International Journal of Studies in Business Management, Economics and Strategies
Volume 02, Issue 05, May, 2023
ISSN (E): 2949-883X
Scholarsdigest.org

BETWEEN THE SHARE PRICE OF THE JOINT STOCK COMPANY AND THE EXCHANGE RATE ECONOMIC MODELING OF DEPENDENCY

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Abstract
This article assesses the impact of exchange rates on stock prices. For this purpose, the stock prices of the 7-year period from 2016 to 2022 and the exchange rate of the US dollar against the som were taken as the object of analysis.

Keywords. Investment, financial risk, currency risk, stock.

Introduction

Literature analysis

A Currency risk in the pricing of international equity returns is analyzed from an empirical point of view. (Manoj Gupta, 1992)

Kroon witnessed the following results in his research: first, For the average company, most currency effects seem to go indirectly via general market movements. Secondly, looking beyond global and regional market factors common to all stocks in a given region, it was found that only 16 percent of companies had one or more significant 'stock-specific' currency exposures. Thirdly, In particular, no meaningful relationships were discovered in the dataset between currency exposure and either company size, foreign sales or country openness. (Croon, 2004)

Muhammad Owais in his research examines the portfolio diversification benefits of alternative currency trading in Bitcoin and foreign exchange markets. (Owais, 2021)

Deng studied the barrier options of the uncertain currency model. (Deng, 2021)

Hypothesis

In our opinion, there is an inverse relationship between the stock prices of joint stock companies and the exchange rate.

Econometric formulas

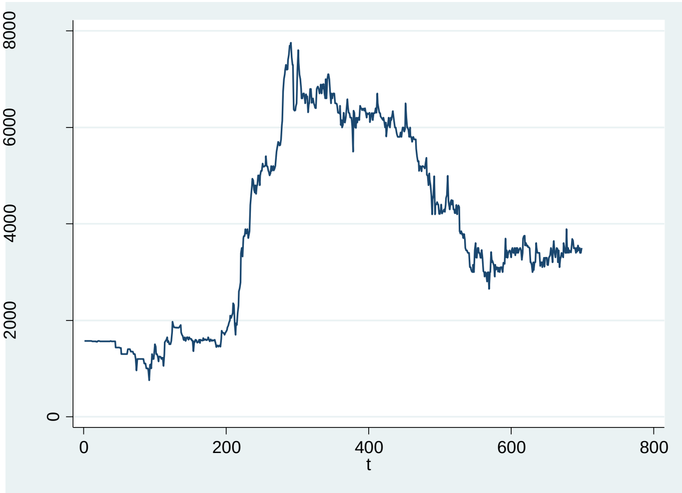
Variable	Obs	Mean	Std. Dev.	Min	Max
qizilqum	699	3840.71	1948.096	760	7755
kurs	699	9815.666	2033.788	2989.64	11571.99

Figure 1. Descriptive statistics of indicators

In order to confirm the author's hypothesis above, 7-year stock prices of "KIZILQUMSEMENT" joint stock company and exchange rates during the same period, i.e. the exchange rate of the US dollar against the Uzbek som, were obtained, which contained 699 pieces of information. database has been created. According to him, the lowest share price of the company was 760 soums, and the most expensive one was 7755 soums. We can see that the course price has increased from 2989 soums to 11571 soums over the years. During the studied years, the share price was equal to 3840 soums on average and the exchange rate was equal to 9815 soums on average. Here, the standard deviation was equal to the share price of 1948 soums and the exchange rate to 2033 soums.

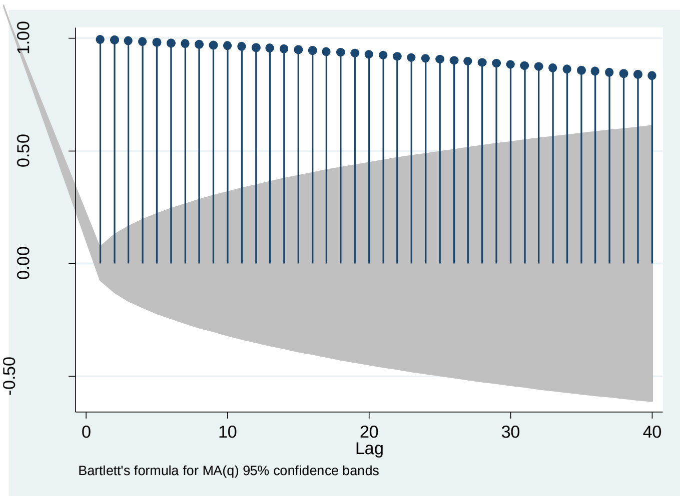
It is necessary to test them for stationarity in order to find out whether the relationship between the outcome and the factor indicators can be determined.

First, let's check the stock prices. For this, we use the graphic method.



Graph 1. Analysis of autocorrelation for stocks

In this method, we check for autocorrelation since precision is not specified.



Graph 2. Analysis of autocorrelation for stocks

Here, all lags are above the confidence interval. Hence, this time series is non-stationary. To be more sure, it is worth checking the Dickey Fuller test.

International Journal of Studies in Business Management, Economics and Strategies
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Dickey-Fuller test for unit root Number of obs = 698

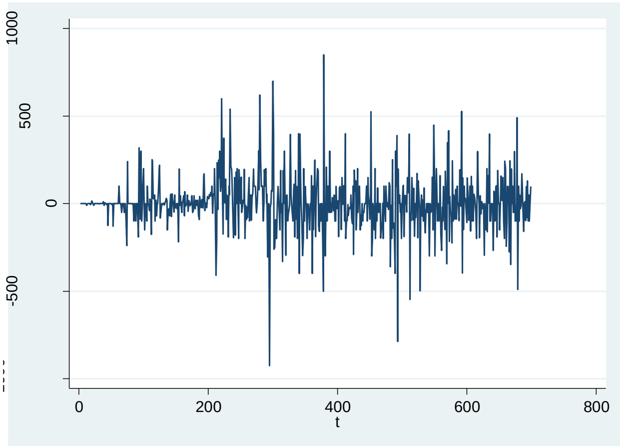
	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.372	-3.430	-2.860	-2.570

MacKinnon approximate p-value for Z(t) = 0.5958

Figure 2. Dickey Fuller test for stocks

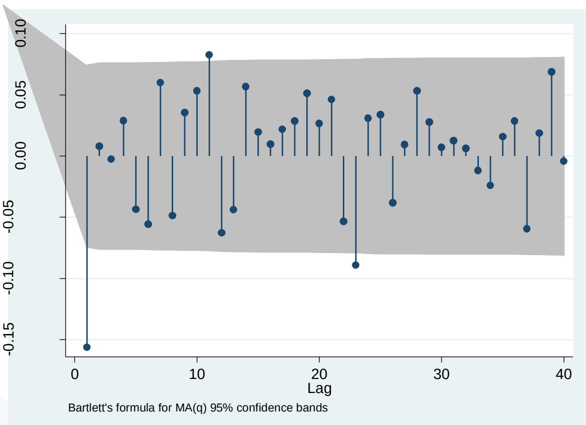
If the test value is -1.37, at 1% the value is -3.43, at 5% the value is -2.86 and at 10% the value is -2.5. It was found that the test value is greater than the values of 1%, 5% and 10%. We can see that the probability level is also greater than 0.05. therefore, stock prices are non-stationary.

To make stock prices stationary, it needs to be differentiated. We again check for stationarity of differentiated stock prices. Let's see in the first graphic way.



Graph 3. Autocorrelation test after dedifferentiation for stocks

As you can see from the graph, share prices have been stationary. Now we check its autocorrelation.



Graph 4. Autocorrelation test after dedifferentiation for stocks

All lags are within confidence intervals. And let's check for the final clarifying test.

Dickey-Fuller test for unit root Number of obs = 697

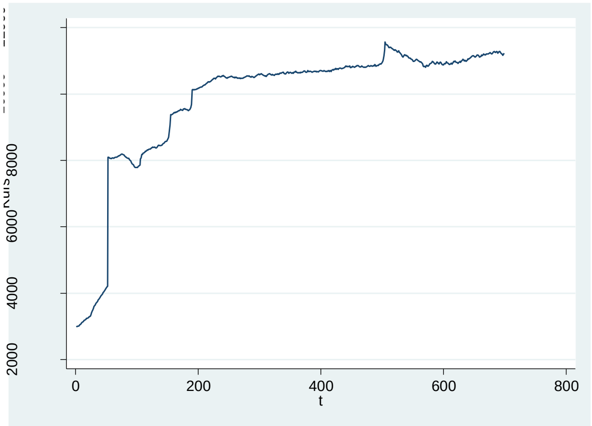
	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-30.858	-3.430	-2.860	-2.570

MacKinnon approximate p-value for Z(t) = 0.0000

Figure 3. Dickey Fuller test after dedifferentiation for stocks

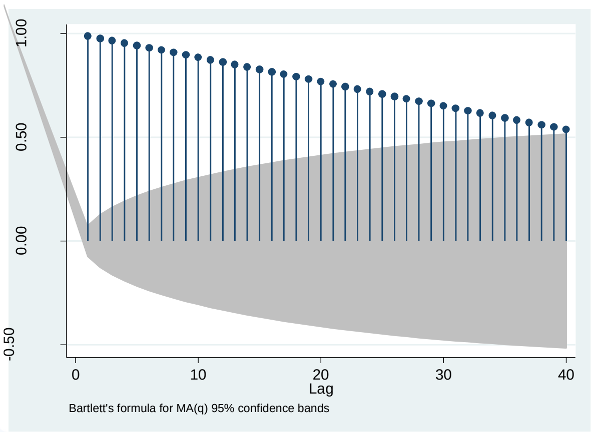
The test value is less than the values of 1%, 5%, and 10%, and the probability level is also less than 0.005. So, stock prices are stationary of order 1.

Now we can check the exchange rates. We do this in the above order. First, let's check graphically.



Graph 5. Analysis of autocorrelation for currency

A graph with growth characteristics was depicted. So it is not stationary. In the next step, autocorrelation is checked.



Graph 6. Analysis of autocorrelation for currency

Lags are not within confidence intervals. Hence, exchange rates are not stationary. Now it is necessary to check the Dickey-Fuller test.

International Journal of Studies in Business Management, Economics and Strategies
Volume 02, Issue 05, May, 2023
ISSN (E): 2949-883X
Scholarsdigest.org

Dickey-Fuller test for unit root Number of obs = 698

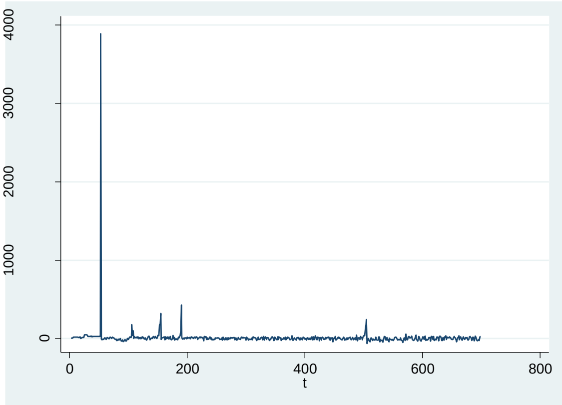
	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-3.776	-3.430	-2.860	-2.570

MacKinnon approximate p-value for Z(t) = 0.0032

Figure 4. Dickey-Fuller test or currency

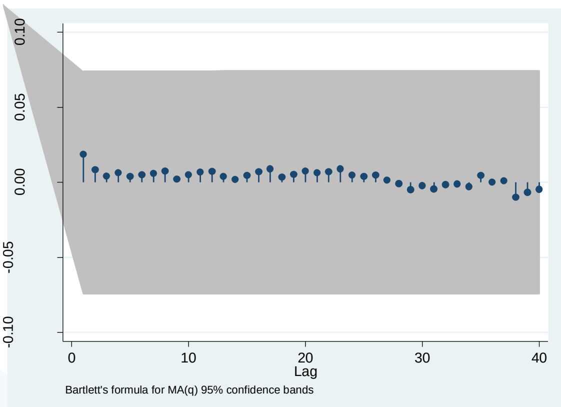
If the test value is -3.77, at 1% the value is -3.43, at 5% the value is -2.86 and at 10% the value is -2.5. It was found that the test value is greater than the values of 1%, 5% and 10%. We can see that the probability level is also greater than 0.005. therefore, stock prices are non-stationary.

Therefore, it is necessary to differentiate the exchange rate. Then we start checking for stationarity. First, we will use the graphic method.



Graph 7. Autocorrelation test after dedifferentiation for currency

From this graph, the exchange rate has reached a state of stationarity after the first degree of differentiation. Now we need to check for autocorrelation.



Graph 8. Autocorrelation test after dedifferentiation for currency

As you can see from this graph, all the lags are within the confidence interval. And the exchange rate is fixed. Now let's check for the test.

Dickey-Fuller test for unit root   Number of obs = 697

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-25.877	-3.430	-2.860	-2.570

MacKinnon approximate p-value for Z(t) = 0.0000

Figure 5. Dickey Fuller test after dedifferentiation for currency

According to the result of this test, the exchange rate is 1st degree stationary.

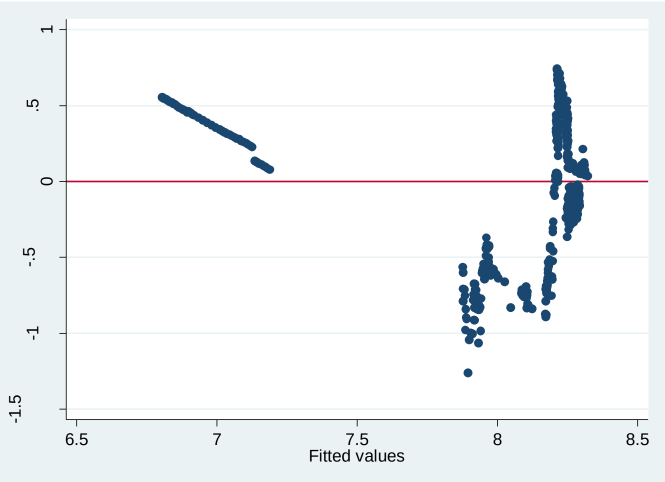
It is clear from this that the outcome and factor signs we are studying are stationary of the 1st degree. It will be possible to determine the relationship between them.

It is important to verify that the necessary conditions are met to determine the relationship between the outcome and the factor indicator. Therefore, we first check them for the 6 Gauss-Markov conditions.

Condition 1. The number of traces should be 7 times the number of characters. In our example, 7 years of monthly data are given. So, the first condition is satisfied.

Condition 2. The sum of empirical data should equal the sum of theoretical data.

Condition 3. Residues must not be associated with factor symbols.



Graph 9. Correlation between factor and residual characters

Factor and residual characters are scattered, there is no correlation between them. There is no hydroscadastic condition.

Condition 3 can also be determined by the Breusch-Pagan test.

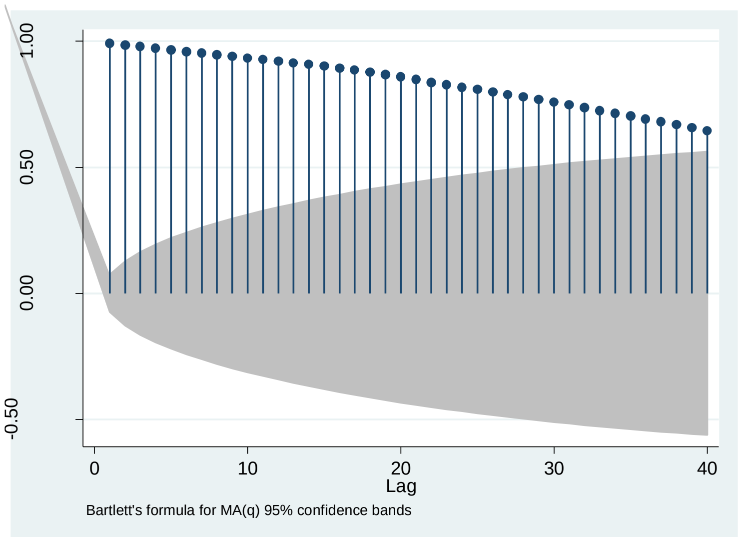
```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of lnq

         chi2(1)      =     8.92
         Prob > chi2  =   0.0028
```

Figure 6. Breusch-Pagan test

In this case, according to the result of the Breusch-Pagan test, there is a relationship between the residuals and the corresponding values. If greater than 0.05, condition 3 would be satisfied. But here the condition was not satisfied. So we rebuild the model or multiply the data.

Condition 4. Residuals should be free of cross-correlation or autocorrelation. This can be checked in 3 different ways.

1. Graph
2. Autocorrelation test
3. Durbin-Watsin test. Here, if it is between 0 and 4, the condition is satisfied. Around 2, autocorrelation will not exist. Then the 4th condition is satisfied.



Graph 10. Durbin-Watsin test

This drawing , there are 40 lags. All of them are positive, 10 are negative. The strongest is 1 chi lag and decreasing in value to 40 lag. It had a value from 1 to 0.7.

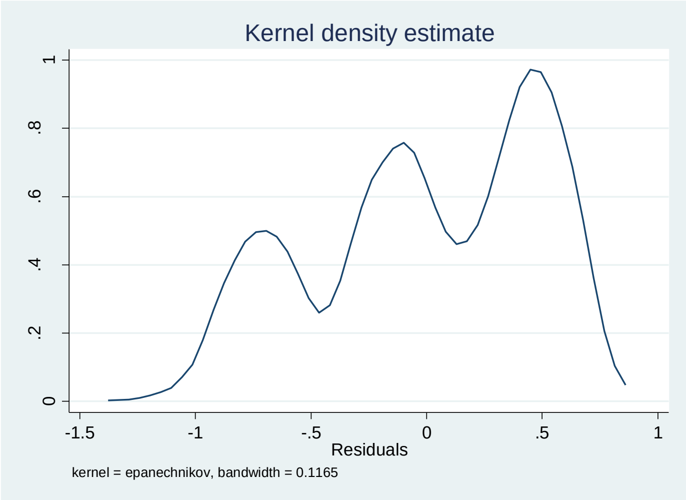
Let's look at the Durbin-Watson test .

```
Durbin-Watson d-statistic(  2,    699) =  .0142037
```

This indicator should be around 2. Indeed it is. That is, the condition has been fulfilled.

Condition 5. Factors are examined if there are many . Factor characters must not be mutually exclusive. In our example, the factor symbol is 1. Therefore, we do not examine this test.

6 conditions. The residuals must be normally distributed.



Graph 11. Distubition of residuals

We can see that the residuals are not normally distributed.

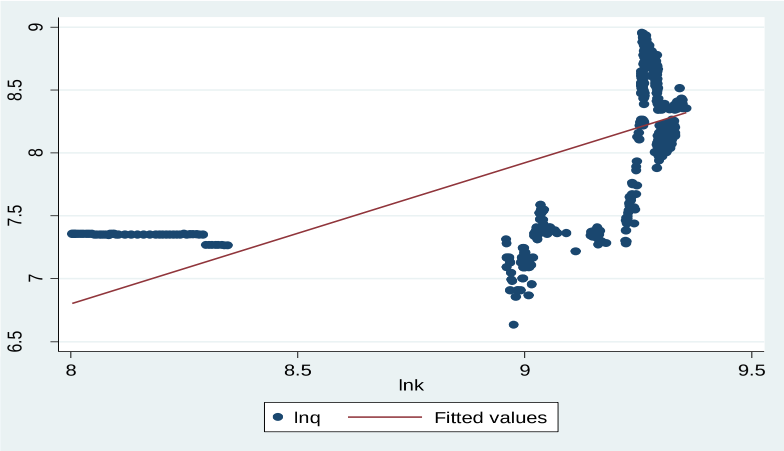
After reviewing the descriptive statistics of the indicators, we will consider the correlation of factors and indicators.

	lnq	lnk
lnq	1.0000	
lnk	0.5775	1.0000

Figure 7. Correlation analysis of stock prices and exchange rates

Based on the data in the table, it can be said that the correlation between stock prices and exchange rates is 0.57, which represents a correct and significant relationship between stock prices and exchange rates.

We can also see this graphically.



Graph 12. Correlation analysis of stock prices and exchange rates

International Journal of Studies in Business Management, Economics and Strategies
Volume 02, Issue 05, May, 2023
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It can be seen from the figure that there is no correlation between exchange rates and stock prices.

Source	SS	df	MS			
				Number of obs	=	699
				F(1, 697)	=	348.69
Model	80.397686	1	80.397686	Prob > F	=	0.0000
Residual	160.707036	697	.230569636	R-squared	=	0.3335
				Adj R-squared	=	0.3325
Total	241.104723	698	.345422239	Root MSE	=	.48018

lnq	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnk	1.122102	.0600913	18.67	0.000	1.00412	1.240083
_cons	-2.17624	.5505287	-3.95	0.000	-3.257133	-1.095347

Figure 8. Regression analysis of stock prices and exchange rates

Share price = 1.12lnkurs – 2.17

An increase in the exchange rate by 1 unit causes the share price to increase by 1.12 units on average.

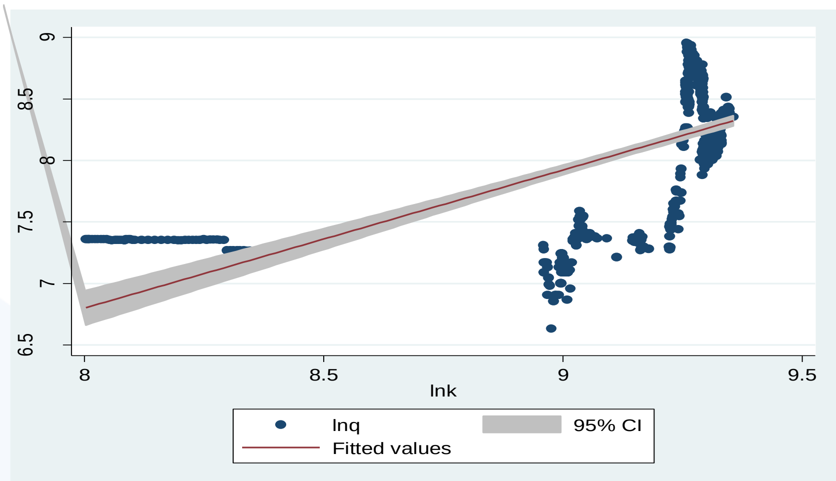
Let's start checking the model with some tests.

Fisher's test probability is 0. So, we reject the main hypothesis and accept the alternative hypothesis. That is, we can say with 95% confidence that the model values are statistically significant.

The coefficient of determination is 0.33. Hence, the exchange rate affects stock prices by an average of 33%. 67% have other influencing factors.

According to the t-test probability, the probability of the coefficient is equal to 0, so we reject the main hypothesis and accept the alternative hypothesis. The coefficient is statistically significant.

From the analysis, the confidence interval of the parameter is from 1 to 1.24. If the share price increases by 100 soums, the daily average exchange rate will increase from 1 soum to 1.24 soums.

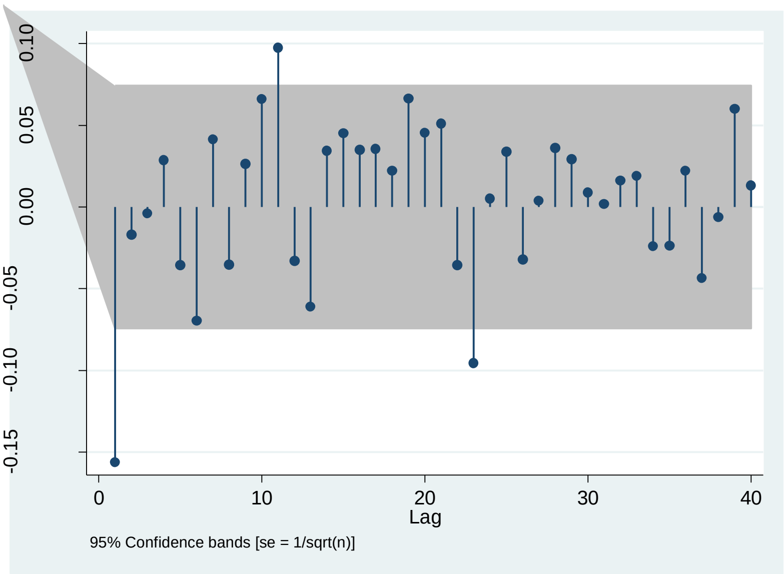


Graph 13. Correlation analysis of stock prices and exchange rates

We will now forecast stock prices and exchange rates using the ARIMA model. In turn, this model includes 3 stages.

Stage 1.

For this, it is necessary to find the values of p, d and q. In our example, d=1. Because, 1 became stationary in order.



Graph 14. Finding factors for ARIMA model

It can be seen from the graph that 2 lags fall outside the confidence interval. So p=2. q=1.

Now let's look at the combination of these values.

(1;0;1)	(0;0;1)	(2;0;1)
(1;1;1)	(0;1;1)	(2;1;1)
(1;1;0)	(0;1;0)	(2;1;0)

So there are 9 combinations.

2 stages. It is necessary to choose which of the ARIMA models is optimal.

In the first model, we get the following results:

Criterion	ARIMA(1;0;1) A model	ARIMA (1;1;1) B model	ARIMA (1;1;0) C model	ARIMA (2;1;1) D model	Comparison
Parameter	3(0)	3(0)	2(0)	4(0)	
Sigma	153.88	153.98	154.00	153.98	C
Log likelihood	-4514.6	-4506.137	-4506.238	-4506.134	A
Akaike's	9037.24	9020.27	9018.475	9022.26	C
BIC	9055.44	9038.46	9032.12	9045.01	C

Figure 8. ARIMA models

```
ARIMA regression

Sample:  1 - 699                                Number of obs     =        699
                                                Wald chi2(2)      =  161506.23
Log likelihood = -4514.624                      Prob > chi2       =     0.0000
```

qizilqum	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
qizilqum						
_cons	3166.934	1653.774	1.91	0.055	-74.40383	6408.272
ARMA						
ar						
L1.	.9973733	.0024897	400.60	0.000	.9924936	1.002253
ma						
L1.	-.1559649	.0238171	-6.55	0.000	-.2026456	-.1092842
/sigma	153.8873	2.155924	71.38	0.000	149.6618	158.1129

Note: The test of the variance against zero is one sided, and the two-sided confidence interval is truncated at zero.

Akaike's information criterion and Bayesian information criterion

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
.	699	.	-4514.624	4	9037.248	9055.447

Figure 9. Values of model A

```
ARIMA regression

Sample:  2 - 699                                Number of obs     =        698
                                                Wald chi2(2)      =      41.75
Log likelihood = -4506.137                      Prob > chi2       =     0.0000
```

D.qizilqum	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
qizilqum						
_cons	2.745226	5.02966	0.55	0.585	-7.112726	12.60318
ARMA						
ar						
L1.	-.0527338	.221943	-0.24	0.812	-.4877342	.3822666
ma						
L1.	-.1060616	.2144711	-0.49	0.621	-.5264172	.3142941
/sigma	153.9816	2.195597	70.13	0.000	149.6784	158.2849

Note: The test of the variance against zero is one sided, and the two-sided confidence interval is truncated at zero.
Akaike's information criterion and Bayesian information criterion

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
.	698	.	-4506.137	4	9020.275	9038.468

Figure 10. Values of model B

International Journal of Studies in Business Management, Economics and Strategies
Volume 02, Issue 05, May, 2023
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Scholarsdigest.org

```
ARIMA regression

Sample:  2 - 699                                Number of obs     =        698
                                                Wald chi2(1)      =      37.50
Log likelihood = -4506.238                      Prob > chi2       =     0.0000
```

D.qizilqum	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
qizilqum						
_cons	2.741472	5.080927	0.54	0.589	-7.216962	12.69991
ARMA						
ar						
L1.	-.1561848	.0255051	-6.12	0.000	-.2061739	-.1061957
/sigma	154.0047	2.174363	70.83	0.000	149.743	158.2664

Note: The test of the variance against zero is one sided, and the two-sided confidence interval is truncated at zero.

Akaike's information criterion and Bayesian information criterion

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
.	698	.	-4506.238	3	9018.475	9032.12

Figure 11. Values of model C

```
ARIMA regression

Sample:  2 - 699                                Number of obs     =        698
                                                Wald chi2(3)      =      62.15
Log likelihood = -4506.134                      Prob > chi2       =     0.0000
```

D.qizilqum	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
qizilqum						
_cons	2.746077	4.959284	0.55	0.580	-6.973941	12.46609
ARMA						
ar						
L1.	.4537077	1.011306	0.45	0.654	-1.528415	2.435831
L2.	.0820068	.1800131	0.46	0.649	-.2708124	.434826
ma						
L1.	-.6121899	1.015676	-0.60	0.547	-2.602878	1.378498
/sigma	153.9852	2.225916	69.18	0.000	149.6225	158.3479

Note: The test of the variance against zero is one sided, and the two-sided confidence interval is truncated at zero.

Akaike's information criterion and Bayesian information criterion

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
.	698	.	-4506.134	5	9022.269	9045.01

Figure 12. Values of model C

In our example, model C was found to be optimal.

Stage 3

Model C is tested for reliability in 3 aspects.

We forecast the stock price for 5 days. Now we will develop its optimistic and pessimistic model.

A realistic forecast	Optimistic	Pessimistic
700	854	546
701	855	547
702	856	548
703	857	549
704	858	550

Figure 12. Realistic, optimistic and pessimistic models

Conclusion

In conclusion, it can be said that in the 7-year period from 2016 to 2022, the correlation of share prices and exchange rates (US dollars) of the joint-stock company "KIZILQUMSEMENT" was obtained. According to him, the lowest share price of the company was 760 soums, and the most expensive one was 7755 soums. We can see that the course price has increased from 2989 soums to 11571 soums over the years. During the studied years, the share price was equal to 3840 soums on average and the exchange rate was equal to 9815 soums on average. Here, the standard deviation was equal to the share price of 1948 soums and the exchange rate to 2033 soums.

Both of these indicators were found to be first-order stationary. This makes it possible to study the relationship between them. It was found that this result and the factor sign satisfied the 6 conditions of Gauss-Markov.

According to the hypothesis, there should be an inverse relationship between stock prices and exchange rates. However, according to the correlation table, the correlation between stock prices and exchange rates is 0.57, which represents a valid and significant relationship between stock prices and exchange rates.

According to the results of the regression analysis, it was found that an increase in the exchange rate by 1 unit leads to an average increase in the share price by 1.12 units.

stock prices using the ARIMA model, the realistic forecast was that the stock price would increase by 1 unit each day.

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