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CORRELATION BETWEEN OIL PRICES AND CURRENCY EXCHANGE RATES.

Abstract. In this article, we study how oil prices affect the USD vs. KZT exchange rates. Our methods base on elementary statistical data analysis. For this purpose, we collect Brent oil prices and US dollar exchange rates in Kazakh tenge for entire year of 2016, in a weekly basis. Our findings suggest that there is a strong correlation between two variables. Besides, we use simple linear regression analysis to provide a formula that predicts the USD rate given the oil price. To make the paper accessible to High school students, we keep most of the analysis as elementary as possible and self-contained.

Key words: linear regression, oil price, currency exchange, correlation.

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Аңдатпа. Бұл мақалада мұнай бағасының АҚШ доллары және теңге айырбастау бағамына қалай әсер ететінін қарастырамыз. Біздің әдістер қарапайым статистикаға негізделген. Осы мақсатта біз 2016 жылғы апта сайын мұнай бағаларын және де теңге бойынша доллар айырбастау бағаларын жинаймыз. Біздің нәтижелеріміз екі айнымалы арасында мықты корреляцияның бар екенін көрсетеді. Бұдан басқа, мұнай бағасын ескере отырып, АҚШ долларының айырбастау бағасын болжайтын формуланы ұсыну үшін қарапайым сызықтық регрессиялық талдауды қолданамыз. Мақаланы орта мектептің оқушыларына қол жетімді ету үшін талдаудың көп бөлігін барынша қарапайым және өздігінен қамтамасыз етеміз.

Кілт сөздер: сызықтық регрессия, мұнай бағасы, валюта айыр бастау, корреляция.

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Аннотация. В этой статье мы изучаем, как цены на нефть влияют на курс доллара США по отношению к тенге. Наши методы основаны на анализе элементарных статистических данных. С этой целью мы собираем цены на нефть и курсы доллара США за весь 2016 год. Наши результаты показывают, что существует сильная корреляция между двумя переменными. Кроме того, мы используем простой линейный регрессионный анализ, чтобы представить формулу, которая предсказывает курс доллара США с учетом цены на нефть. Чтобы сделать статью доступной для учащихся старших классов, мы проводим большую часть анализа как можно более элементарно и автономно.

Ключевые слова: линейная регрессия, цена на нефть, обмен валюты, корреляция.

Kazakhstan has the largest economy in Central Asia. Its economy mainly rests on the growth of oil and gas sector. Kazakhstan is considered as «oil rich» country and as such it is a large oil exporter. Scientists believe that the current oil reserve of the Kazakhstan is three times higher than previously predicted back in 1980's.

In 2015, the Central Bank of Kazakhstan set the national currency to free float. This means, from this point, the market will determine the exchange rate by itself according to the supply and demand. In particular, the changes in oil prices will affect the currency exchange rates.

As (Gronwald, Mayr, & Orazbayev, 2009) concluded, the drop in oil prices has significant negative response to GDP, inflation, exports, and exchange rates. It is an important task to quantify these negative responses. In this note we want to investigate the relation between dollar exchange rates and world oil price fluctuations [1]. More specifically, we would like to see how changes in oil prices affects the USD rate in Kazakhstan. Similar problems were considered in different contexts, see e.g. (Chen & Chen, 2007) [2], (Basher, Haug, & Sadorsky, 2016) [3], (Reboredo, Rivera-Castro, & Zebende, 2014) [4], (Turhan, Hacihasanoglu, & Soytas, 2013) [5], (Zhang, 2013) [6].

Next section reviews some of the statistics notions used in this article. In §3 we provide our data and carry out the statistical analysis to investigate the relation between oil prices and dollar rate. Finally, we end with a conclusion.

Preliminaries

In this section we review some preliminary material from statistics that we use throughout the text.

Value	Interpretation
From 0 to 0,3	Very Weak
From 0,3 to 0,5	Weak

From 0, 5 to 0,7	Medium
From 0,7 to 0, 9	Strong
From 0,9 to 1	Very Strong

Pearson Correlation coefficient is real number$r$ between -1 and 1 that quantifies the dependence of two variables. If r is positive then there is a positive relation, which means if the first variable increases then so does the second variable. On the other hand, a negative value indicates that when one variable increases the other decreases. The Table 1summarizes the interpretation of r for positive values, and for negative values the ordering is reversed. If we are given the data points $x_1, x_2, \dots, x_n$ and $y_1, y_2, \dots, y_n$ from two variables then the correlation coefficient is computed by the following formula:

Table 1. Interpretation of correlation coefficient

$$r = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2 \sum(y-\bar{y})^2}},$$

where $\bar{x} = \frac{1}{n}\sum_{t=1}^{n} x_t$, $\bar{y} = \frac{1}{n}\sum_{t=1}^{n} y_t$.

When thereis a strong correlation, first attempt is to try to find out if there is a linear relation. This is done in Statistics by considering Simple Linear Regression method. Given the data points $x_1, x_2, \dots, x_n$ and $y_1, y_2, \dots, y_n$ from two strongly correlated variables, the formula for linear regression line is given by

$$Y = aX + b,$$

where$a = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{n\sum x_i^2 - (\sum x_i)^2}$and $b = \frac{\sum y_i - a\sum x_i}{n}$. Regression line is the best fitting line to the data, that is, it is the line that minimizes the total distance from the line to the dependent variables (y_i's). One can use the least square methods to obtain the above formulas for a and b.

Statistical analysis

Table 2

Weekly oil prices and USD rates in KZT for the entire year of 2016.

Date	Brent oil prices ($)	USD rate in KZT
04.01.2016	29,36	339
11.01.2016	29,22	360
18.01.2016	29,57	361
25.01.2016	32,16	375
01.02.2016	30,83	370

Date	Brent oil prices ($)	USD rate in KZT
04.07.2016	44,95	335
11.07.2016	45,09	337
18.07.2016	44,11	339
25.07.2016	41,31	344
01.08.2016	41,31	353

08.02.2016	28,94	358	08.08.2016	41,81	351
15.02.2016	29,98	363	15.08.2016	44,53	343
22.02.2016	29,71	350	22.08.2016	47,19	338
29.02.2016	32,72	352	29.08.2016	44,18	339
07.03.2016	38,38	344	05.09.2016	44,25	353
14.03.2016	38,52	343	12.09.2016	43,06	337
21.03.2016	39,29	345	19.09.2016	43,13	338
28.03.2016	36,56	340	26.09.2016	44,53	336
04.04.2016	36,63	343	03.10.2016	47,88	334
11.04.2016	40,34	336	10.10.2016	49,42	331
18.04.2016	40,27	333	17.10.2016	50,76	332
25.04.2016	43,55	333	24.10.2016	48,44	330
02.05.2016	44,34	327	31.10.2016	43,97	335
09.05.2016	44,46	333	07.11.2016	42,92	339
16.05.2016	46,21	329	14.11.2016	42,92	344
23.05.2016	48,31	336	21.11.2016	45,75	339
30.05.2016	48,52	336	28.11.2016	45,44	340
06.06.2016	48,72	334	05.12.2016	51,31	333
13.06.2016	48,07	336	12.12.2016	51,31	330
20.06.2016	47,47	341	19.12.2016	51,94	335
27.06.2016	47,54	338	26.12.2016	53,13	330

This is the main part of the article. Here we study our data and obtain the results we were aiming. To this end, we first list our data set in Table 2.

We used websites such as oilprice.com, oil-price.net, xe.com, and kase.kz to collect the data in Table 2. We considered the entire year of 2016, in a weekly basis. The first column shows the date (Monday) of a week when the corresponding values observed. The second and third columns contain the Brent oil price per barrel and dollar rate in KZT for the given date respectively.

We made use Microsoft Excel to make statistical computations. In particular, we obtained Pearson Correlation coefficient to be $r = -0.775$, which according to Table 1 shows that there is a strong negative correlation. This can be seen in Figure 1.

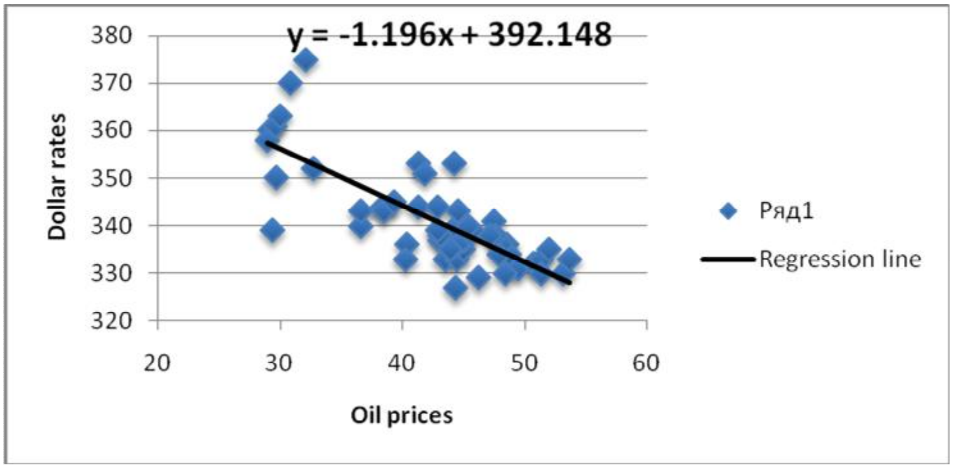

Fig.1.Oil price vs. dollar exchange rate graph with Trend line.

The same figure includes the simple regression line and formula:

$$y = -1.2x + 392.15.$$

Here, x is the independent variable, that is, oil price and y is the dependent variable, dollar rate in terms of Kazakh Tenge. More detailed linear regression analysis is depicted in Figure 2 which is obtained using StatPlus add-in for Excel.

Linear Regression							
Regression Statistics							
R	0.77517						
R-square	0.60089						
Adjusted R-square	0.59307						
S	6.73137						
N	53						
USD rate in KZT = 392.14759 - 1.19614 * Brent oil prices ($)							
ANOVA							
	d.f.	*SS*	*MS*	*F*	*p-level*		
Regression	1.	3,479.23281	3,479.23281	76.78497	9.53115E-12		
Residual	51.	2,310.88039	45.31138				
Total	52.	5,790.11321					
	Coefficient	*Standard Error*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%)*
Intercept	392.14759	5.88848	380.32597	403.9692	66.59573	0.	*rejected*

Brent oil prices ($)	-1.19614	0.1365	-1.47019	-0.9221	-8.7627	9.53115E-12	*rejected*

Fig.2. Linear Regression analysis of the data.

A high value of $R^2 = 0.66$ and small p values in Figure 2are strong indicators that the model formula presented abovewell explains the given data. For instance, when oil price is $x = 50$ dollars, our formula predicts the dollar rate$y = -1.2 * 50 + 392.14 = 332.14$ KZT. For our data we see that on 10.10.2016 the oil price was 49.42$ and dollar rate was 331 KZT which very close what formula gives.

We end this section by providing a forecast for dollar rate in 2018. In various websites it is possible to find oil price forecasts. We use average Brent oil price forecast of $54.1 per barrel in 2018 from knoema.com website. Then, our formula predicts that average dollar exchange rate in 2018 will be $y = -1.2 * 54.1 + 392.15 = 327.23$ KZT.

Conclusion

In this note we studied relation between oil price and currency exchange rate by analyzing the data obtained for 2016. Our findings show that there is a strong relation between the two: 1 unit-decrease of oil price per barrel increases the dollar rate by about 1.3 units.

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