“The relationship between logistics and information and communication technologies and their impact on the economy of Kazakhstan”

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THE RELATIONSHIP BETWEEN LOGISTICS AND INFORMATION AND COMMUNICATION TECHNOLOGIES AND THEIR IMPACT ON THE ECONOMY OF KAZAKHSTAN

Abstract

This study aims to analyze the impact of logistics and information and communication technologies (ICT) on Kazakhstan's economic growth, which requires rethinking search and management tools. The study used the methods of descriptive data statistics, checking the data for the normality of the distribution, and Spearman's correlation analysis. The information database comprised the National Bank, the World Development Bank, and the national statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. The paper determined the dynamics of GDP per capita and logistics, including export and import, for 2005–2020. The construction of the correlation model was carried out in SPSS. Interestingly, the most significant negative relationship was revealed between database-related services and the population and the volume of communication services (.761*).

On the other hand, the results show a positive impact of ICT's strong relationship with Kazakhstan's logistics system. A close relationship was revealed between the volume of postal and courier activities and GDP per capita (.946*), and foreign trade turnover and exports and imports (.897*). Furthermore, the correlation analysis showed that the cost of investments in developing data processing services decreases with an increase in GDP and the volume of communication services. The findings of this study are relevant for governmental bodies operating in the field of logistics and transportation. Moreover, they are valuable for the digitalization of existing and designing new logistics systems as a factor in the development of the economy.

Keywords economic growth, logistics, transport, information and communication technologies, correlation analysis, Kazakhstan

JEL Classification L91, L92, R40

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INTRODUCTION

In current conditions of technological improvement of the economy, the main challenges in providing transport and logistics services are a high level of services aimed at customer focus. Digitalization of the transport system and automation of logistics processes together ensure the inclusion of the country's economy in global trade and industrial networks. Optimization, efficiency, and speed are essential in logistics and transportation. Under these conditions, the growth rates of digital technologies and the digital environment lead to the next evolution in the industry, such as Industry 4.0. One of the main tasks of Industry 4.0 is the development of transport infrastructure, automation of warehouse activities, and

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automated workplace management using digital technologies. This is especially important because digitalization promotes logistics chain optimization and reduces cost and time.

In recent years, scientists have shown interest in studying the level of development and the relationship between information and communication technologies (ICT) and economic growth in logistics. ICTs require various skills to fully utilize their capabilities in developing transport and logistics. This relationship can be considered from two points of view. First, ICT is necessary for economic growth. Second, in the process of ICT development, it is necessary to learn how to best use these technologies in various fields of activity, including logistics.

Logistics infrastructure needs to succeed in many countries, so assessing its feasibility and sustainability is vital. In addition to the technical aspects, this requires management tools, ways to retain customers, and support for creating innovative business models and value chains. Therefore, integrated solutions in the logistics system are the leading resource for ensuring the effective management of value chains. Thus, in growing demand, the logistics system plays an essential role in each country's economy.

However, there are problems in the logistics industry of Kazakhstan, such as disordered competition, poor transport infrastructure, and uneven distribution of resources, which are an obstacle to economic growth. In recent years, Kazakhstan has been developing a mixed economy, intensively developing the market of transport services and many logistics processes. So naturally, digital transformations began to ensure an increase in the efficiency of main processes of the Kazakh logistics industry. Therefore, it is crucial to expand logistics potential within the framework of developing digital transport and logistics services and accelerate the transition from traditional to digital logistics. In addition, managing logistics processes and solving the problem of developing research in the context of digital transformation requires further research and rethinking the tools for searching and managing traffic flows.

Digitalization of the transport system and automation of logistics processes provides an opportunity for the transition of the country's economy to global commercial and industrial networks. This topic is fascinating and has received coverage in several scientific areas. However, the context of the relationship between logistics and ICT indicators and the economy still needs to be investigated. The literature review showed that ICTs in the logistics industry have a significant impact on the country's economic development.

This paper uses statistical data across the country to study the logistics industry's impact on Kazakhstan's economic development in different periods. It also studies the contribution of various factors and their relationship. This study divides the indicators into logistics and digital since there is an assumption about the positive impact of ICT on logistics and, appropriately, on economic growth. GDP per capita, imports, exports, communication and logistics, and financial indicators were analyzed. The study assessed the impact of logistics, economic, and ICT indicators on the economic growth of Kazakhstan.

1. LITERATURE REVIEW

Most logistics firms have implemented ICT in their business processes. At the same time, restructuring the logistics business model in the direction of digitalization is initially an expensive process. However, ICTs have increased the efficiency and effectiveness of business processes by speeding up the exchange of information, eliminating the language barrier, and reducing geographical boundaries. As a result, there was a reduction in material and time costs for logistics between the companies-sellers and buyers. Therefore, the acceleration of trade turnover leads to an increase in the country's GDP level. Furthermore, within the framework of Dawe's (1994) assumption, ICTs provide a timely physical flow of goods to customers and the fast and efficient transfer of business information between organizations. In addition, with the reduction of transportation costs, there are finan-

cial savings of funds remaining within companies, which also supports economic growth (Hidalgo & Albors, 2010; Naveed et al., 2018; Ferrari et al., 2022).

Another important positive aspect of the logistics system development is the improvement of the population's standard of living. Intelligent technologies develop urban transport logistics and improve cooperation between the state, transport companies, businesses, and customers (Kauf, 2016). Of course, customers are not always satisfied with the quality of the services provided by the transport company, which in the future may lead to an increase in the quality of logistics services and even more significant development of smart applications. However, the positive environmental effect is obtained through the automation of intelligent transport systems, cloud computing technologies, and cashless payments (Watanabe et al., 2015; Paiva et al., 2021).

The speed of service delivery, flexibility in working with clients, and stability in work are the leading indicators that affect companies' business image and competitiveness. For example, theories, concepts, and models of the relationship between logistics, ICT, and economic indicators and their impact on spatial development are widely discussed (Meepetchdee & Shah, 2007; Bolumole et al., 2015; Han et al., 2019; Shi et al., 2019; Moldabekova et al., 2021). The logistics system in production is effective only when all conditions are created for integrating current production and commercial processes. This task is solved by creating an information base corresponding to this type of product, its volume, and other characteristics of enterprises.

Some studies have shown that ICT brings several advantages to logistics firms (Lai et al., 2005). Firstly, processing orders, cargo delivery, and vehicle management are accelerated. Optimization of these operations reduces time and financial costs, which in turn reduces the cost of insurance or cargo support. Secondly, it is possible to assess the potential of possible alternatives and ways of developing more accurately and comprehensively. This is extremely important in a fierce competition on the modern cargo transportation market. Thus, for logistics management, ICT is one of the primary sources of improving the efficiency of decisions, economic growth, and competitiveness.

The efficiency and success of a company directly depend on the speed of order processing and obtaining the necessary information (Champan et al., 2003). This became especially relevant when personal contacts were banned, and it became essential to have a sound system for establishing cargo turnover (Lin, 2006). Obviously, innovative logistics programs existed before, but not all companies were integrated into such systems or were not ready to invest financially in software. In addition, constant access to the Internet is one factor in the spread of ICT in logistics (Billon et al., 2008). Every action in logistics is associated with the processing and transmitting information, and ICTs have a widespread impact on the value chain. Finally, Kayikci (2018) indicated that to meet the requirements of Industry 4.0, logistics should adopt a broader vision with the most significant possible sustainability, as well as use appropriate modern technologies and adapt them in application between supply chain partners.

The high interest of the world community in the concept of supply of logistics chain management leads not only to an increase in publications and research but also to a wide range of opinions on this issue (Achlor & Kotler, 1999; Zhang et al., 2011). Other studies focus on linking marketing and logistics and the concept of supply chain management (Mentzer, 2004; Stock & Lambert, 2005). At the same time, enterprises should be aware of modern network supply chain management to increase their competitive positions on the global market (Ngai et al., 2004; Orynbet et al., 2019). In addition, information technology makes communication more efficient, reduces costs, and thus, increases productivity and bridges gaps (Cooper et al., 2006). The use of information technology in logistics has significantly improved working conditions and living standards (Sauvage, 2003; Phuong & Swierczek, 2008). Thus, ICTs affect many logistics processes, providing flow and information management to support operational activity.

There are several scientific papers in Kazakhstan that explore the processes of digitalization, logistics, and transport, as well as the use of digital technologies in organizing transportation and cargo storage, investment in digitalization, personnel issues in ICT and logistics (Beysenbaev & Dus, 2020; Satpayeva et al., 2020; Kireyeva et al., 2021). In some studies, indicators of several states (159 countries) are taken, and indexes reflecting the state of the logistics system on

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a national scale are displayed. Thus, these indices, calculated taking into account statistical patterns, can be used to analyze logistics indicators between countries (Beysenbaev & Dus, 2020). Moldabekova et al. (2021) calculated the level of technology application in logistics as indices by studying the spread of innovations, the willingness of companies to accept innovations, and the degree of logistics efficiency in the context of Industry 4.0.

The literature review showed that the presence of ICT mechanisms in the logistics industry significantly affects economic development in various countries. Basic concepts and theories have shown the impact of ICT indicators on logistics and, thus, on economic growth, explaining the problems of supply chain management. The main determinants affecting economic development are productivity, human capital, investments, ICT indicators, logistic management, and other resources. In addition, there are studies, views, and theories about the relationship between economic growth and logistics. However, in general, the literature review showed a lack of studies considering Central Asian countries.

2. AIM AND HYPOTHESIS

This study aims to analyze the relationship between logistics, ICT, and the economy of Kazakhstan. Therefore, special attention is paid to logistics-trade indicators. The paper also divides the indicators into logistics and digital since there is an assumption about the positive impact of ICT on logistics and, consequently, on economic growth. The variables include GDP per capita, imports and exports, communication and logistics, and financial indicators. Thus, the following hypothesis is elaborated:

H1: The correlation indicator is not equal to 0 (zero), i.e., there is a relationship between GDP per capita and independent indicators (including logistics indicators).

3. METHODOLOGY

Various methods are aimed at finding factors that affect the economic growth of a country (Svazas et al., 2022). The basis for this study was taken from Woschank and Dallasega (2021), who used the influence of three factors (SAL, ICT, and AUT) on logistics efficiency (LP). The data used to form the dependent variable and the components of the set of variables are collected from various sources. Thus, this study focused on the dependent variable, which was constructed as the first principal component from the analysis of the main components.

Further, to identify nonlinear dependencies between variables, the Spearman correlation indicator is used:

$$r_{xy} = 1 - \frac{6\Sigma d^2}{n\left(n^2 - 1\right)}, \quad (1)$$

where x – the independent variable; y – the dependent variable; d^2 – the square differences of ranks; n – the number of selected features in the ranking.

Additional calculations are made to check the correctness of the data set based on the construction of the matrix. If the calculations of the matrix by columns are equal to each other and the verification amount, then the matrix is compiled correctly. The control check for correctness is calculated by:

$$\sum x_{ij} = \frac{\left(1+n\right)n}{2}, \quad (2)$$

where i – the value of the first parameter; j – the value of a parameter j; n – the number of selected features in the ranking.

The basis for the calculations performed is secondary data for 16 years – from 2005 to 2020. The initial data were taken from official sources in the Bureau of National Statistics (Agency for Strategic Planning and Reforms of the Republic of Kazakhstan), the National Bank, and the World Development Bank. The indicators of GDP per capita, population, export/import, foreign trade turnover, and the volume of communication are the mainstay of this study. The interpretation of the data used in the calculations is presented in Table 1.

Next, the study collected panel data from open official sources (the World Bank, the Bureau of National Statistics, and the National Bank of Kazakhstan). It further performed coding of used determinants. Then, data analysis employed the SPSS package,

Table 1. Data description for the variables

Variable	Interpretation of indicator	Data area	Source
GDP	Gross domestic product per capita, US dollars	Economic indicators	World Bank
Pop	Population, number		Bureau of National Statistics
Exp	Foreign trade turnover of the Republic of Kazakhstan, export, in US dollars	Logistics indicators	Bureau of National Statistics
Imp	Foreign trade turnover of the Republic of Kazakhstan, import, in US dollars		Bureau of National Statistics
ScPCA	Scope of postal and courier activities, in mln. KZT		Bureau of National Statistics
ScCS	Scope of communication services, in mln. KZT	ICT indicators	Bureau of National Statistics
DataRS	Database-related services, in mln. KZT		Bureau of National Statistics
N/A	Average annual US dollar exchange rate	Financial indicators	National Bank of Kazakhstan

carried out descriptive data statistics, checked the data for the normality of distribution, and conducted correlation analysis. Finally, a description and interpretation of the results were obtained.

Seven out of eight indicators were included in the further study. The average annual US dollar exchange rate was used only for converting tenge into dollars, so it was not encoded (N/A). The stages of the study, based on the collection, processing, and interpretation of data, include reduction of indicators, descriptive statistics, Spearman's rho correlations, and description and interpretation of results.

Collecting and grouping initial data are one of the crucial tasks of this study since objective statistical information will provide accurate characteristics of the studied phenomena. Therefore, this paper collected the initial data for 2005–2020 from open official sources. Further, the SPSS program was used, which analyzed the results of statistical data processing and measured the effects of the relationship between the dependent variable and other selected variables. As a result, data encoding was performed by reading the results. The determinants (selected variables) concerned the following areas: economics, logistics, finance, connection, and ICT. In addition, financial indicators were used to bring indicators to a single currency (US dollar), as data sources differed, and some indicators were found in millions of tenge.

4. RESULTS

In this study, the dependent variable – the indicator of GDP per capita – is expressed in US dollar. The remaining groups of indicators were expressed in KZT or in the number of units as a whole per country. In any case, all indicators were converted to a single currency – the US dollar – and per unit of population. For these recalculations, the annual

Source: Bureau of National Statistics (2021).

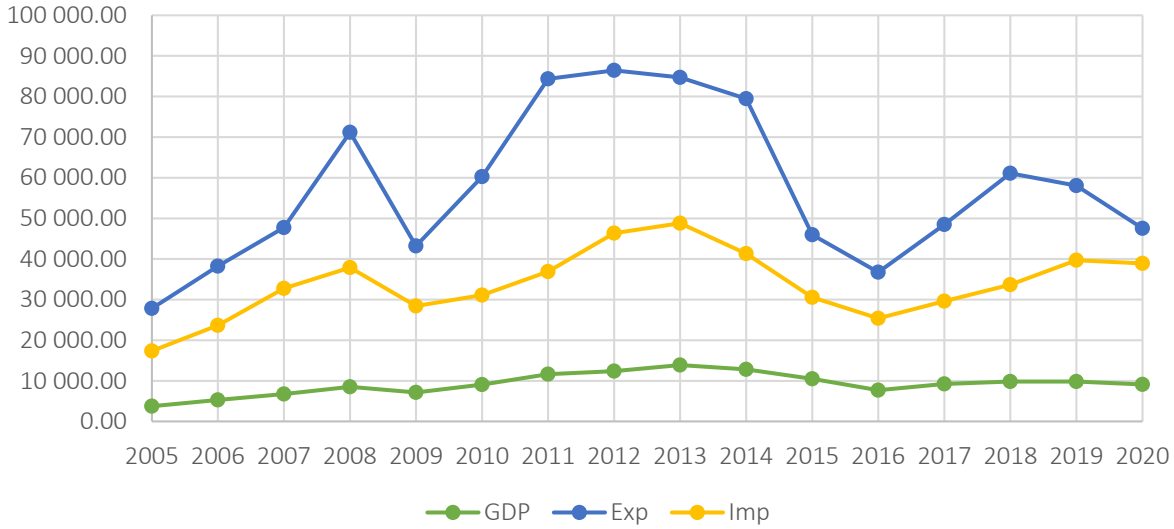

Figure 1. Dynamic of GDP and logistics factors units of measurement (US dollars)

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exchange rate of KZT to US dollar was used. The source of the exchange rate was the National Bank of Kazakhstan. The population was taken from the website of the Bureau of National Statistics. At the same time, both indicators were not considered but were indirectly used. According to the results, the dynamics of the GDP per capita and the leading logistical indicators are presented in Figure 1.

Figure 1 shows the dynamics of GDP per capita, export (Exp), and import (Imp) for 2005–2020. Interestingly, the lines showing an active trade turnover repeat the lines of the country's rise and decline in GDP. This suggests that the logistics industry is very active with a stable economy. However, during the period under review, GDP fell sharply three times: in 2009, 2015–2016, and 2020.

2009 showed such results due to the mortgage crisis of the end of 2008 in the USA, which affected the Kazakh banking system. The tenge (KZT) devaluation in February 2009 and the reduction of the discount rate by 50% subsequently had a positive effect on the economy, and GDP in 2010 rose by seven percent. Still, the consequences of the crisis were already increasing. At that time, the financing of logistics transportation became banks issued limited, short and long money at a high-interest rate. In addition, the preservation of the warehouse business led to the ruin of large logistics companies. Disrupted freight, air, and rail traffic have also led to a crisis in transport logistics. This was followed by the oil commodity crisis of 2015–2016. In 2015, freight turnover fell by 30%, especially related to exports and imports. Since the price of transporting goods raised the costs of Kazakhstani companies by 20%, some of them became unprofitable and went bankrupt. In 2016, cargo transportation fell by 10%. Moreover, it was more difficult for automobile exports than rail and air transportation due to the destruction of small agreements. The trade turnover with Uzbekistan and China made it possible to raise further the indicators of exports and imports, which were hit by the next crisis.

The COVID-19 pandemic caused a worldwide scale in which only food products were transported under specific requirements. As a result, large and small trade turnover was suspended. Moreover, some regions had a strict quarantine regime in the first half of 2020. In addition, there is an active development of digital logistics platforms and websites, which logistics companies now use (for example, the Analytics website – KazLogistics). Thus, the last crisis showed the importance of the development of ICT systems for the logistics industry. Table 2 presents the logistics, ICT determinants, and communication indicators used in further calculations.

Based on the periods of economic crises, the following periods were selected: 2005–2011, 2012–2015, and 2016–2020. In Table 2, for the first period under review, the number of operating legal entities of the Republic of Kazakhstan by economic sectors (NTSC) showed an increase of 0.18% in 2011 compared to 2005. Approximately the same rate as observed in subsequent periods – 0.39% in 2012–2015 and 0.34% in 2016–2020.

The volume of postal and courier services (ScPCA) grew most strongly in the first period – 1.12%. This may be due to the active delivery of mail, letters, and parcels to the addresses of individuals and legal entities. With the spread of the Internet and mobile communications, there is a bias from the delivery

Table 2. Growth of ICT and logistic indicators

Source: Bureau of National Statistics (2021).

Year	2005	2011	The growth in 2005–2011, %	2012	2015	The growth in 2012–2015, %	2016	2020	The growth in 2016–2020, %	The growth in 2005–2020, %
NTSC, count	5,314	6,287	0.18	6,319	8 791.00	0.39	9 312	12,436	0.34	1.34
ScPCA, mln. US dollar	56.72	120.44	1.12	135.04	129.25	–0.04	82.70	121.15	0.46	1.14
ScCS, mln. US dollar	106.51	289.34	1.72	297.89	349.33	0.17	359.49	462.16	0.29	3.34
DataRS, mln. US dollar	1 586.6	36.86	–0.98	33.26	40.08	0.21	43.45	0.10	–1.00	–1.00

of paper letters by the state postal service toward the distribution of delivery to the points of delivery of goods by private courier companies. The weakest growth (–0.04%) was observed in 2012–2015.

The volume of communication services (ScCS) decreased over time by 1.72% in the first period, 0.17% in the second, and 0.34% in the last. Although the growth rate is low, the stability in the growth of Internet usage has led to an actual increase in users. In 2020, the volume of communication services was 462.16 mln. US dollar.

Database-related services (DataRS) are the only indicator that fell during other indicators' growth periods. The growth was only in 2012–2015 and amounted to 0.25%. The remaining periods showed –0.98% and –1% in the first and third periods, respectively. Indeed, the ICT sector's development positively affected the logistics business after the last pandemic.

Accessible Internet in the regions has largely appeared thanks to the state program "Digital Kazakhstan" and the actions of some national welfare funds, for example, Samruk-Kazyna (Sansyzbayeva & Ametova, 2015). Kazakhstan's most used logistics programs are Warehouse Management System, Sales and Operations Planning (S&OP), Supplier Relationship Management, Transportation Management System (TMS), and Electronic Document Management System on the SAP platform.

4.1. Correlation analysis

The paper used statistical data on Kazakhstan for 16 years to analyze the relationship between logistics and GDP per capita. The correlation between logistics indicators, ICT, and their impact on the country's economic development was calculated. Mean and Std. Deviation are omitted since these indicators are presented later. Thus, this study calculated some indicators of descriptive statistics (Table 3).

Panel data for 2005–2020 are taken as a basis – a total of 16 observations. The maximum is one of the extremum types, showing the function's most significant value on a given set. The minimum, however, shows the minimum value on a given data set. A range of statistics demonstrates the difference between these indicators. First, compiling the variance for a small sample (just for the data under consideration) is of great utility. Finally, Table 3 shows the variance – a measure of the range of values of a random variable X around its mathematical expectation. Next, Table 4 shows a test for the normality of the data distribution.

The one-sample Kolmogorov-Smirnov test was used. The Pearson correlation coefficient calculation is used if the data have a normal distribution. Spearman's rank correlation coefficient is applied if the data do not have a normal distribution. The number of observations is also essential: less than 50 leads to calculations of Spearman's rank correlation coefficient.

Asymp. Sig. (2-tailed) is 0.200, i.e., the distribution of the presented data is normal, with a certain average value of the general population. The Lilliefors correction was applied in the "Analysis-> Nonparametric Tests" procedure to adjust the significance value to use the sample mean and standard deviation instead of the assumed population mean and standard deviation. In this case, data with a normal distribution with a sample of less than 50 are obtained. The degree of reliability of the results of the study is presented in Table 5.

Table 3. Descriptive statistics of samples

Variable	N	Range	Minimum	Maximum	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic
GDP	16	10119,5	3771,3	13890,8	7402953,761
Pop	16	3557012	15074767	18631779	1359663519228,785
Exp	16	$58,600	$27,849	$86,449	352150028,391
Imp	16	$31,453	$17,352	$48,806	69057384,632
ScPCA	16	$105	$57	$162	824,715
ScCS	16	$356	$107	$462	10827,071
DataRS	16	$1,587	$0	$1,587	291476,345
Valid N (listwise)	16				

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Table 4. One-sample Kolmogorov-Smirnov test

Verification Parameters		GDP	Pop	NTSC	ScPCA	ScCS	DataRS
N		16	16	16	16	16	16
Normal Parameters[a,b]	Mean	9220.156	16801381.125	7848.375	109.261	292.910	322.160
	Std. Deviation	2720.8370	1166046.1051	2263.7391	28.7178	104.0532	539.8855
Most Extreme Differences	Absolute	.103	.104	.204	.089	.111	.428
	Positive	.101	.104	.204	.089	.078	.428
	Negative	–.103	–.084	–.131	–.085	–.111	–.275
Test Statistic		.103	.104	.204	.089	.111	.428
Asymp. Sig. (2–tailed)		.200[c,d]	.200[c,d]	.074[c]	.200[c,d]	.200[c,d]	.000[c]

Note: a. Test distribution is Normal. b. Calculated from data. c. Lilliefors Significance Correction. d. This is a lower bound of the true significance.

The obtained data show the correlation matrix between logistics, ICT indicators, and economic development. The most substantial relationship is observed between the scope of communication services (ScCS) and population (Pop), with a correlation coefficient equal to 1. Further, there is a strong relationship between the scope of postal and courier activities (ScPCA) and GDP per capita (GDP) (.946**). There is also a strong relationship between the foreign trade turnover of the Republic of Kazakhstan and export and import (Exp, Imp) (.897**). Interestingly, the correlation coefficient is the same between the foreign trade turnover of the Republic of Kazakhstan, import (Imp) and gross domestic product per capita (GDP) (.826**), and between foreign trade turnover of the Republic of Kazakhstan, import, and scope of postal and courier activities (.826**). In all cases, the coefficients are statistically significant.

The significant relationships are between foreign trade turnover of the Republic of Kazakhstan, export (Exp), and gross domestic product per capita (GDP) (.798**); and foreign trade turnover of the Republic of Kazakhstan, and export (Exp), and scope of postal and courier activities (ScPCA) (.735**). In other cases, the correlation is weak (less than 0.7).

It can also be noted that most of the coefficients are positive. This means that when one parameter increases, the second one increases. The only indicator – database-related services (DataRS) – has a negative relationship in all cases. The most significant negative relationship is between DataRS and population (Pop) and scope of communication services (ScCS) (–.761**). The statistical relationship is also significant.

According to the correlation results, the following conclusions can be drawn: logistics indicators are fundamental, and imports have the most positive impact on the economy of Kazakhstan. On the other hand, ICT indicators have shown the most

Table 5. Spearman's rho

Spearman's rho		GDP	Pop	Exp	Imp	ScPCA	ScCS	DataRS
GDP	Correlation Coefficient	1.000	.537*	.798**	.826**	.946**	.537*	–.574*
	Sig. (2–tailed)		.032	.000	.000	.000	.032	.020
Pop	Correlation Coefficient	.537*	1.000	.174	.338	.529*	1.000**	–.761**
	Sig. (2–tailed)	.032		.520	.200	.035		.001
Exp	Correlation Coefficient	.798**	.174	1.000	.897**	.735**	.174	–.328
	Sig. (2–tailed)	.000	.520		.000	.001	.520	.215
Imp	Correlation Coefficient	.826**	.338	.897**	1.000	.826**	.338	–.531*
	Sig. (2–tailed)	.000	.200	.000		.000	.200	.034
ScPCA	Correlation Coefficient	.946**	.529*	.735**	.826**	1.000	.529*	–.577*
	Sig. (2–tailed)	.000	.035	.001	.000		.035	.019
ScCS	Correlation Coefficient	.537*	1.000**	.174	.338	.529*	1.000	–.761**
	Sig. (2–tailed)	.032		.520	.200	.035		.001
DataRS	Correlation Coefficient	–.574*	–.761**	–.328	–.531*	–.577*	–.761**	1.000
	Sig. (2–tailed)	.020	.001	.215	.034	.019	.001	

Note: * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

mixed results. With an increase in GDP and the volume of communication services, the cost of investments in developing services related to data processing falls. In addition, with an increase in the number of people, data processing costs decrease. Therefore, based on the study results, *H1* is accepted.

5. DISCUSSION

Panel data were selected to study the relationship between economic, logistical, financial, and ICT indicators. The determinants were selected for the period 2005–2020 from various sources: the World Bank, the National Bank of Kazakhstan, and most of the annual statistical data of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. The results are consistent with earlier studies on the relationship between logistics indicators, ICT indicators, and the economic growth of a country or individual regions (Bolumole et al., 2015; Han et al., 2019; Shi et al., 2019; Moldabekova et al., 2021). In addition, although the speed of data transfer between firms is essential, the results confirmed that it is necessary to reduce the cost of processing big data when performing logistics operations (Billon et al., 2008).

This paper achieved its aim, and the positive impact of ICT on the logistics system of Kazakhstan and, as a consequence, on the country's economic growth was studied in general. The results show that logistic indicators are significant, and imports have the most positive effect on developing the country's economy. It should be noted that the ICT indicators showed the most ambiguous results. The correlation and regression analysis showed that the cost of investments in developing data processing services decreases with an increase in GDP and the volume of communication services. In addition, the cost of data processing decreases under conditions of increasing population.

According to the correlation matrix between the indicators of logistics, ICT, and the level of economic development, the results show the most substantial relationship between the scope of communication services and population, while the correlation coefficient is 1. Moreover, there is a close relationship between the scope of postal and courier activities and gross domestic product per capita (.946**), as well as between foreign trade turnover of the Republic of Kazakhstan and export and import (.897**). Interestingly, the correlation coefficient is the same between foreign trade turnover of the Republic of Kazakhstan, import, and gross domestic product per capita (.826**), and between foreign trade turnover of the Republic of Kazakhstan, import, and scope of postal and courier activities (.826**). In all cases, the coefficients are statistically significant.

A significant relationship was found between foreign trade turnover of the Republic of Kazakhstan, export, and gross domestic product per capita (.798**); and foreign trade turnover of the Republic of Kazakhstan, export, and scope of postal and courier activities (.735**). In other cases, the correlation was weak (less than 0.7). It can also be noted that most of the coefficients are positive. Only database-related services have a negative relationship in all cases considered. The most significant negative relationship is between database-related services and population and scope of communication services (–.761**). Most of the results are statistically significant (have a value from 0.000 to 0.035).

Thus, ICT is one of the priority directions of logistics development in Kazakhstan and abroad. This issue is given special attention as a way to increase competitive advantages. Developing new approaches to managing the logistics process promotes efficiency, safety, and reliability. Nevertheless, with changes in other system elements, the entry into a new stage of development of the transport industry will be faster, in which a qualitatively different level of services is achieved through the introduction of digital technologies. In general, improving the logistics system through ICT has inherent risks that must be considered when designing the effectiveness of these technologies. Reducing these risks from introducing digital technologies in logistics requires decreasing non-targeted costs and increasing control and manageability of the system.

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CONCLUSION

This paper aims to analyze the relationship between logistics indicators, ICT, and the economy of Kazakhstan. The study divided the indicators into logistics and digital ones since there is an assumption about the positive impact of ICT on logistics and, consequently, on economic growth.

The correlation analysis showed that the cost of investments in developing data processing services decreases with an increase in GDP and the volume of communication services. In addition, the cost of data processing costs decreases under conditions of increasing population. At the same time, it should be borne in mind that the indicators may be interdependent, i.e., a change in one variable may affect another. The results of this study can be considered when designing the digitalization of logistics and supply chains. This study confirms the need for the state to develop mechanisms for introducing digital technologies in the transport and logistics industry. Ensuring the development of ICT as a separate element of the logistics system leads it to a state where it can work quickly and efficiently.

Thus, the results can complement the theoretical and conceptual basis for determining the policy of economic development. To continue research in this area, subsequent analyses may consider the following issues. First is the level of involvement and effectiveness of information and communications technology in supply chain management in the context of financial, economic, political, and health crises (for example, the COVID-19 pandemic). Second are prospects for developing information and communications technology in logistics in the regions. Third are perceptions of information and communications technology among small logistics service providers. Finally, the issue of the level of modern logistics technologies is worth investigating.

Special attention is paid to the digital transformation of transport systems, which is becoming one of the priorities of the country's strategic development. At the same time, the interaction of the state, logistics enterprises, and developers of digital infrastructure (new technologies, innovative institutions, etc.) is required. Indeed, there is a problem with breaking existing supply chains at the present stage of the development of intercountry economic relations. This determines the state's direction to develop programs to establish new trade routes. In this case, the digitalization of transport logistics makes it possible to design new logistics processes large-scale. Therefore, the issues discussed in this paper are relevant for governmental bodies operating in logistics and transportation, with the digitalization of logistics systems as a factor in the development of the economy.

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