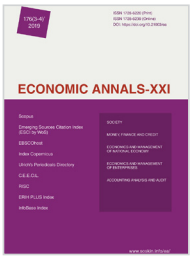

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Digitalisation and energy: world experience and evidence of correlation from Kazakhstan

Abstract. The rapid pace of development of the digital economy is an effect conditioned by technology and innovation that have been developing over several decades and becoming more common. The number of Internet users in Kazakhstan increased from less than 1% in the 1990s to 81% in 2018, which happened due to a sharp decline in the cost of access and a high increase in computing power. The technological revolution has become a source of stimulating economic growth with less energy consumption. Digitalisation is considered to be a factor contributing to energy efficiency in the economy. The relationship between digitalisation, energy consumption and economic growth is a theme which has gained momentum recently. This paper attempts to estimate the effects of technology and economic factors on the energy intensity in Kazakhstan. The paper employs econometric methods: the unit root test, cointegration methods and the Granger causality test. All data were obtained from the World Bank's database for the period between 1994 and 2018 as well as the Statistics Committee of the Ministry of National Economy of the Republic of Kazakhstanand the Odyssee database by EU. The results demonstrate that Internet usage and trade openness impact energy intensity. The results demonstrate that Internet usage and trade openness has a negative effect on energy consumption in the long run. The liberalisation trade and economy reduces the consumption of energy obtained from fossil fuels and minimises environmental degradation. Digitalisation is supposed to stimulate the efficiency of the energy system by optimising consumption and metering, reducing losses, generating with lowest possible costs and emissions, etc. Economic growth has a positive and statistically significant impact on energy intensity. The article contains certain recommendations for policy makers: the government should attract more investment and provide consistent support for ICT to increase the energy efficiency and to decrease total energy consumption.

Keywords: Energy Consumption; Internet Usage; Digitalisation; Economic Growth; GDP; Technological Revolution; Energy Intensity Index; ICT
JEL Classifications: O40; Q43; O1
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Цифровізація та енергетика: світовий досвід і казахстанський приклад взаємозв'язку

Анотація
Швидкі темпи розвитку цифрової економіки є результатом впровадження технологій та інновацій, які розвивалися протягом декількох десятиліть, і стають усе більш поширеними. Число користувачів мережею Інтернет у Казахстані збільшилося з менш ніж 1% в 1990-х роках до 76% у 2017-му році завдяки різкому зниженню вартості доступу до мережі, а також значному збільшенню обчислювальної потужності. Технологічна революція стала джерелом економічного зростання при меншому споживанні енергії. Цифровізація вважається чинником, що сприяє енергоефективності в економіці.

Взаємозв'язок між цифровізацією та економічним зростанням є темою, яка останнім часом стає все більш популярною. У статті зроблено спробу оцінити вплив технологічних й економічних факторів на енергоємність Казахстану. В роботі використано економетричні методи: тест на одиничний корінь, коінтеграцію, тест причинності Грейнджера. Результати показують, що зростання числа користувачів мережею Інтернет і відкритість торгівлі знижують споживання енергії в довгостроковій перспективі. Лібералізація торгівлі й економіки знижує споживання енергії, отримуваної з викопного палива, а також зменшує деградацію стану навколишнього середовища. Цифровізація повинна стимулювати ефективність енергосистем за рахунок оптимізації споживання й обліку, скорочення витрат, генерування з найменшим рівнем витрат і викидів тощо. Економічне зростання має позитивний і статистично значимий вплив на енергоємність. У статті містяться рекомендації для уряду: залучати більше інвестицій у галузі ІКТ й надавати послідовну підтримку для підвищення енергоефективності та зниження загального споживання енергії.
Ключові слова: енергоспоживання; енергетика; цифровізація; Інтернет; економічне зростання; енергоємність; ВВП.

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Аннотация
Быстрые темпы развития цифровой экономики являются результатом внедрения технологий и инноваций, которые развивались в течение нескольких десятилетий и становятся все более распространенными. Число пользователей сети Интернет в Казахстане увеличилось с менее 1% в 1990-х годах до 76% в 2017-м году благодаря резкому снижению стоимости доступа к сети и значительному увеличению вычислительной мощности. Технологическая революция стала источником стимулирования экономического роста при меньшем потреблении энергии. Цифровизация считается фактором, способствующим повышению энергоэффективности в экономике. Взаимосвязь между цифровизацией, потреблением энергии и экономическим ростом является темой, которая в последнее время набирает обороты. В данной статье предпринята попытка оценить влияние технологий и экономических факторов на энергоемкость Казахстана. В работе используются эконометрические методы: тест на единичный корень, методы коинтеграции, тест причинности Грейнджера. Результаты показывают, что использование сети Интернет и открытость торговли влияют на энергоемкость. Рост числа Интернет-пользователей и открытость торговли снижают потребление энергии в долгосрочной перспективе. Либерализация торговли и экономики снижает потребление энергии, получаемой из ископаемого топлива, и уменьшает деградацию состояния окружающей среды. Цифровизация должна стимулировать эффективность энергосистем за счет оптимизации потребления и учета, сокращения потерь, генерирования с наименьшими затратами и выбросами и т. д. Экономический рост имеет положительное и статистически значимое влияние на энергоемкость. Статья содержит некоторые рекомендации для правительства: привлекать больше инвестиций и предоставлять последовательную поддержку отрасли ИКТ для повышения энергоэффективности и снижения общего потребления энергии.
Ключевые слова: энергопотребление; энергетика; цифровизация; Интернет; экономический рост; энергоемкость; ВВП.

1. Introduction

Achieving energy saving and energy efficiency is a strategic goal of the state. Improving energy efficiency in all sectors is necessary to maintain economic growth. Nowadays, the energy intensity of Kazakhstan's GDP is 2-1.5 times higher than in the European Union and OECD countries. The energy intensity index of Kazakhstan's GDP for 2018, according to the Statistics Agency of Kazakhstan, is 1.5 tons of oil equivalent per one thousand USD at 2000 prices. This indicator has remained unchanged since 2014. The industry consumes about 45% of the total final energy consumption, while the housing and utilities sector accounts for about one third of the total amount. The main reasons for the high energy intensity of Kazakhstan's GDP are as follows.

The current structure of the economy with energy-intensive types of industries, including extractive and metallurgical industries. The most energy-intensive industries of Kazakhstan are similar to the world ones: ferrous and non-ferrous metallurgy, chemical industry and oil refining and cement production.

The overall technological backwardness of many sectors of the economy and, accordingly, the high energy intensity of production, which in some industries exceeds the European indicator by several times. 1.04 kg of oil equivalent in metallurgy is needed for 1 euro of product in Kazakhstan, while in Germany it is required to have 0.78 kg of oil equivalent.

Also, this is because of a low cost of energy prices, which does not stimulate energy conservation and deterioration of networks and equipment, associated with this significant loss of energy.

The housing and utilities sector has reserves for energy savings. According to the author's calculations, based on the data of the Statistics Committee of the Ministry of National Economy of the Republic of Kazakhstan and the Odyssee database by EU for 2017-2018, an average of 13.8 kg of oil equivalent is required for heating a square meter in Kazakhstan (162 kWh per m^2), while in Germany and France it is 3.24-3.76 kg for apartments (38-43.7 kWh) and 7.2-8.2 kg for individual houses (83.7-95 kWh). The reason, in addition to the climatic conditions, is the deterioration of the housing stock. Approximately 70% of buildings in Kazakhstan were built between the 1950s and 1980s and do not meet modern requirements for thermal insulation, which causes considerable heat loss.

Kazakhstan should reduce the energy intensity of GDP compared to the levels of the EU member states to improve the competitiveness of the economy and reduce the burden on the environment. Only a noticeable increase in the productivity of all factors of production (including energy) can be a source of economic growth.

The technological revolution is a source of stimulating economic growth with less energy consumption. Digitalisation is considered a factor contributing to energy efficiency in the economy. Improvements in data collection and analytics, which form the fundamental elements of digitalisation, should have a major impact on energy systems in buildings, industry and transport. The main global trend in the energy sector is the introduction of various smart technologies in order to ensure effective information exchange between all elements and participants of the network, protection and self-recovery from major disruptions. The greatest potential savings in housing and public utilities are heating, cooling and lighting. In industry, digital technologies increase competitiveness by improving the control of production processes, reducing losses, reducing production costs and increasing labour productivity.

The digital economy is rapidly developing globally in the world. According to the European Commission, the digital economy is estimated at EUR 3.2 trillion in the G20 and accounts for about 8% of GDP. In Kazakhstan, the total ICT expenses in 2018 were USD 885 million, which is 12.8% less than in 2017. 52% of ICT expenses are software and services of IT companies. Kazakhstan's ICT industry is 3.5% of GDP. The number of Internet users in Kazakhstan is growing - from less than 1% in the 1990s to 81% in 2018 due to a sharp decrease in the cost of access and a significant increase in computing power.

In Kazakhstan, according to the Government's forecasts, the annual growth of productivity will be at 2%-10%, the growth of resource extraction will be 3%, reduction of production costs is estimated 10-20% due to the digitalisation in the sectors of the economy. Intelligent energy management systems and energy-saving technologies have begun to be introduced to improve energy efficiency and reduce energy losses in Kazakhstan. These systems allow for the interaction of consumers with the system to manage electricity consumption, to generate electricity into the network with their own renewable energy sources. The total economic effect of the digitalisation of the extract and energy complex is estimated at USD 415 million, according to the Ministry of Energy Republic of Kazakhstan. Many obstacles stand in the way of realising the benefits of the wide distribution of digital technologies in buildings. They range from privacy concerns to technical and economic considerations.

New business models allow for broader energy efficiency delivery, requiring a minimum energy performance of the building. The emergence of ESCOs or similar business models could also create opportunities for the provision of comprehensive energy packages, such as smart controls and automatic system. Supportive policy frameworks, such as procurement of energy-efficient technologies and white certificates, can help in this regard by driving down costs of products and ensuring those technologies actually deliver on savings.

Policy-making processes can also advantage from more timely and complex collection and publication of energy data, which can facilitate greater access to digital data.

The relationship between digitalisation, energy consumption and economic growth is a topic that has been of a particular interest recently.

Digitalisation and ICT usages brings up a few interesting questions: How does an increase in the use of digital technologies affect the energy intensity of GDP and economic growth? Is there a correlation between these variables? Our research, based on the case of Kazakhstan, is trying to answer these questions.

2. Brief Literature Review

The role of ICT and digitalisation in providing economic growth has attracted significant attention. Based on aggregate data, early evidences suggested that information technology, particularly computers, have effect on growth or productivity (Gordon, 2000; Jorgenson & Sitroh, 1999; Berndt & Morrison, 1995) [1-3].

Other researchers suggest that there is a positive relationship between ICT and economic growth (Yoo, 2003; Biscourp et al., 2002; Muhammad Shahbaz at al., 2014) [4-6].

The relationship between digitalisation and energy consumption is infrequently examined and most of the work on this subject is carried out basing on data relating to developed economies (Sadorsky, 2012) [7]. J. Romm (2002) examined the energy usage intensity of the ICT sector in United States. He (2002) further noted that the Internet appears to be propelling efficiencies [8].

K. Takase and Y. Murota (2004) examined the effect of information technology investment on energy consumption and CO2 emissions in the US and Japan. They noted that an increase in the information technology lowers energy intensity [9]. In the case of France, Collard et al. (2005) examined the relationship between ICT and energy consumption. Their research suggests that the impact of communication technology is greater than the impact of information technology on energy usages [10]. Using a logistic growth model, Cho et al. (2007) examined that ICT investments lead to a higher consumption of electricity in a few manufacturing sectors and in the services sector On the other hand, ICT investments in some specific manufacturing sectors decrease electricity consumption. They noted that electricity prices significantly impact electricity consumption in industry [11].

J. Campo and V. Sarmiento (2013) found a bidirectional causality between energy consumption and GDP for Latin American countries. They noted that the increase in energy consumption and real GDP impact each other with regard to selected countries of Latin America (the increasing of one indicator by 1% increases the other by 0.59%). The results show that energy generates economic growth and policies that promote energy efficiency do not negatively affect GDP [12].

M. Shahbaz et al. (2014) found a relationship between information communication technology (ICT), economic growth and electricity consumption by using data for the UAE for the period between 1975 and 2011.They found that ICT adds in electricity demand, but electricity prices lower it [6].

L. Hung-Pin (2014) investigated the causal relationship between renewable energy consumption and economic growth for the OECD countries, namely Denmark, France, Germany, Italy, Japan, Portugal, Spain, the United Kingdom and the United States for the 1982- 2011period. Lin Hung-Pin concluded that the United States, Japan, Germany, Italy and the United Kingdom could promote their investments in the renewable energy infrastructure or regulate renewable energy conservation policies to avoid the possibility of reducing the consumption of renewable energy sources that negatively affect economic growth. He also found that renewable energy conservation policies can have a little impact on economic growth in France, Denmark, Portugal and Spain [13].

M. Salahuddin and K. Alam (2015) studied the short-term and long-term effect of using the Internet on the Australian economic growth over the 1985-2012 period. They found that the use of the Internet and economic growth stimulate electricity consumption in Australia. Australia has yet to achieve improved energy efficiency as a result of ICT expansion. The researchers suggest that Australia should promote its existing carbon capture and storage facilities, significantly increasing its investment in the renewable energy sector, particularly solar energy, and build nuclear power plants to generate electricity to reduce CO2 emissions [14].

K. Saidi et al. (2015) investigated the impact of ICT and economic growth (GDP) on electricity consumption (EC) for a group of 67 countries using a dynamic panel data model. They found a positive and statistically significant effect of ICT on electricity consumption [15].

M. Salahuddin and K. Alam (2016) investigated the short- and long-run effects of ICT use and economic growth on electricity consumption for OECD countries. They used panel data for the 1985-2012 period. The results verify that both the use of ICT and economic growth is the cause of electricity consumption and electricity consumption, in its turn, impacts economic growth [16].

M. Rahimi and A. A. Rad (2017) investigated short- and long-run effects of Internet usage and economic growth on electricity consumption for eight developing (D-8) countries, using panel data for the period between 1990 and 2013. They found that the Internet usage effects electricity consumption only in the long-run period. However, economic growth impacts electricity consumption in both the short run and the long run [17].

From previous researches, the authors concluded the following:

- on the one hand, ICT consumes energy; therefore it can increase energy intensity (especially data centres);
- on the other hand, ICT reduces the energy intensity of GDP through increasing the efficiency of economic sectors (for example, e-substitutes for physical products).

Figure 1 shows the relative lag of the energy efficiency of the economy of Kazakhstan from the leading countries - Germany and Norway. The indicators in Germany and Norway were taken as the benchmark equal to 1 or 100%, according to calculations using the DEA method.

As can be seen from the figure, the gap between Kazakhstan's energy intensity and the energy intensity of the selected countries at the world or European level is significant. This gap is typical not only of energy intensity, but also of many other economic indicators. As follows from the previous studies, economic growth is only possible when we increase the efficiency of all factors of production, including energy.

Dynamic economic growth in Kazakhstan is possible only on the basis of a deep modernisation of the existing facilities, as well as the development of new competitive industries.

In Kazakhstan, digitalisation can have a positive impact through changes in production processes and supply chains, replacement of inefficient equipment, introduction of elements of smart buildings and virtual work and learning. In our research, we will try to determine the interconnection between ICT and the energy intensity of Kazakhstan's economy.

3. Purpose

The purpose of this paper is to determine the effects of Internet usage, trade openness and GDP per capita on energy intensity. The functional form of the model is:

$$Eintensity = f(GDP, INT, Trade)\,. \tag{1}$$

Making the log linear form of the both sides of the Equtaion (1), we obtain the following Equation (2):

$$lnEintensity_{it} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnINT_{it} + \beta_3 lnTrade_{it} + \varepsilon_{it}\,, \tag{2}$$

where:

ln denotes the natural logarithm;

β_1, β_2, β_3 parameters are the long-run elasticities of energy intensity relative to GDP per capita, individuals using the Internet (% of population) and trade openness;

$lnEintensity_{it}$ is a logarithmic meter corresponding to energy intensity;

$lnGDP$ is a logarithmic meter corresponding to the GDP per capita;

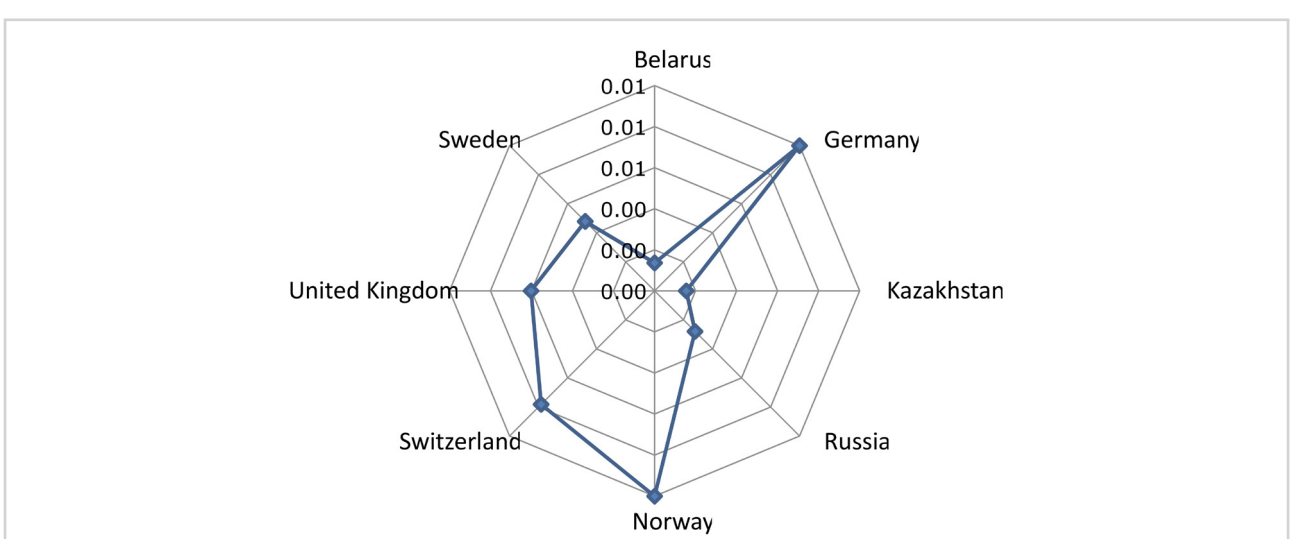

Figure 1:
Graphic interpretation of the energy intensity of GDP of selected countrie
Source: Compiled by the authors based on data by the World Bank and the Statistics Committee of the Ministry of National Economy of the Republic of Kazakhstan

$lnINT$ is a logarithmic meter corresponding to the Internet usage;
$lnTrade$ is a logarithmic meter corresponding to trade openness.

The energy intensity level of primary energy (MJ / 2011 PPP USD GDP) is the ratio between energy supply and gross domestic product measured at purchasing power parity. Energy intensity shows the amount of energy used to produce one unit of economic output. A lower ratio indicates that less energy is used to manufacture one unit of output.

GDP per capita is measured in USD. In this study, the ICT variable includes individuals using the Internet (% of the population). Trade openness is calculated by dividing the aggregate value of imports and exports over a period by the gross domestic product for the same period. An indicator of trade openness is the ratio of trade to GDP. This indicator has increased for most trading states, and is a result of globalisation and trade liberalisation. It is argued that trade openness brings many economic benefits, including increased technology transfer, transfer of skills, increased labour and total factor productivity, as well as economic growth and development. All data were obtained from the World Bank's database for the 1994-2018 period.

4. Results

This research uses Augmented Dickey-Fuller (ADF) unit root tests to check the stationary properties (Dickey and Fuller, 1979; 1981). The null hypothesis of the ADF tests is non-stationary distribution. If it is rejected, the time series variable is stationary [18-19]. Otherwise, the variable is non-stationary.

To study the causal relationship between the selected variables, the Granger test (1969) was used. The idea of the test is as follows: if changes in Variable A cause changes in Variable B, then changes in Variable A precede changes in Variable B [17-18].

R. Engle and C. Granger (1987) observe that even though economic time series may wander through time, that is, may have the characteristic of nonstationarity in their level, there may exist some linear combination of these variables that converges to a long run relationship over time. If the series individually are nonstationary, then after differencing a linear combination of their levels is stationary. Therefore the series are said to be cointegrated. According to Granger (1969), there must be an error correction model (ECM) representation if the variables share a co-integration relationship [20-21].

Keeping in mind the basic idea behind cointegration, it is necessary to determine the order of integration of each variable before proceeding to using cointegration techniques.

The results in Table 1 point out that the hypothesis that the levels of all variables under study contain a unit root is accepted at the 1% significance level. When these tests are applied on the first differences of those variables, the reported results display that the unit root hypothesis is rejected.

The results at the level form show that all variables are non-stationary at the 5% significance level (Table 1). The test results indicate that the first difference variables are stationary. This implies that energy consumption, economic growth, CO_2 emission, trade openness and urbanisation are integrated in order one.

The results of the Granger causality test are presented in Table 2.

This shows that there is a one-way causality flowing from the Internet use, GDP per capita and trade openness to energy intensity.

Table 1:
Unit root tests

	ADF Unit root test		
	Level	First difference	Integration order
lnEintensity	-1.88	-4.74	I(1)
lnInt	0.37	-5.45	I(1)
lnGDP	0.47	-3.00	I(1)
ln Trade	-1.34	-4.36	I(1)

Source: Compiled by the author

Table 2:
Granger causality test

Null Hypothesis:	Lag	F-Statistic	Prob.
lnTrade does not Granger Cause lnEintensity	3	3.3278	0.0565
lnGDP does not Granger Cause lnEintensity	4	4.1314	0.0359
lnINT does not Granger Cause lnEintensity	1	4.7479	0.0437

Source: Compiled by the author

The co-integration among the variables is explored by using the Johansen co-integration test. The relevant results are presented in Table 3 [22]. The maximum trace statistics is 78.4, which is greater than the 95% critical value of 54.1. Further, the Max-Eigen test exhibits that statistics is 49.8, which is greater than the 95% critical value of 28.6. This implies that the null hypothesis $r = 0$ is rejected at the 5% significance level. But the results for $r \leq 1$, $r \leq 2$, $r \leq 3$ and $r \leq 4$ demonstrate that the null hypotheses cannot be rejected. As a result, the trace test and the maximum Eigen test detected the existence of a single co-integrating vector. Therefore, the study concludes that there is a long run relationship between energy consumption, economic growth, electricity consumption and internet usage.

Table 3:
Co integration rank test

	Trace				Max-Eigen			
Hypothesized No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.	Eigenvalue	Statistic	Critical Value	Prob.
None *	0.927	78.3646	54.079	0.0001	0.927	49.831	28.5887	0.0000
Atmost 1	0.486	28.534	35.193	0.2182	0.486	12.657	22.300	0.5903
Atmost 2	0.433	15.877	20.262	0.1802	0.433	10.767	15.892	0.2695
Atmost 3	0.236	5.109	9.164	0.2716	0.236	5.1097	9.164	0.2716
Trace test indicates 1 cointegrating eqn.(s) at the 0.05 level								

Source: Compiled by the author

As a result, we obtain the following:

$$lnEintensity = 2.314 + 0.113\ lnGDP - 0.206\ lnTrade - 0.097\ lnINT, \quad R\text{- squared} = 0.91,$$
$$se \qquad 0.5 \qquad (0.029) \qquad (0.079) \qquad (0.0099)$$

The dependent variable is the energy intensity level of primary energy (MJ / 2011 PPP USD GDP) as energy consumption in our model. The positive and negative values of the coefficients show the impact of independent variables on the dependent variable.

The coefficient of lnGDP is positive as it is 0.11 and statistically it is significant as its absolute t-value is 3.9. Its coefficient value indicates that the GDP adds to the energy use in long run. Thus, the coefficient of GDP suggests that a 1% increase in per capita GDP will lead to an increase in the energy intensity of 0.11%.

In the case of Internet use ($lnINT$), the coefficient is negative and statistically it is significant as its value is 0.097. It implies that a 1% increase in the number of individual users will decrease the energy use per capita by 0.097% in the long run. In the case of trade openness, we have a negative impact: a 1% increase will lead to a decrease in the energy intensity of 0.21% in long run. It means that the trade and economy liberalisation, along with bringing more investments in technologies, including access to products with high energy efficiency, reduces the consumption of energy from fossil fuels and the environmental degradation.

In short run, we have the following equation:

$$DlnEintensity = -0.035 + 0.261\ DlnGDP - 0.274\ DlnTrade(-1) - 0.051\ DlnINT(-2),$$
$$se \qquad 0.0215 \qquad (0.0812) \qquad (0.116) \qquad (0.0197)$$

The cointegration reveals that there is a long-run relationship between the variables, yet it can distinguish neither the endogeneity nor the exogeneity of the variables. The results reveal that all the variables impact energy intensity.

5. Conclusion

Energy is the main factor impacting both the internal and external development strategy and economic security of the state. Worn out facilities and low rates of modernisation will lead to lower competitiveness, lower product quality and preserve the extractive nature of the economy unless energy-saving and energy-efficient technologies are introduced.

The most effective solution to reducing natural resources is the practice of energy saving and the introduction of energy efficient technologies.

Energy saving and energy efficiency of all sectors of the national economy are currently priority tasks of the Government of the Republic of Kazakhstan, the solution of which will eliminate a complex of energy, environmental, economic and social problems.

On 13 January 2012, the Law of the Republic of Kazakhstan «On Energy Saving and Improving Energy Efficiency» No. 541-IV ZRK was adopted to solve the problem of improving the energy efficiency of the economy. In 2015, amendments were made to the Law and the Rules for the formation and maintenance of an energy efficiency map (the republican list of projects in the field of energy saving and energy efficiency) were adopted.

The progress of energy saving in the leading countries is ensured by the transition from energy efficiency to a more modern strategy of digitisation and the development of renewable energy. The rapid pace of the development of the digital economy is the result of technology and innovation that has been developed over several decades and is becoming more common.

The Government of the Republic of Kazakhstan approved the program «Digital Kazakhstan» on December 12, 2017 to implement the strategy of digitisation and modernisation of the technological base of the economy. The program aims to develop a digital ecosystem to achieve sustainable economic growth, enhance the competitiveness of the economy, and improve the quality of life of the population.

The traditional industries in Kazakhstan have a low degree of automation and a low level of digital technologies. Technical re-equipment of industries involves the use of elements of Industry 4.0. Technological improvements include the use of predictive maintenance, machine learning and artificial intelligence, cloud technologies, intelligent planning and control of production, integration of information systems for managing production processes, industrial Internet, transition to intelligent accounting systems and remote control of utility networks. Digitalisation in the construction industry and utilities will provide a qualitative leap: a transition to new radically different approaches to the design, construction and operation of buildings, improving the energy efficiency of new construction, and the reconstruction of the existing housing stock will significantly reduce energy consumption.

According to our conclusions, the Government should value the potential of digitalisation to provide sustainable lowering of energy intensity. The Government of the Republic of Kazakhstan has realised some projects in this field. The State Energy Register, an electronic collection of information on energy consumption by monitoring objects (26,573 enterprises in 2019), was created with the support of the World Bank in 2016. The introduction of the relevant tools is aimed at reducing the energy intensity of GDP by 50% by 2050, compared with 2008 (the current indicator is 18% lower by 2008).

In this paper, we have studied Internet usage and economic growth as engines of energy consumption. We have applied a model relation between energy intensity, GDP, trade openness and Internet. The results show that Internet usage and trade openness have a negative effect on energy consumption in the long run. Nevertheless, the estimated coefficients show that Internet usage cannot be considered to have more impact on energy consumption than economic factors, such as GDP and trade openness. Economic growth has a positive and statistically significant impact on energy intensity. The contribution of economic growth and trade openness have the opposite trend.

Both ICT and trade openness contribute to reducing energy intensity, which is consistent with the previous studies. Trade openness may help the country to import high value inputs, products and technologies that may have a positive impact on the overall capacity of the country's economy. Investments in ICT have significantly reduced energy consumption in Japan (Ishida, 2015) and the OECD countries (Schulte et al., 2014).

We suggest that the advantages of the reduction of energy intensity occur due to its impact on industrial structure and optimisation of the existing networks, including lower operating and maintenance costs.

The article contains certain recommendations for policy makers: the government should attract more investment and provide consistent support for ICT to increase the energy efficiency and to decrease total energy consumption. It is important that more ICT products be introduced into the mining and manufacturing industries in order to increase energy efficiency and reduce the overall energy consumption.

Further research could be dedicated to the assessment of the effect of other indicators of ICT on energy intensity.

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