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The Value of Investment Resources Influx for the Development of the Electric Power Industry of Kazakhstan

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ABSTRACT: The article analyzes the state of the energy system for the past 23 years in Kazakhstan. The main objective of the study is to conduct an econometric analysis on effective development of electric power industry of Kazakhstan for the period of 1991-2013. We justify some patterns and relationships inherent in the process of electricity generation. At the same time, have a significant negative value depreciation of fixed assets of the electricity sector and losses in electric networks. Regression estimation proved the hypothesis that an increase in the volume of electricity generated depends on the level of investment in fixed capital injections industry. The constructed model can be used to reliably predict in the medium term and allows the Government to make effective decisions in the modernization of the electricity sector.

Keywords: Electric power industry of Kazakhstan; investment; econometric estimation; Granger causality analysis.
JEL Classifications: C13; L94; Q47; O13

1. Introduction

Electricity is an essential element of the fuel and energy sector of Kazakhstan. Total installed capacity of all power plants amount is around 18992.7 MW of electricity, the available capacity is 14558.0 MW. More than 70% of the electricity in the country is produced from coal, 12% from hydro-resources, 10.6 percent from gas and 4.9% from oil. Power output is distributed the way that 87.7% is produced by thermal power stations, while hydroelectric power stations produce about 12%. The main characteristic of the Kazakhstan power system is that it has no consistent locations of its facilities across the country. There is an acute shortage in southern and western regions.

Analysis of the structure of industrial production by different sectors over the last 23 years has shown that the share of electricity in 2014 reached the level of 1991 and was only 5%. The highest value of this index is in 1994 -18.9%, the lowest for the year 2007-3.5%. Generation of electric power in Kazakhstan during the period under review shows two clear trends: the decline of energy production (1991-1999yy) and the growth of this indicator (2000-2014yy). For instance, the production of electricity in 2013 was 7% more than in 1991 and almost 2 times higher than in 1999.

At regional level the highest amount of electricity production in Kazakhstan is in Pavlodar and Karaganda regions, which accounts for more than 58% of the total. The least amount of electricity (in 2013-2.3%) produced in Akmola, Zhambyl oblasts and Almaty City, each of them producing less than 1000 million kWh of electricity. Leading positions in energy consumption belong to abovementioned Pavlodar and Karaganda, where 40.2% of all electricity consumed.

Throughout this investigation period, despite the existing generating capacity, the lack of electricity is observed, which is covered by importing electricity from neighboring states. For example, in 2013 8.3 billion kWh of electricity was imported to Kazakhstan, including 4.6 billion kWh from Russia and 1.6 billion kWh from Kyrgyzstan. Electricity from Russia supplied to western regions, while energy from Kyrgyzstan primarily consumed by southern regions of the country. Export of the electricity from Kazakhstan is amounted 5.6 billion KWh, which is 5% of total energy consumption of the country.

Wear out of an equipment most of Kazakhstan's power plants exceeds the calculated resource of its work, and average depreciation of fixed assets estimated in 2014 is more than 34%, which is 2% less than the average for the industry. Percentage of fully depreciated fixed assets is equal to 8% of total. Existing power generation sector have considerable lifetime (25 years or more). However, depreciation peak was fixed in 1995-1999, when the indicator was 45-48%. In addition, in recent years there has been a positive trend of renovation growth rate of the fixed assets. Due to the adoption of industry development programs and growth of investment flows in 2013 the increase was more than 3 times compared with 1991.

Thus, at present, the development of energy sector of the country has reached a critical limit of ageing capital stock, resulting in the energy crisis of the southern and western regions, raising tariffs for service suppliers of heat and energy. Depreciation of fixed assets of power plants and networks is fairly high, which could lead to negative consequences in the coming years.

At the same time, the inefficiency of the centralization of power and significant deterioration of the equipment in terms of a vast territory that spans 2.7 million km^2 and low population density - 5.5 people/km^2 results in a substantial loss of energy during its transportation to remote users. So, despite the reduction of energy losses in almost 2 times in 2013 compared with 1995 (15.2% versus 8%), this figure has increased significantly in real terms, reaching 7.1 billion kWh.

The energy intensity of GDP is one of the main indicators of energy efficiency in the country. This indicator is calculated as the ratio of primary energy (coal, oil, gas) to the value of the real GDP at US dollar prices. At the end of 2012, the energy intensity of GDP of the Republic of Kazakhstan has dropped on average at 2.3% compared to 2008 (1.77) and amounted 1.73. The peak drop occurred in 2009, when there was a decrease of energy intensity by 8% due to the global financial crisis and reduction of energy-intensive products manufacturing volumes, which consequently had an impact on reducing the consumption of primary energy resources.

Real GDP growth in the Republic is accompanied by growth of specific indexes, confirming the trend in the inefficient use of energy resources, since the economy is based on energy-intensive industries. A large number of industrial and energy companies in the country are using outdated technology and operate equipment with a high degree of depreciation.

It should be noted that the energy intensity of GDP in Kazakhstan is very high in comparison to other countries. For this indicator Kazakhstan falls far short not only compared to developed countries of the world (10-15 times), but also compared to Russia and Belarus, which has the identical structure of the economy with Kazakhstan.

This fact demonstrates the potential for reducing energy intensity of the domestic industry that consumes most of the country's electricity, from 15% to 40%. Kazakhstan possesses significant resources of renewable energy in the form of hydropower, solar energy, wind power, biomass. The country has significant water resources, the potential power of all the water resources of the country are 170 billion kWh per year.

It should be noted that nuclear power in Kazakhstan is not used, despite the fact that, according to the IAEA, uranium reserves in the country are estimated at 900 thousand tons. Now it is being considered building a new Nuclear Power Plant with capacity of 600 Mw. But, except the hydropower, those resources are not yet widely used. In general, the study found that the total energy capacity of the country is favorable, but still not enough for further development. The main source of sustainable economic growth, the industry and the national economy are the capital infusion.

2. Literature Review

Many of the issues related to the subject, are quite common in scientific thought. In this regard, a review of works dedicated to the study of the development of the electric power industry from the perspective of investment flows in the world practice was undertaken.

In order to determine prospective demand volumes of the power system for the country, the dynamics of power generation needs to be analyzed. According to Rachmatullah et al. (2007), it is necessary to apply the method of scenario planning, including future uncertainties. This method allows saving hundreds of millions of US dollars for the development of the energy sector and, therefore, minimizing production costs, including investment costs.

Ozturk (2010) reviewed recent studies of cause-effect relationships between energy consumption and economic growth in several countries. He came to the conclusion that for different countries, there are some conflicting results. For example, he found that more developed countries have a strong correlation between energy production and the creation of wealth than poor countries. Eventually, this leads to an increase in the well-being of the population and increased investment in infrastructure of electric power industrial countries. At the same time, in developing countries there is also growth in electricity consumption, however economic growth is low and well-being of citizens is quite weak. Probably, these contradictory results associated with the use of different methodologies in statistics.

For a more reliable econometric analysis of influence factors on economic phenomenon indicators are expressed in comparable units, check the time series of indicators on the fixed using autocorrelation function, as well as to the stationary types based on logarithms (Dougherty, 2011). To examine the dynamics and direction of cause-effect relationships between signs and making reliable forecasts of economic sectors (including electricity) using causal analysis (Granger, 2001).

Yoo and Kim (2006) conducted a study using a time series on the basis of the definition of the causal relationship between electricity generation and economic growth. Authors statistically proved that economic growth promotes increased electricity generation. In this regard, with the aim of increasing power generation and reduce its deficits investments need to be attracted.

Electricity production is accompanied by the electricity generation plants, requiring long-term attachments of material resources, which are expensive. Therefore, identifying the determinants of demand and the cost of electricity are essential to predict the energy sphere. Subsequently, this will help the Government ensure effective decision-making in the energy sector (Theologos, 2008)

Borensztein et al. (1998) conducted an analysis of the impact of foreign direct investment on economic growth by the model of moving regression using data on foreign direct investment flows from industrialized countries in 69 developing countries over the past two decades. The results of the study showed that investments contribute to the more rapid rate of technology transfer than domestic investment.

So, in some studies, it is shown that the amount of electricity generated, including through alternative sources (wind, solar) depends on the level of investment and depreciation of equipment. Selected indicators are analytical tool based on basic statistics that aim to describe the linkages among the various parties to the studied phenomena. Indicators provide an opportunity to analyze and understand the reasons for the changes that occur over the time within the framework of the energy industry (Mukund, 2005).

Mah (2010) considered the relationship between the flow of investment and the economic growth of Korea. He researched hypothesis, which states that foreign investment is more beneficial for economic growth in an open trade regime. Unlike previous works on the same hypothesis, test of small co-integration samples was applied to time series data. It proved the existence of short-term correlation between domestic investment per capita and real GDP growth.

It is worth to note that the cause-effect link may be useful in predicting the formation of electricity policy, for example, the construction of new electricity generation capacity and power plants by attracting investment. However, it is required use of planning system to optimize energy consumption (Magazzino, 2014).

Narayan and Popp (2012) address the impact of consequences of energy consumption to the real GDP of 93 countries on long-term interim stage. Based on the results of their research, it was found that there are differences in most countries. In particular, there is no long-term Granger's cause effect relationship of electricity consumption to the level of real GDP in many countries. One of the author's suggestions is the use of energy-saving policies.

In addition, adoption of innovative technologies is important in the development of the electric power industry. For example, practical influence coefficient of renovation of fixed assets for the amount of electricity generated in the country was proved (Greene, 2008).

3. Data, Methodology and Empirical Analysis

In the study of energy sector of the country general techniques of statistical studies were applied, that were recognized by general theory of statistics and economic science. Methodology used in this study helped to monitor the financial and economic situation in the energy and energy consumption markets. Common techniques for collecting statistical materials, their processing and further analysis received specific content and, to some extent, have been specialized while studying energy industry. Data from 1991 to 2013 was used for the econometric analysis of the impact of investment on the development of the energy sector of Kazakhstan (Table 1).

Table 1. Key indicators of the electric power industry of Kazakhstan for the period 1991-2013 years

Indicators	**Years**						
	1991	**1995**	**1999**	**2003**	**2007**	**2011**	**2013**
Production of electricity, billion KW/h	85,9	66,5	50,1	63,9	76,6	83,7	91,9
Power consumption, billion KW/h	104,7	73,5	50,3	65,1	76,7	87,7	92,7
Losses, %	9,4	15,2	12,5	10,5	9,4	7,2	8
Electricity exports, billion KW/h	14,1	12,7	2,9	3,5	3,3	4,9	5,6
Electricity imports, billion KW/h	31,4	19,5	5,7	5,3	3,4	7,7	8,3
Depreciation of fixed assets,%	36,1	48,2	45,7	34,2	34,7	34,3	34,2
The coefficient of renewal of fixed assets,%	7,9	2,6	4,2	7,8	4,4	9,7	9,8
Share in the industry, %	4,8	15,7	7,3	5,4	3,5	4,2	5
Investments, million $	20	82,6	76	176	878	2 332	2 778

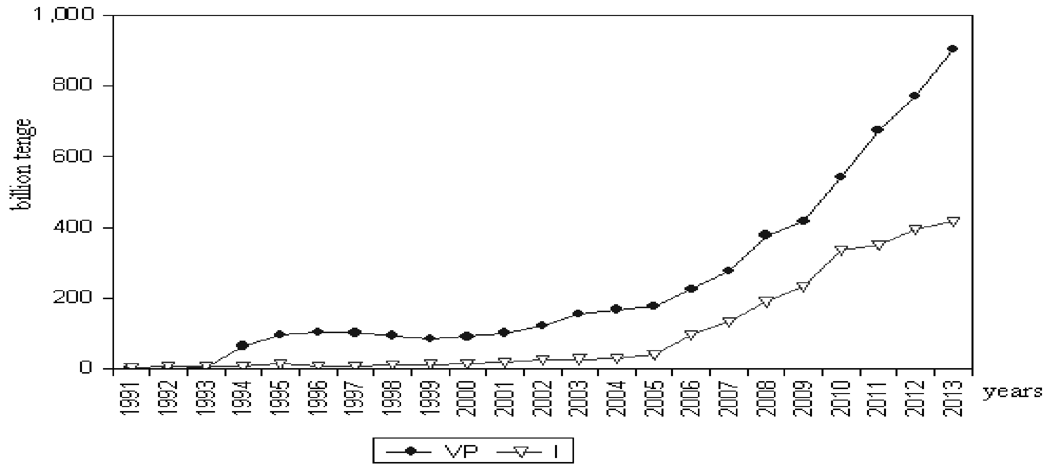
Notes: The compiled by the authors based on Agency on statistics of the Kazakhstan. Date Views 12.02.2014 www.stat.gov.kz.

Estimation of electricity production (VP) in the Republic of Kazakhstan showed that this ratio gradually increased over this period (Figure 1). In 2013 production volume was 113 thousand times more than in 1991 and 17% more than the level of previous year. In the case of investments (I) there has been a similar trend, they increased in 1389 times and 5.7% compared to 1991 and 2013 respectively.

However, the highest rates of growth were observed after 2007 that has been caused by increase of investment flows in the framework of the implementation of electric power industry developmental government programs and economic recovery of the economy as a whole.

During the study, all the indicators are expressed in comparable units, and time series have been transformed in logarithmic. This allows imagining links between the studied indicators within the same range (Table 2).

Figure 1. Dynamics of the key indicators of electricity, 1991-2013 years



Source: The compiled by the authors based on Agency on statistics of the Kazakhstan. Date Views 11.03.2014: www.stat.gov.kz.

Table 2. Symbols of the studied parameters

Variables	Indicator	Symbol	Logarithm	Differences
y	Electricity production, billion kW/h	*VP*	*LOG(VP)*	*DLOG (VP)*
x_1	Electricity losses in networks, %	*L*	*LOG(L)*	*DLOG (L)*
x_2	Electricity imports, billion kW/h	*Im*	*LOG(Im)*	*DLOG(Im)*
x_3	Depreciation of fixed assets, %	*D*	*LOG(D)*	*DLOG (D)*
x_4	The coefficient of renewal of fixed assets, %	*R*	*LOG(R)*	*DLOG (R)*
x_5	Investments, $	*I*	*LOG(I)*	*DLOG (I)*

Primary hypothesis is that electricity production depends more on investment infusions, however indicators of equipment depreciation and losses in electric networks also play an important role. Time series of indicators was checked for the stationarity using two techniques before the modeling: visualization and also building correlograms and partial autocorrelation. Autocorrelation shows the degree of connection tightness between time series observations scattered time t counts, and is calculated by analogy with the pair correlation coefficient.

The analysis revealed that in the dynamics of the logarithms of the indicators for the whole period there can be traced periods having a trend and trajectory of these trends were similar (Figure 2, Figure 3).

Figure 2. Logarithmic scale of the studied parameters

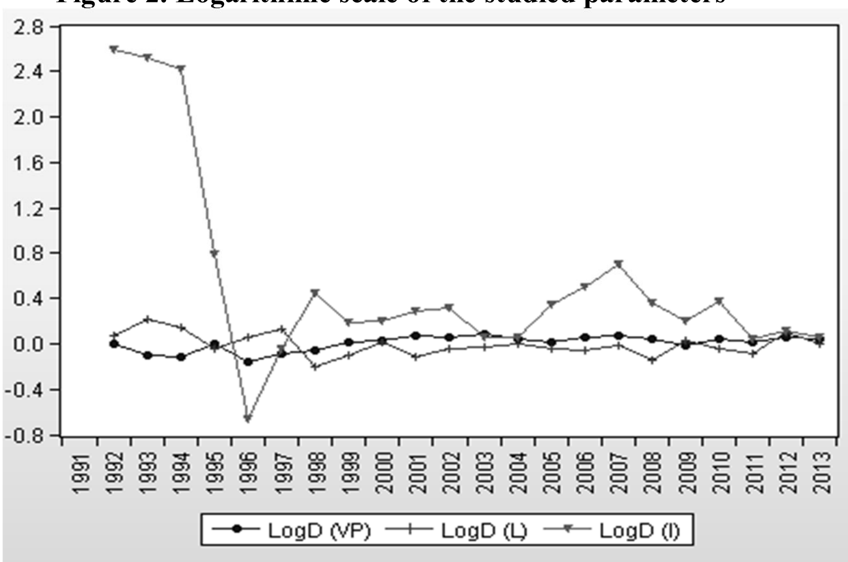
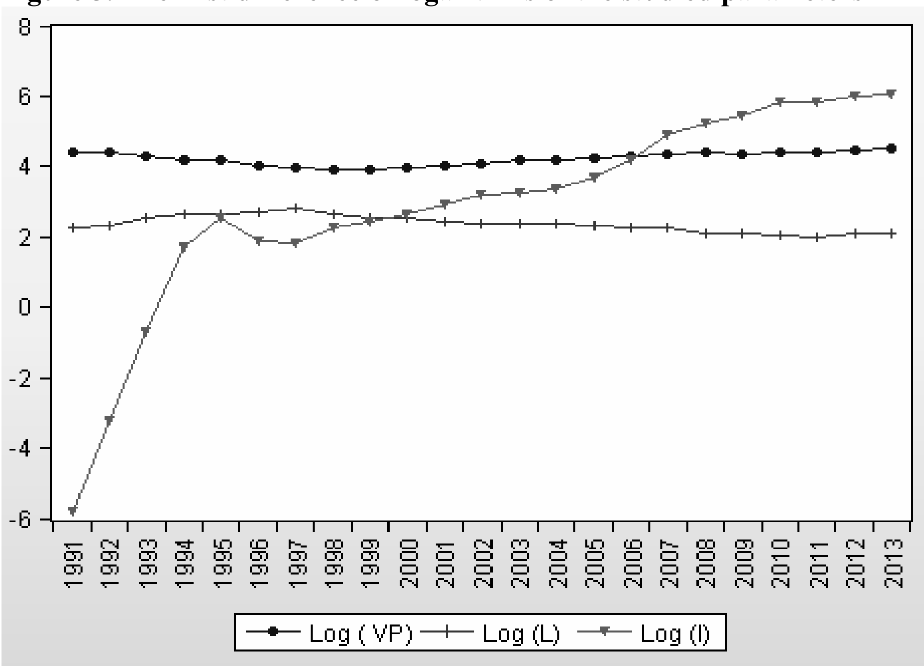


Figure 3. The first difference of logarithms of the studied parameters



This shows that the time series has no stationarity, making it difficult for further analysis. Therefore traditional method for removing trend was used, which is described as the use of the first difference of logarithms of indices. Then in the dynamics of the first difference of logarithms is no longer an indicator of trend plots (Figure 4, Figure 5) that was proved by the method of visualizing, plotting autocorrelation and partial autocorrelation functions.

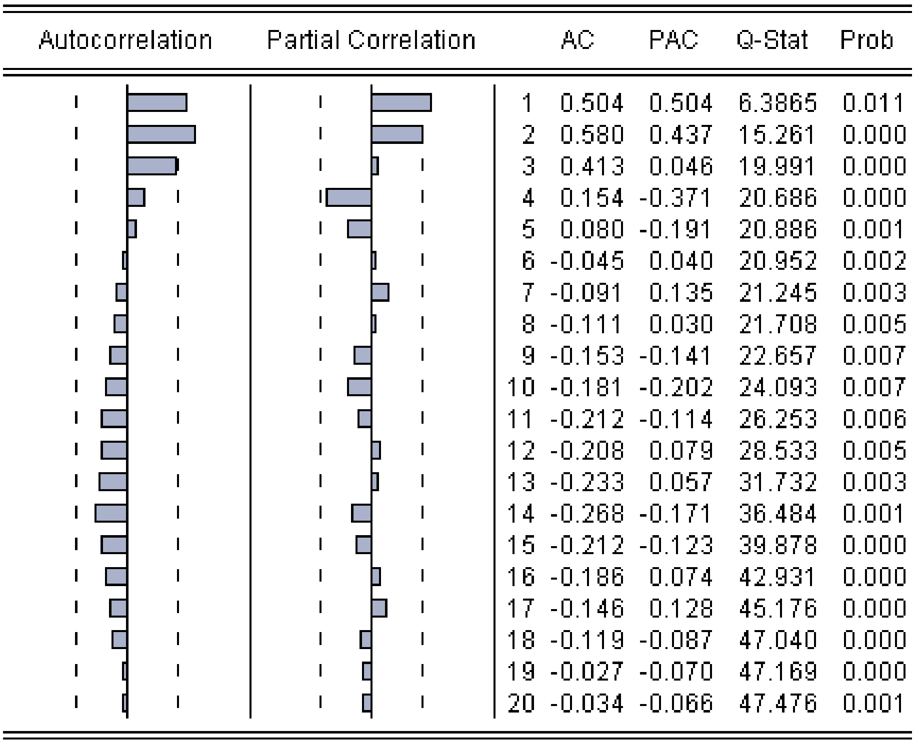
Figure 4. Autocorrelation AC and partial autocorrelation PAC function variable LOG(I)

Sample: 1991 2013
Included observations: 21

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.599	-0.599	8.6547	0.003
		2	0.263	-0.149	10.412	0.005
		3	0.069	0.257	10.541	0.014
		4	-0.196	-0.009	11.637	0.020
		5	0.052	-0.253	11.718	0.039
		6	-0.084	-0.284	11.943	0.063
		7	-0.022	-0.128	11.960	0.102
		8	0.026	0.048	11.985	0.152
		9	-0.011	0.067	11.989	0.214
		10	0.006	-0.070	11.991	0.286
		11	-0.046	-0.278	12.093	0.357
		12	0.031	-0.235	12.144	0.434
		13	0.021	0.082	12.172	0.514
		14	-0.076	0.103	12.571	0.561
		15	0.084	-0.061	13.142	0.591
		16	-0.022	-0.193	13.188	0.659
		17	-0.001	-0.148	13.189	0.723
		18	0.009	-0.022	13.203	0.779
		19	-0.006	0.075	13.213	0.827
		20	0.001	0.020	13.214	0.868

Figure 5. Autocorrelation AC and partial autocorrelation PAC function variable DLOG(I)

Sample: 1991 2013
Included observations: 22



	AC	PAC	Q-Stat	Prob
1	0.504	0.504	6.3865	0.011
2	0.580	0.437	15.261	0.000
3	0.413	0.046	19.991	0.000
4	0.154	-0.371	20.686	0.000
5	0.080	-0.191	20.886	0.001
6	-0.045	0.040	20.952	0.002
7	-0.091	0.135	21.245	0.003
8	-0.111	0.030	21.708	0.005
9	-0.153	-0.141	22.657	0.007
10	-0.181	-0.202	24.093	0.007
11	-0.212	-0.114	26.253	0.006
12	-0.208	0.079	28.533	0.005
13	-0.233	0.057	31.732	0.003
14	-0.268	-0.171	36.484	0.001
15	-0.212	-0.123	39.878	0.000
16	-0.186	0.074	42.931	0.000
17	-0.146	0.128	45.176	0.000
18	-0.119	-0.087	47.040	0.000
19	-0.027	-0.070	47.169	0.000
20	-0.034	-0.066	47.476	0.001

It should be noted that the time series are non-stationary in a logarithmic measure, but demonstrate their stationarity in first difference. This circumstance allowed applying classical methods of statistical analysis for the studied factors. The remaining data has a similar nonstationarity in a logarithmic measurement that empirically verified during the study and by results obtained. In the initial stage of research classic correlation analysis, based on the definition of pair correlation coefficient, was conducted (1).

$$r_n = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}}. \qquad (1)$$

where r_n - correlation coefficient, x_i - is the value of an independent factor, x - sample average independent force, y_i - the value of effective signs, y - sample mean efficient evidence.

Results of correlation and regression analysis revealed some peculiarities in the development of the economy and the tight link between the productive trait of electricity production and a number of indicators of energy development. The analysis resulted in building the correlation matrix of the first differences of the logarithms of the values (Table 3).

Table 3. Correlation matrix of the first differences of logarithms exponents

Indicators	DLOG (VP)	DLOG(L)	DLOG(Im)	DLOG(D)	DLOG(R)	DLOG(I)
DLOG (VP)	1	0,78	0,09	–0,28	0,71	0,79
DLOG(L)	–0,78	1	0,44	0,71	–0,65	–0,74
DLOG(Im)	0,09	0,44	1	0,76	0,18	–0,32
DLOG(D)	–0,28	0,71	0,76	1	–0,26	–0,54
DLOG (R)	0,71	–0,65	0,18	–0,26	1	0,47
DLOG (I)	0,79	–0,74	–0,32	–0,54	0,47	1

Econometric analysis proved the hypothesis that growth in electricity output in Kazakhstan depends on the volume of investment in fixed capital investments and losses in electric networks. Other factors, those have coefficient of correlation less than *0.75* with the amount of electricity generation were removed from the model due to their limited influence. In particular, the assumption of a significant relationship between the effective characteristic with depreciation of fixed assets of the electricity industry (DLOG (D)) was not confirmed during the study. It has been proved a quite strong impact of update factors (DLOG (R)) on the amount of electricity generated.

The existence of a linear relationship between the figures provided a base for further identification of type and shape of the existing links. However, in order to establish cause-effect relationships between signs significant assistance is provided by causal analysis using Granger's test (2). Designed by scientists method of economic-statistical analysis helps to explain the long-term trends and build more reliable forecasts for the economy as a whole and its individual sectors.

$$Y_i = \mu_i + \sum\alpha_k Y_{i-k} + \sum\beta_k X_{i-k} + \varepsilon_i \quad (2)$$

where Y_i - is the value of the variable Y at time i, X_i - the value of the variable X at time i, k - time delay.

The essence of the method is that the 0-th hypothesis "*x* has no effect on *y*" – means the equality of *0* for all coefficients β. F-test is applied for testing. Alternative hypothesis "*y* does not affect *x*" is tested in the same way, only *x* and *y* need to be reversed. To confirm our conclusion that "x affects y" hypothesis "x does not affect y" needs to be rejected, while hypothesis "*x* affects *y*" is adopted. If both hypotheses are rejected, then there is a relationship between the variables, which is denoted by - $x \leftrightarrow y$. If the null hypothesis is not rejected, the causal relationship between the variables is absent. In addition, it should be noted that the causal analysis is very sensitive to the number of lags (*m*) in the regression equation, which was used as a time periods from *2* to *7*. Originally was launched the *0*-th the hypothesis that electricity production does not depend on the identified indicators. For its rejection to the *5%* level of significance, the p-value for the corresponding pairs of indicators needs to be up to *0.05*.

Based on the results of the causal analysis we interpret Grangers test (Table 4), which reflects the long-term aspect of interaction between discussed indicators in terms of direction of relationships. The analysis led to the identification of dynamic interaction, in particular, the direction of the causal relationship between conjuncture-forming electricity factors. So, each of the selected indicators has the relationship with the volume of electricity production. For example, losses in the networks affect the productive factor within *t+2*, *t+3* and *t+4* counts or *2-4* years, which demonstrates the link with the depreciation of the electrical equipment and imperfections on distribution system in the Republic.

Table 4. Interpretation of test results Granger

m=2	m=3	m=4	m=5	m=6	m=7
L→VP Im →VP D →VP R →VP	L↔VP Im →VP D →VP	L→VP Im →VP	Im →VP I →VP	no connection	R →VP

Change in the volume of capital investments at time t influences the production of electricity over the next *t+5* samples or in accordance with the original data *5* years. This is due to the complexity of embedded technology and investment funds. The power industry is a capital-intensive industry, so it requires greater investment, and therefore quite long payback projects. So, based on the world experience (United States, Japan, Europe) it is spent hundreds of billions of U.S. dollars annually for the construction of new facilities and upgrading the production over a long period.

However, the correlations are often not limited to connections between the two signs: efficient and factorial. In fact, productive trait, volume of electricity depends on several factors. Therefore, the best option is the use of multivariate regression models. Following multifactorial linear model was used to build the regression equation (3):

$$y = a + b_1 * x_1 + b_2 * x_2 + \cdots + b_n * x_n \quad (3)$$

where y - is the effective sign, a - free member of the equation, $b1, b2 ... b_n$ - regression coefficients characterizing the level of influence of each factor on the outcome indicator in absolute terms, $x_1, x_2 ... x_n$ are independent determinants of the level of effective target.

The numeric values of parameters of regression model applied the method of least squares (MoLS). The essence of the method consists in finding the values of the parameters of a, b functions, when the sum of squares of deviations of actual values of the y_i tend to be lower than the values found by regression equation (4).

$$\sum_{i=1}^{n}(y_i - y)^2 = min \quad (4)$$

where y_i - is the value effective trait, y - the actual value effective trait, n - is the number of observations.

In the next phase, multi-factorial (two-factorial) linear model was built with two-step MoLS, that included two dominant independent trait-DLOG(I) and DLOG(L), as proven by their very strong relationship with the productive trait (Table 5).

Table 5. The regression results

Econometric model parameters	Value indicators
Multiple regression equation	y=97,5–2,84*x_1+0,03*x_5
R-squared	0,66
The adequacy of the model and the statistical significance of its parameters	F=19,6 t_{b1}=8,26 t_{b5}=2,98 $t_{табл} < t_{b1}, t_{b5}$

Initially regression model was introduced by the factor that has the greatest correlation coefficient with productive sign, i.e. investments. One-factorial model was obtained as a result. After including the second factor, losses in the electricity grid, has increased the coefficient of determination (*R-squared*) from *0.51* to *0.66*, which demonstrated the feasibility of its inclusion in the economic model. The coefficient of determination is an alternative version of the degree of dependence between variables and is calculated by squaring the correlation coefficient. This indicator is more preferable than the correlation coefficient, since it is used to quantify the characteristics linking variables. This value gives the proportion of the total volume of production of electricity, which can be explained by the change of the two chosen independent factors. Hence, this shows that 66% of the variation in a meaningful sign (*VP*) due to changes in investment funds (*I*) and power loss (*L*).

It is worth to note that a full assessment of the reliability of the final multivariate regression equation is impossible without taking into account the criterion of Fisher and Student. So, the *F-test* is an assessment of the quality of the regression equation, which is to verify the hypothesis of statistical regression equations independence and tightness of the connection. This is done by comparing the actual F_{act} and critical F_{crit} Fishers *F-criteria*. F_{act} is determined from the ratio factor and residual variances calculated for one degree of freedom (5):

$$F_{факт} = \frac{\sum(\hat{y} - \bar{y})^2 / m}{\sum(y - \hat{y})^2 / (n - m - 1)} = \frac{r_{xy}^2}{1 - r_{xy}^2}(n-2) \quad (5)$$

where n - is the number of units of the universe, m - is the number of parameters in the variable x; F_{act} - is the maximum value of the criterion under the influence of random factors in these degrees of freedom and the significance level a.

The level of significance of the a - probability of the rejection of the correct hypothesis, provided that it is true. Usually it is taken as equal to *0.05* or *0.01*.

If $F_{crit} < F_{act}$, the hypothesis of random nature of the characteristics is rejected and is recognized by their statistical significance and reliability. If $F_{crit} > F_{act}$, then the hypothesis is accepted and regression equation is recognized as statistically non-significant and unreliable. Student's *t-test* is used to evaluate the statistical significance of correlation and regression coefficients. The hypothesis of non-significant difference from *0* in the regression or correlation coefficient is put forward as a hypothesis. Alternative hypothesis is the hypothesis of the inverse, i.e. *0* is not equal to correlation coefficient.

Value *t-test* (also called the observed or actual) is compared to a table (critical) the value, determined by the Student's t - distribution table. The table value is determined according to the level of significance *(a)* and the number of degrees of freedom, which in the case of linear regression is equal to *(n-2), n* is the number of observations. If the actual value of the *t-test* is more than table module, then with probability *1-a* regression parameter (correlation coefficient) significantly different from *0*. If the actual value is less than the *t-test* table, there is no reason to reject the hypothesis, i.e., the regression parameter is not significantly different from *0*.

Evaluation of reliability of the regression equation is made on the basis of narrowness of communication between *R* and *F*-criteria. The actual calculated value of the Fisher criterion is usually more than table value i.e. the probability of getting a value of *F-test* does not exceed the permissible level of significance of 5%. The resulting value was formed under the influence of the factors essential to the equation, which is proved by statistical significance of the equation and narrowness indicator of *R*. Student criteria indicate that the parameters of the x_1 and x_5 are statistically significant since the *t-statistic* corresponding regression coefficients are more than table-value *2.0739* with significance level $a = 0.05$ and the number of degrees of freedom $k = 22$. Hence, the regression equation is adequate, and the study is reliable.

4. Conclusions

Evaluation of the electric power sector development in Kazakhstan over the past *23* years has revealed some growth mainly due to power generation by thermal power plants. At the same time, the shortage of electricity is covered through imports from neighboring countries. There are in the country-specific wear of electrical equipment at 34% and the loss of energy during its transportation. However, in recent years there has been a positive trend increase of factor update of fixed assets due to the attraction of investments.

Correlation and regression analysis made it possible to empirically show the importance of investment resources for the development of the electric power industry, as well as to detect existing problems and contradictions. In particular, the analysis of investment structure showed that the investment policy of the industry development is focused on the use of borrowed funds, underutilized tools market investing industry, and there are energy losses in the networks.

It should be noted that a number of risks inherent in other industries (product price fluctuations, changes in environmental standards, etc.), in the power sector are compounded by the long-term nature of the projects and their high cost. The period of full payback and return on investment, for example, in the construction of large power plants can be approximately 15-25 years. Therefore, as a guide, we offer to invest in the construction of power plants using renewable energy sources (in the form of hydropower and solar energy available in the country). Such power stations require less investment and payback periods significantly reduced compared to conventional power plants. In addition, they are environmentally friendly and energy efficient.

Correlation evaluation showed that due to the inflow of investment resources, losses in distributive electric mains and depreciation of high-tech equipment are reduced, which leads to the resolution of major problems of the energy sector. Participating in the investment of the state through a system of state orders plays an important role in the modern world; provide the appropriate level of interest rates on loans, direct capital investment, etc. In this regard, in our opinion, it is necessary to strengthen the emphasis on state support to the energy sector of the country.

Investment will enable enterprises in Kazakhstan update fixed assets and acquire innovative equipment. The introduction of new equipment and technology, improving the organization of manufacture at the enterprises will generate economic benefits in the form of: growth of power production, increase labor productivity, and improve their environmental performance, reduce material consumption and the energy intensity of industrial production, raise returns on assets, etc. In the end, they all would help to reduce the cost of electricity and increase profits at domestic enterprises.

Analysis of the current state of the industry indicates that maximum use should be made of existing capacities of electric power, as well as address increase of investment attractiveness of the industry, reducing wear on equipment of power stations and the introduction of alternative sources.

Therefore, in order to effectively develop and increase the proportion of energy complex in the total industrial production is required to increase the flow of investment into the economy of Kazakhstan, with an active support of the state. In the end, this will facilitate the acquisition of innovative electric power equipment and launch innovative capacity of power stations with the advanced world experience.

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