__in_the_Cz	35.0889	14.5454	2.4124	0.02053	**

Mean dependent var	-0.335581	S.D. dependent var	1.698702
Sum squared resid	94.16561	S.E. of regression	1.534321
R-squared	0.223022	Adjusted R-squared	0.184173
F(2, 40)	5.740748	P-value(F)	0.006429
Log-likelihood	-77.86724	Akaike criterion	161.7345
Schwarz criterion	167.0181	Hannan-Quinn	163.6829
rho	0.081032	Durbin-Watson	1.836035

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 29.6807
with p-value = P(Chi-square(5) > 29.6807) = 1.70439e-005

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 0.259947
with p-value = P(F(4,36) > 0.259947) = 0.901644

Model 18: OLS, using observations 2001:2-2011:4 (T = 43)
Dependent variable: Average_Consumption_of_Beer_in_

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	230.528	6.96185	33.1130	<0.00001	***
d_Average_Income_of_Czech_Cit	0.110169	0.36586	0.3011	0.76496	
d_Average_Price_of_Beer_in_th	2.50835	3.48919	0.7189	0.47661	
d_Population_of_15__in_the_Cz	151.315	30.8101	4.9112	0.00002	***
Average_Consumption_of_Wine_in_	-4.31158	0.392288	-10.9909	<0.00001	***

Mean dependent var	155.8721	S.D. dependent var	6.827150
Sum squared resid	379.5442	S.E. of regression	3.160381
R-squared	0.806119	Adjusted R-squared	0.785711
F(4, 38)	39.49924	P-value(F)	4.74e-13
Log-likelihood	-107.8364	Akaike criterion	225.6729
Schwarz criterion	234.4789	Hannan-Quinn	228.9202
rho	0.542346	Durbin-Watson	0.887640

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 18.0023
with p-value = P(Chi-square(14) > 18.0023) = 0.206675

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 7.68875
with p-value = P(F(4,34) > 7.68875) = 0.000158964

Model 8: OLS, using observations 2001:2-2011:4 (T = 43)
Dependent variable: Average_Consumption_of_Beer_in_

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	164.662	1.32724	124.0634	<0.00001	***
d_Average_Income_of_Czech_Cit	0.0808836	0.45888	0.1763	0.86105	
d_Average_Price_of_Beer_in_th	-1.14825	3.96171	-0.2898	0.77356	
d_Population_of_15__in_the_Cz	147.101	34.9571	4.2080	0.00016	***
d_Average_Consumption_of_Wine	2.38357	2.76537	0.8619	0.39428	
Dummy	-1.66039	0.177566	-9.3508	<0.00001	***

Mean dependent var	155.8721	S.D. dependent var	6.827150
Sum squared resid	471.5936	S.E. of regression	3.570122
R-squared	0.759098	Adjusted R-squared	0.726544
F(5, 37)	23.31793	P-value(F)	1.64e-10
Log-likelihood	-112.5051	Akaike criterion	237.0102
Schwarz criterion	247.5774	Hannan-Quinn	240.9070
rho	0.556470	Durbin-Watson	0.832432

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 8.62845
with p-value = P(F(4,33) > 8.62845) = 7.00235e-005

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 18.9121
with p-value = P(Chi-square(20) > 18.9121) = 0.527544

Model 30: OLS, using observations 2001:2-2011:4 (T = 43)
Dependent variable: Average_Consumption_of_Beer_in_

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	236.717	6.49238	36.4607	<0.00001	***
d_Average_Income_of_Czech_Cit	-0.0758483	0.294529	-0.2575	0.79816	
Average_Price_of_Beer_in_the_Cz	-4.55963	1.39959	-3.2578	0.00237	***
d_Population_of_15__in_the_Cz	109.093	29.198	3.7363	0.00061	***
Average_Consumption_of_Wine_in_	-2.35528	0.688962	-3.4186	0.00152	***

Mean dependent var	155.8721	S.D. dependent var	6.827150
Sum squared resid	300.7156	S.E. of regression	2.813107
R-squared	0.846387	Adjusted R-squared	0.830217
F(4, 38)	52.34374	P-value(F)	5.95e-15
Log-likelihood	-102.8311	Akaike criterion	215.6622
Schwarz criterion	224.4682	Hannan-Quinn	218.9096
rho	0.545687	Durbin-Watson	0.817478

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 31.9098
with p-value = P(Chi-square(14) > 31.9098) = 0.00412594

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 4.72951
with p-value = P(F(4,34) > 4.72951) = 0.00383493

Model 23: OLS, using observations 2001:2-2011:4 (T = 43)
Dependent variable: d_Average_Consumption_of_Beer

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-0.413037	0.307236	-1.3444	0.18680	
d_Average_Income_of_Czech_Cit	0.153479	0.19191	0.7997	0.42883	
d_Average_Price_of_Beer_in_th	-2.22095	1.65681	-1.3405	0.18804	
d_Population_of_15__in_the_Cz	31.8205	14.5428	2.1881	0.03488	**
d_Average_Consumption_of_Wine	-1.59195	1.15148	-1.3825	0.17488	

Mean dependent var	-0.335581	S.D. dependent var	1.698702
Sum squared resid	84.76970	S.E. of regression	1.493580
R-squared	0.300549	Adjusted R-squared	0.226923
F(4, 38)	4.082084	P-value(F)	0.007536
Log-likelihood	-75.60723	Akaike criterion	161.2145
Schwarz criterion	170.0205	Hannan-Quinn	164.4618
rho	0.093578	Durbin-Watson	1.806687

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 34.0721
with p-value = P(Chi-square(14) > 34.0721) = 0.002013

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 0.433971
with p-value = P(F(4,34) > 0.433971) = 0.783093

Model 26: OLS, using observations 2001:2-2011:4 (T = 43)
Dependent variable: d_Average_Consumption_of_Beer

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-0.575179	0.285295	-2.0161	0.05072	*
d_Average_Income_of_Czech_Cit	0.240152	0.182526	1.3157	0.19595	
d_Population_of_15__in_the_Cz	36.1701	14.3203	2.5258	0.01572	**
d_Average_Consumption_of_Wine	-1.77658	1.15483	-1.5384	0.13203	

Mean dependent var	-0.335581	S.D. dependent var	1.698702
Sum squared resid	88.77824	S.E. of regression	1.508763
R-squared	0.267474	Adjusted R-squared	0.211126
F(3, 39)	4.746809	P-value(F)	0.006456
Log-likelihood	-76.60060	Akaike criterion	161.2012
Schwarz criterion	168.2460	Hannan-Quinn	163.7991
rho	0.089371	Durbin-Watson	1.819019

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 31.4965
with p-value = P(Chi-square(9) > 31.4965) = 0.00024322

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 0.384213
with p-value = P(F(4,35) > 0.384213) = 0.818412

Model 25: OLS, using observations 2001:2-2011:4 (T = 43)
Dependent variable: d_Average_Consumption_of_Beer

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-0.307633	0.276245	-1.1136	0.27226	
d_Average_Price_of_Beer_in_th	-2.66737	1.55272	-1.7179	0.09375	*
d_Population_of_15__in_the_Cz	31.1586	14.452	2.1560	0.03731	**
d_Average_Consumption_of_Wine	-1.99197	1.03237	-1.9295	0.06097	*

Mean dependent var	-0.335581	S.D. dependent var	1.698702
Sum squared resid	86.19649	S.E. of regression	1.486663
R-squared	0.288776	Adjusted R-squared	0.234067
F(3, 39)	5.278361	P-value(F)	0.003751
Log-likelihood	-75.96609	Akaike criterion	159.9322
Schwarz criterion	166.9770	Hannan-Quinn	162.5301
rho	0.088499	Durbin-Watson	1.814936

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 34.2861
with p-value = P(Chi-square(9) > 34.2861) = 7.95743e-005

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 0.449511
with p-value = P(F(4,35) > 0.449511) = 0.772012

Model 28: OLS, using observations 2001:2-2011:4 (T = 43)
Dependent variable: d_Average_Consumption_of_Beer

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-0.541892	0.296159	-1.8297	0.07494	*
d_Average_Income_of_Czech_Cit	0.268728	0.174867	1.5368	0.13243	
d_Average_Price_of_Beer_in_th	-2.49493	1.66403	-1.4993	0.14184	
d_Population_of_15__in_the_Cz	30.329	14.6712	2.0672	0.04539	**

Mean dependent var	-0.335581	S.D. dependent var	1.698702
Sum squared resid	89.03361	S.E. of regression	1.510931
R-squared	0.265367	Adjusted R-squared	0.208857
F(3, 39)	4.695908	P-value(F)	0.006805
Log-likelihood	-76.66235	Akaike criterion	161.3247
Schwarz criterion	168.3695	Hannan-Quinn	163.9226
rho	0.090353	Durbin-Watson	1.812220

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 27.6393
with p-value = P(Chi-square(9) > 27.6393) = 0.00109561

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 0.246504
with p-value = P(F(4,35) > 0.246504) = 0.909839

Model 18: OLS, using observations 2001-2011 (T = 11)
Dependent variable: Average_Consumption_of_Beer_in_

	Coefficient	Std. Error	t-ratio	p-value	
const	297.907	44.966	6.6252	0.00017	***
l_Average_Income_of_Czech_Cit	-1.6623	14.3133	-0.1161	0.91041	
l_Average_Price_of_Beer_in_th	-63.3098	34.8424	-1.8170	0.10674	

Mean dependent var	155.8955	S.D. dependent var	6.997592
Sum squared resid	175.2499	S.E. of regression	4.680411
R-squared	0.642101	Adjusted R-squared	0.552626
F(2, 8)	7.176331	P-value(F)	0.016408
Log-likelihood	-30.83407	Akaike criterion	67.66815
Schwarz criterion	68.86183	Hannan-Quinn	66.91569
rho	0.436523	Durbin-Watson	0.788982

LM test for autocorrelation up to order 1 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 1.8043
with p-value = P(F(1,7) > 1.8043) = 0.221109

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 4.73516
with p-value = P(Chi-square(5) > 4.73516) = 0.449049

Model 60: OLS, using observations 2001-2011 (T = 11)
Dependent variable: l_Average_Consumption_of_Beer

	Coefficient	Std. Error	t-ratio	p-value	
const	7.45103	0.793093	9.3949	0.00001	***
l_Average_Income_of_Czech_Cit	0.20439	0.152021	1.3445	0.21567	
l_Average_Consumption_of_Wine	-1.04502	0.420932	-2.4826	0.03796	**

Mean dependent var	5.048242	S.D. dependent var	0.045909
Sum squared resid	0.006024	S.E. of regression	0.027441
R-squared	0.714179	Adjusted R-squared	0.642724
F(2, 8)	9.994793	P-value(F)	0.006674
Log-likelihood	25.69600	Akaike criterion	-45.39199
Schwarz criterion	-44.19831	Hannan-Quinn	-46.14445
rho	0.332460	Durbin-Watson	1.249618

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 8.77913
with p-value = P(Chi-square(5) > 8.77913) = 0.118205

LM test for autocorrelation up to order 1 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 0.845756
with p-value = P(F(1,7) > 0.845756) = 0.388348

Model 9: OLS, using observations 2001:1-2011:4 (T = 44)
Dependent variable: l_Average_Consumption_of_Beer

	Coefficient	Std. Error	t-ratio	p-value	
const	6.37177	0.147193	43.2886	<0.00001	***
l_Average_Price_of_Beer_in_th	-0.329163	0.0913143	-3.6047	0.00084	***
l_Average_Consumption_of_Wine	-0.212539	0.0945829	-2.2471	0.03008	**

Mean dependent var	5.048242	S.D. dependent var	0.044279
Sum squared resid	0.022432	S.E. of regression	0.023391
R-squared	0.733924	Adjusted R-squared	0.720944
F(2, 41)	56.54557	P-value(F)	1.63e-12
Log-likelihood	104.3588	Akaike criterion	-202.7175
Schwarz criterion	-197.3650	Hannan-Quinn	-200.7326
rho	0.852596	Durbin-Watson	0.194936

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 28.3432
with p-value = P(Chi-square(5) > 28.3432) = 3.11855e-005

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 23.4093
with p-value = P(F(4,37) > 23.4093) = 1.04379e-009

Model 10: OLS, using observations 2001:1-2011:4 (T = 44)
Dependent variable: l_Average_Consumption_of_Beer

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	5.58932	0.0484596	115.3399	<0.00001	***
Average_Price_of_Beer_in_the_Cz	-0.0392889	0.00992792	-3.9574	0.00029	***
Average_Consumption_of_Wine_in_	-0.0111265	0.00519485	-2.1418	0.03820	**

Mean dependent var	5.048242	S.D. dependent var	0.044279
Sum squared resid	0.020346	S.E. of regression	0.022276
R-squared	0.758671	Adjusted R-squared	0.746899
F(2, 41)	64.44641	P-value(F)	2.21e-13
Log-likelihood	106.5065	Akaike criterion	-207.0130
Schwarz criterion	-201.6604	Hannan-Quinn	-205.0280
rho	0.841368	Durbin-Watson	0.209485

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 27.6041
with p-value = P(Chi-square(5) > 27.6041) = 4.3494e-005

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 21.7949
with p-value = P(F(4,37) > 21.7949) = 2.61545e-009

Model 8: OLS, using observations 2001:1-2011:4 (T = 44)
Dependent variable: l_Average_Consumption_of_Beer

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	6.16634	0.125523	49.1253	<0.00001	***
l_Average_Income_of_Czech_Cit	0.0160781	0.0359536	0.4472	0.65709	
l_Average_Price_of_Beer_in_th	-0.537139	0.091623	-5.8625	<0.00001	***

Mean dependent var	5.048242	S.D. dependent var	0.044279
Sum squared resid	0.025072	S.E. of regression	0.024729
R-squared	0.702604	Adjusted R-squared	0.688097
F(2, 41)	48.43173	P-value(F)	1.60e-11
Log-likelihood	101.9106	Akaike criterion	-197.8212
Schwarz criterion	-192.4686	Hannan-Quinn	-195.8362
rho	0.834226	Durbin-Watson	0.227546

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 27.1408
with p-value = P(Chi-square(5) > 27.1408) = 5.3551e-005

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 21.3332
with p-value = P(F(4,37) > 21.3332) = 3.43033e-009