THE IMPACT OF CHANGES IN PRICES OF PETROLEUM PRODUCTS ON THE GENERAL PRICE LEVEL

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Abstract

Market is a complex mechanism; a regulator which, using the logic of competition and price, balances the supply and demand for products and services. In quantitative terms, the price is an expression of a seller's willingness to trade goods or services for their cash equivalent, and at the same time a customer's willingness to pay this amount of money in exchange for acceptable goods or services.

The economic importance of the price of a product is not the same for all products. The prices of some products are more important for the functioning of the entire economy than the prices of other products. Such are the prices of crude oil and petroleum products because they have a strong and direct impact on the pricing of other products and services, because petroleum products are inputs in almost every manufacturing process.

This paper attempts to establish the correlation between changes in the prices of oil and petroleum products and the prices of consumer goods.

The main hypothesis is that an increase, or a decrease, in crude oil and petroleum product prices directly and automatically increases, or decreases, the prices of consumer goods.

The paper explores the regularity and patterns that appear between changes in the prices of petroleum products and the prices of consumer goods in Bosnia and Herzegovina for the period from 2008 to 2014.

Keywords: *general price level, correlation, regression, time series, prices of petroleum products.*

JEL Classification: R11, E3, E31

INTRODUCTION

In this paper is written about topic which is always current, impact of oil price changes on general price movement. It has been analyzed situation and movement of consumer products prices as oil prices changes in same period of time. It has been analyzed market of Bosnia and Herzegovina.

Main hypothesis, which is center of research, is: "Changes of oil prices in analyzed time period have positive correlation with consumer prices change for the same period."

Today when all business activities are made throughout advanced information technologies, which accelerated process of globalization, local market is impacted with global market as well. Specific impact of globalization could be seen on oil market. Oil prices on any local market is reflection of crude oil price changes on global market. Market of Bosnia and Herzegovina, which is analyzed, is not an exception.

Economic growth and social development are very strongly linked and are impossible without using different aspects of energy. Significance of oil in global economy as well as in EU members, is of essential importance. Crude oil and it´s price volatility is a key indicator for various market participants such as investors, producers and most important for consumers. It is a major factor for international and national economic growth. Increasing dynamics of oil prices has provoked many researchers to study it´s instability. Global increase in crude oil prices is causing a sustained increase in prices of petroleum products in the world as well as in Bosnia and Herzegovina. In 2013 the EU consumed about

4 billion barrels. At an average price of $100 this translated into $400 billion of EU final oil consumer spending or 2, 2% of EU GDP (Zachman, 2015). Recent studies have tried to explain this dynamics by taking into account the role of various market participants many of whom have increasingly used crude oil for portfolio diversification (D´Ecclesia et al, 2014, vol. 46).

Keun-Young Lee concluded that a rise in oil prices reduces the GDP and increases the CPI (consumer price index). After analyzing the asymmetric effect of oil prices on the GDP and CPI, it is shown that a rise in oil prices affect the GDP and inflation more significantly than a decline in oil prices. In particular, the asymmetric effect is more attuned to the CPI rather than to GDP (Keun-Young, 2002, 103).

1. OIL AS A KEY ENERGY SOURCE FOR EVERY ECONOMY

Oil is one of the most important and strategic energy resource in world economy. On the global level, still more than 40% of energy needs is completed with oil, and in USA (as the biggest oil consumer) more than that. Therefore it can be reasonable that crude oil pricing, consumption and demand analysis are in main focus of many researches and energy analysis.

Strategic role of oil and its whole meaning for every economy can be analyzed throughout whole last century, starting from world war one. Oil prices, beside politics and diplomatic affairs are affected by increase of demand and by insufficient producers' reserves in situation of offer decrease (Dekanić, 2011, str. 360). Oil is very important strategic part of energy system and it has significant impact on economy of every country. Today, oil sector is characterized by trend of constant increase of demand, especially in developing countries where average yearly growth rate is 2.5%.

Developed countries increase their consumption as well but with slower pace, because of their rationalizations programs and high technologic improvements. Oil market is still very sensitive of global political changes, whereas by every new crisis, price of oil increases. That implicates on fact that every country needs to have its own energy policy with long-term vision of this energetic sector development.

In world oil market analysis, in economic terms, it can be supply domination or demand domination. Although, political relations in the world can be characterized as dominant bipolar or dominant multipolar political relations. At the dominant bipolar relations, as for example in time of cold war or in time of détente, key political relations were between two most powerful countries. In the stage of dominant multipolar structure (time before world war two for example or postindustrial development in second part of 80's last century) is present higher complexity in political relations and multiple dependency in global relations (Dekanić, 2011, str. 360).

Those relations result with four possible situations on oil market:

- Stability at the lower price level (demand domination and bipolar political stage);
- Stability at the higher price level (supply domination and bipolar political stage);
- Price oscillation with supply domination and multipolar global political structures (oil shocks);
- Price oscillation with demand domination and multipolar global political structures.

In stage of stability there are these tendencies:

- Demand domination which develops technology of oil refining;
- Supply domination (high oil prices) which forces development of technology of saving energy, as well as technology of exploring oil and gas fields (Dekanić, 2001, str.360).

In stage of market oscillation, technology of exploring resources has priority with:

- Domination of supply which develops technologies which are base for exploring of oil and gas fields, as well as technology for energy save;
- Domination of demand with technologies of exploring new resources and new ways of oil refining.

Chart 1: Brent Crude oil price in US dollars per barrel (2000-2015)

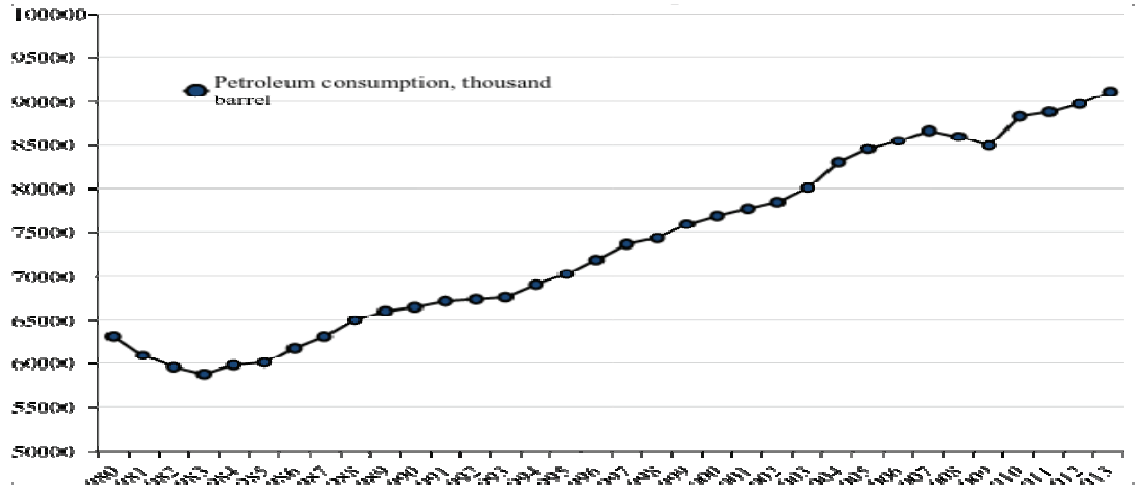
Note: The chart is taken from http://blogs.lse.ac.uk/europpblog/2015/01/21/falling-oil-prices-should-help-europes-ailing-economies-but-the-wider-implications-of-the-price-drop-remain-to-be-seen/

Chart 1 shows crude oil Brent movements expressed in American dollars for period from 2000 till 2015.

With the increase in oil prices, rises costs, particularly in the production and transport, wherein grows prices even on products that are not directly related to oil. The so called winners of the decrease in prices of oil are countries that import more than they produce, countries most dependent on agriculture, because agriculture is more energy-intensive than manufacturing.

The so called losers are EU, trying to reduce dependence on Russia and to cut carbon emissions by turning away from fossil fuels, cheaper oil makes these aims slightly harder to achieve, Saudi Arabia – at $115 a barrel makes $360 billion in net export a year, at $85 it is $270 billion (The Economist, Winners and losers, 2014).

Chart 2. Oil consumption



Note: Author calculation

As shown in chart 2. in 1980 world annual consumption of petroleum products amounted 63, 1 million barrels per day, in 2000 it was around 76, 9 million and in 2013 it was around 91, 2 million barrels per day. Since 1980 till 2013, the growth of annual consumption has increased by 44, 47 %. The IMF projected the volume of world oil demand in 2020 to be around 115 million barrels per day (WEO, 2000, 115). North America and Europe rely on oil for about 40% of their energy needs, and this share has been relatively stable over the past several decades (Barrell & Pomerantz, 2004, 154).

2. MARKET OF OIL AND OIL DERIVATIVES IN BOSNIA AND HERZEGOVINA

The oil market in Bosnia and Herzegovina is almost fully dependent on import which was one of the important aspects for analysis. According to available data, petroleum products consumption in Bosnia and Herzegovina ranged from about 800 000 tons by 2000. to 1.3 million tons in 2005. Imports of petroleum products were mostly from Croatia, Serbia, Montenegro and Hungary. According to the structure of the final consumption the largest share in final consumption of petroleum products takes traffic (almost 70%) followed by industry with 12%, households with 10%, agriculture with 8% and services with only 2%.

In Bosnia and Herzegovina operates more than 800 gas stations, of which a large number are built after enactment of law on independent economic activity in Bosnia and Herzegovina in 1990. In terms of competitiveness that may be

perceived as acceptable, but in terms of economically certainly is an irrational investments however, even now management of certain number of gas stations takes place on the verge of profitability, and some are closing. It is important to emphasize that in Bosnia and Herzegovina there is so-called free pricing respectively prices defines market. In comparison with EU countries, the retail price of derivatives are in Bosnia and Herzegovina significantly lower, but it is exclusively due to lower excise duties and taxes. If one compares the net price, then they are in Bosnia and Herzegovina something higher than in EU countries.

In the pre-war period the needs of Bosnia and Herzegovina for petroleum products were between 1.5 and 1.7 million tons annually. For example, in 1990. on the market of Bosnia and Herzegovina was sold 1.68 million tons of various derivatives. During the design and construction of a new line of processing 3 million tons per year in the oil refinery in Bosanski Brod it was calculated that the needs of Bosnia and Herzegovina will be around 2.3 million tons of petroleum products a year. According to available data from 2004. till 2009. consumption of petroleum derivatives in Bosnia and Herzegovina ranged from about 800 000 tons to 1.3 million tons per year.

3. CPI (CONSUMER PRICE INDEX)

The CPI (consumer price index) is a measurement of change in prices of consumer goods tracked from month to month. Consumer goods covers all sorts of products and services (food, clothes, education, transport...) and is considered to be the true "cost of living" concept. CPI is the most common and closely observed price statistics and indicator of efficiency of the economic policy of the state itself.

The Consumer Price Index is a measure of change in prices of goods and services which consumers buy for their personal needs on the economic territory of Bosnia and Herzegovina. The Consumer Price index is a measure of inflation in the county. CPI in Bosnia and Herzegovina is calculated on the basis of the representative list of products. Every month is collected over 21.000 prices in advance defined sample of outlets in twelve major cities in Bosnia and Herzegovina. Prices are collected in twelve locations (cities) in the county (Banja Luka, Bihać, Bijeljina, Brčko, Doboj, East Sarajevo, Mostar, Prijedor, Sarajevo,

Tuzla i Zenica) chosen by the criteria of population and their role in the geographical areas.

For classification of the products from statistics in the CPI it is used classification of individual consumption by purpose which divides expenditure on twelve primary groups of products and services for which are calculated indexes, as follows:

- food and non-alcoholic drinks;
- alcoholic beverages and tobacco;
- clothing and footwear;
- housing, water, electricity, gas and other fuels;
- furniture, household equipment and routine household maintenance;
- health;
- transport;
- communications;
- recreation and culture;
- education;
- restaurants and hotels;
- other goods and services.

4. ANALYSIS OF OIL PRICE CHANGES IMPACT OF CONSUMER PRICE CHANGE

In this chapter will be analyzed consumer product price change and oil price change and its correlation on the market of Bosnia and Herzegovina. Main goal of this analysis is show how consumer products price change due oil price changes on market of Bosnia and Herzegovina in time period from 2008 until 2014.

Analysis of correlation between consumer product price change and oil price change in past 7 years will be done by appliance of programming language R and its packages. All commands in R language are intuitive and there is no need of higher level computer programming knowledge to its understanding. All data for analysis, consumer product price change and oil price change in percentage are prepared in dataset form and stored in Excel worksheet.

Below is shown part of data (only for two years) in Excel worksheet. Data about average oil prices, oil price changes in percentage and consumer products

price changes in percentage for time period from 2008 till 2014. These data are collected throughout conducted research with help of Ministry of trade of BiH and Agency for statistics of BiH.

Table 1. Oil price and consumer prices change data

Year	Months	Average Oil Price	Oil Price Change in %	Consumer Products Price Change in %
2008	1.	2,040	-	-
	2.	2,092	2,55	1,80
	3.	2,164	3,44	0,10
	4.	2,242	3,60	-0,40
	5.	2,405	7,27	0,90
	6.	2,523	4,91	0,90
	7.	2,533	0,40	0,10
	8.	2,447	-3,40	0,10
	9.	2,336	-4,54	0,10
	10.	2,182	-6,59	0,70
	11.	1,996	-8,52	-0,60
	12.	1,79	-10,32	-0,60
2009	13.	1,667	-6,87	-0,10
	14.	1,624	-2,58	-0,10
	15.	1,559	-4,00	-0,10
	16.	1,534	-1,60	-1,20
	17.	1,582	3,13	-0,10
	18.	1,656	4,68	0,10
	19.	1,777	7,31	0,70
	20.	1,855	4,39	-0,20
	21.	1,844	-0,59	0,10
	22.	1,812	-1,74	0,70
	23.	1,869	3,15	0,10
	24.	1,847	-1,18	0,10

Note: Author calculation

Command *conn* = odbcConnectExcel("C:\\DataOilPrice.xls") connects with data stored in Excel file named DataOilPrice. In business intelligence system is usuall to interpret data using three-dimensional visualization (in data cube form). In our example data cube is formed by data of consumer products prices changes, and oil price changes in Bosnia and Herzegovina of time period

for 84 months, from 2008 until 2014. Lines of commands in programming language R to create three-dimensional data cube:

> library(RODBC)

> conn = odbcConnectExcel("C:\\DataOilPrice.xls")

> korel = sqlFetch(conn, "List1")

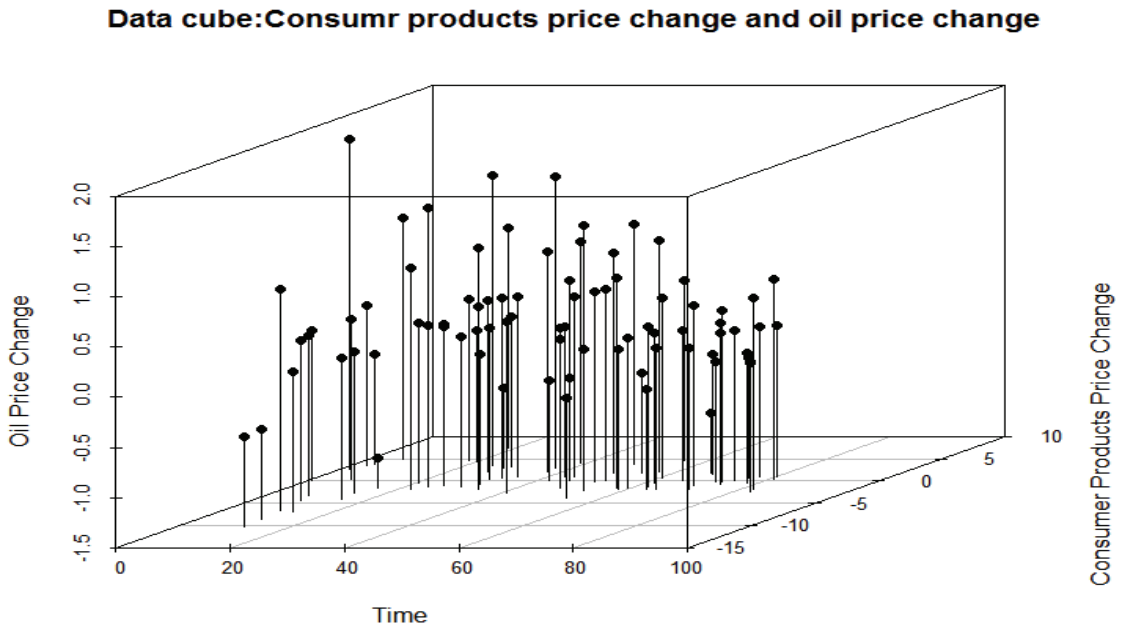
> X=korel$Time

> Y=korel$OPCP

> Z=korel$CCPP

> scatterplot3d (X, Y, Z, pch=16, type="h", main="Data cube:Consumr products price change and oil price change", xlab="Time", ylab=" Consumer Products Price Change", zlab = " Oil Price Change ")

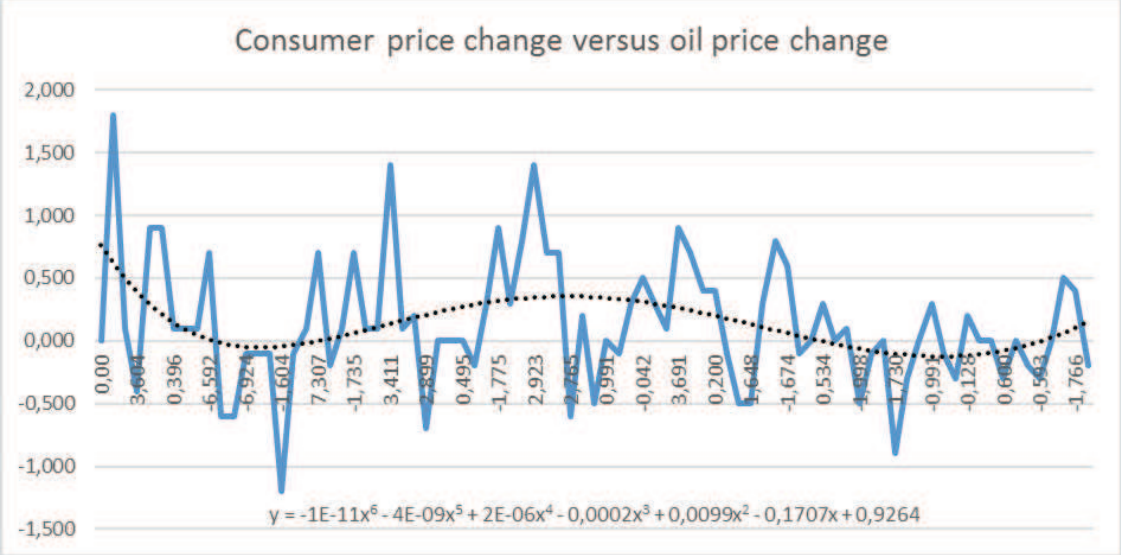
Chart 4. Consumer products price change and oil price change



Note: Author calculation

Picture above shows the correlation between consumer products price change and oil price change for the period from 2008 until 2014. Z-axis represents the percentage of oil price change, Y-axis percentage of consumer products price change and axis-X represents time (84 months).

Graph 5. Regression line



Note: Author calculation

Graph 5 shows regression line which presents correlation between consumer products price change and oil price change in time period from 2008 till 2014. Polynomial sixth grade (regression function), best adapts to the original data (best approximates them).

$$\boldsymbol{CPPC} = -1E\text{-}11OPC^6 - 4E\text{-}09OPC^5 + 2E\text{-}06OPC^4 - 0{,}0002OPC^3 + 0{,}0099OPC^2 - 0{,}1707OPC + 0{,}9264$$

CPPC is the change consumer products price and **OPC** is oil price change in Bosnia and Herzegovina for the period from 2008 till 2014.

4.1. Regression analysis in programming language R

First, data are load from file DataOilPrices.xls Then connection string to that file is set:

```
> conn = odbcConnectExcel("C:\\DataOilPrice.xls")
```

After that data from sheet in Excel are imported with this commands:

```
>korel = sqlFetch(conn, "List1")
```

With command *korel* data are loaded and shown (as below).

```
> korel
```

Time	AOP	OPCP	CCPP
1	2.040	0.00000000	0.0
2	2.092	2.54901961	1.8
3	2.164	3.44168260	0.1
4	2.242	3.60443623	-0.4
5	2.405	7.27029438	0.9
6	2.523	4.90644491	0.9
7	2.533	0.39635355	0.1
8	2.447	-3.39518358	0.1
9	2.336	-4.53616673	0.1
10	2.182	-6.59246575	0.7
11	1.996	-8.52428964	-0.6
12	1.791	-10.27054108	-0.6
.....			
.....			
78	2.359	-0.42211904	-0.2
79	2.345	-0.59347181	-0.3
80	2.369	1.02345416	0.0
81	2.378	0.37990713	0.5
82	2.336	-1.76619008	0.4
83	2.279	-2.44006849	-0.2

After data are loaded, significant model of regression is calculated using function *lm()* in R language.

Commands in R language to call function *lm()*:

> regresija<-lm(korel$CCPP~korel$OPCP,data=korel)

> summary(regresija)

After input of commands in R language for regression analysis, result is:

Call:

lm(formula = korel$CCPP ~ korel$OPCP, data = korel)

Residuals:

Min	*1Q*	*Median*	*3Q*	*Max*

-1.22544 -0.22108 -0.04201 0.24179 1.53383

Coefficients:

	Estimate	*Std. Error*	*t value*	*Pr(>|t|)*
(Intercept)	***0.11840***	*0.05240*	*2.260*	*0.02653 **
korel$OPCP	***0.05797***	*0.01702*	*3.407*	*0.00103 ***

---

*Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Residual standard error: 0.4765 on 81 degrees of freedom

Multiple R-squared: 0.1253, Adjusted R-squared: 0.1145

F-statistic: 11.61 on 1 and 81 DF, ***p-value: 0.001025***

From this calculation result it is possible to form model of regression:

$CCPP = b_0 + b_1 * OPCP$

Where **CCPP** is change of consumer products price, **OPCP** is oil price change and coefficient $\mathbf{b_0}$ is part on Y axis and its value is $\mathbf{b_0 = 0.11840}$ and coefficient $\mathbf{b_1}$ is incline of regression line and it value is $\mathbf{b_1 = 0.05797}$.

From analysis is clear that part on Y axis (coefficient b_0) is not 0, as well as incline of regression line (b_1).

$\mathbf{CCPP} = b_0 + b_1 * \mathbf{OPCP}$

$\mathbf{CCPP = 0.11840 + 0.05797 * OPCP}$

Probability is labeled as *p-value*. That value is probability that coefficient by variable is not significant. Smaller values are better in that case. Bigger p-value indicates bigger probability of insignificance coefficient in regression. In this analysis for coefficient beside variable OPCP, p-value is **0.001025**. That value is small (lower from most common value 0.05), which indicates that value of coefficient beside variable OPCP cannot be considered as equal zero.

R language uses appropriate marks to visualize quick identification of variables. In last column are special marks *. One mark signify value between 0.01 and 0.05 (p-value). (Markić, 2014, 92).

Table 2. P-value marks

***	*p*-value između 0 i 0.001
**	*p*-value između 0.001 i 0.01
*	*p*-value između 0.01 i 0.05
.	*p*-value između 0.05 i 0.1
(blank)	*p*-value između 0.1 i 1.0

Source: Markić, Brano; Sustavi za otporu odlučivanju, 2014, str 92

Column marked with *Std. Error* is standard error estimated coefficients. Column marked as *t value* is t-statistics from which is probability is calculated (*p-value*). Row:*"Residual standard error: 0.4765 on 81 degrees of freedom is* **standard deviation errors e.**

Coefficient determination R^2 is measure of model quality. Higher value is better.

In this analysis Multiple R-squared is *0.1253.*

Row: *F-statistic: 11.61 on 1 and 81 DF, p-value: 0.001025* indicates model significance or it insignificance. Model is significant if one of coefficients is not equal zero. Model is insignificant if all its coefficients are equal zero ($b_1 = b_2 = \ldots = bn = 0$).

If p-value is lower than 0.05 that indicates that model is significant. In presented analysis probability (p-value) is **0.001025** which is less than 0.05. That indicates that presented regression model is significant.

Also using R language is calculated coefficient of correlation between two variables, consumer products price change and oil price change to measure strength of correlation between those two variables.

Commands in R language to calculate coefficient of correlation between two variables:

```
> library(RODBC)
> conn = odbcConnectExcel("C:\\DataOilPrice.xls")
> korel = sqlFetch(conn, "List1")
> X=korel$OPCP
> Y=korel$CCPP
```

> cor(X,Y)

[1] 0.3540327

As a result of calculation in R language is correlation value which is **0.3540327**. That correlation value show that although impact of oil price changes on changes of consumer products prices exists, what is proven by model of regression which is significant, that correlation is not so strong.

5. CONCLUSION

The aim of whole paper is, trough analysis, to show connection/correlation between two variables, change of oil prices as independent variable and change of consumer products prices as dependent variable.

Regression analysis showed that it is possible to describe that correlation with model:

CCPP = 0.11840 + 0.05797 * OPCP.

In this model dependent variable is CCPP – consumer products price change is with positive correlation with oil price change. Percentage change of oil prices implicates percentage price change of consumer products in same direction. By shown model above if oil prices rise by 1% of consumer prices will rise by 1.11840%.

But, although it is shown that assumed model is significant, with calculation of coefficient of correlation (correlation value = 0, 3540327) it was concluded that the relationship between the assumed variables is not so strong.

Based on that analysis it can be concluded that although there is a connection/correlation between the variables it is not so dominant. In another words, oil price change in the short time period, does not implicates strong reaction of consumer products price change.

Based on presented facts it can be concluded that on the Bosnia and Herzegovina market at consumer products pricing doesn't dominate cost principle of price determination.

It is natural to assume that process of pricing is mostly affected with value principle, whereas consumers associate to certain product value based on the purchase or after purchase experience and with market competition.

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