# AN EMPIRICAL INVESTIGATION OF THE RELATIONSHIP BETWEEN DIGITAL ECONOMY AND ECONOMIC DEVELOPMENT IN UZBEKISTAN


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## ABSTRACT

This research aims to look into the dynamic and long-term relationships between digital economy and economic development in Uzbekistan. We have investigated annual time-series data on GDP per capita as a measure of economic development of countries and some factors that parts of digital economy throughout the period of 2005 to 2022 in the country. In our research, particularly, it has been used time-series model, namely, OLS and VAR models. Based on our research, it has been found that digital economy has a positive and substantial connection with GDP per capita both in the short and long term. Moreover, it shows that development of digital economy is a vital component that the government should focus on in order to boost the country's economic growth.



## CCS CONCEPTS

• **OLS model VAR model Gauss Markov's conditions stationary heteroscedasticity autocorrelation long-term correlation short-term correlation**;

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## 1 INTRODUCTION

The present-day digital economy is having a significant impact on the social and economic advancement of all countries. The global economy is seeing a severe leadership competition in the area of digital technology, and it is important to note that falling behind in this growth might have detrimental effects on particular countries.

The term "digital economy" describes a group of commercial and economic endeavors that make use of electronic communications and digital technologies. Activities including e-commerce, digital marketing, digital financial services, digital content creation, software, computer games, cloud services, and more are commonly included in this kind of economy. [1], [2], [3]. A significant movement toward online and digital business contacts is the outcome of the Digital Economy, which is built on digital technologies and electronic communications for economic and commercial activity. In certain countries, this new economy has been identified as the main engine of economic growth and development. As a result of the unique significance of digital technologies, it is currently expanding and growing.

This was stated in the digital economy declaration adopted at the summit of G20 countries (Spain, Chile, Netherlands, Senegal, Singapore, Thailand and Vietnam) held in Osaka, Japan. It says that digitization will radically change the economy and society and is an important source of economic growth, and their effective use will lead to prosperity in all countries [4].

Based on the results of several studies, experts have come to the conclusion that the state itself plays the most important coordinator role in the implementation of advanced technologies in the successful development of the digital economy in a particular country [5]. If we include information on the use of ICT by the population and business as the main indicator of the development of the digital economy, the development of electronic government, and the specific indicators are the activities of personnel, the telecommunications market, and the ICT sector.

In 2019, the President of the Republic of Uzbekistan Sh.M. Mirziyoev said in his address to the Oliy Majlis, we need to develop a national concept of the digital economy that envisages the renewal of all sectors of the economy on the basis of digital technologies,

and based on this, we need to implement the "Digital Uzbekistan – 2030 program", the digital economy allows to increase the gross domestic product of Uzbekistan by at least 30 percent [6].

Currently, at the modern stage of digital economy development, Uzbekistan is characterized by the period of its formation and high dynamics of development. Taking into account the current world trends, the acceleration of ICT in all spheres of social life for Uzbekistan, as well as the general development of digital technologies, will become the driving force of innovations and enable integration and harmonization with the world economy [7]. In this matter, work is being done and measures are being taken at a rapid pace in our republic, but it is worth mentioning that it will not be possible to achieve high efficiency in these processes without a preliminary scientific basis and scientific research. Rapid changes due to the use of ICT and the development of digital technologies make it difficult for world scientists conducting scientific research in the field of digital economy to make observations. As in many countries, these scientific studies are relevant for our republic, which is currently at the initial stage of its development. Therefore, the purpose of this study is to conduct empirical research on the long term and dynamic interaction between digital economy and economic development as well as to study and analyze the specific aspects of the development and formation of the digital economy in Uzbekistan.

This article is divided into five sections. The introduction, which covers the background and purpose of the study, is covered in the first part. The second component of the literature review focuses on the impact of Islamic financial development on economic growth. The third section goes extensively into the specifics of the data and research methodology developed. The fourth section includes the results and discussion. The final part provides an overview of the conclusion.

## 2 LITERATURE REVIEW

The link between digital economy and economic development has attracted economists' attention more in the last decade.

There are a variety of studies have been published to understand to what extent the digital economy's expansion affects household savings, accumulation of capital, technological advance, rising incomes, and economic growth.

Following the industrial and agricultural economies, the digital economy has emerged as a new economic form in recent years [8]. Tapscott [9], who suggested that the age of networked intelligence is about the networking of humans through technology as well as the networking of technology, first introduced the idea of the digital economy. The digital economy is now widely recognized in social and economic contexts due to the integration of digital and network technologies; as a result, its meaning has deepened. Three components comprise the digital economy, according to Mesenbourg [10]: e-business infrastructure, e-business, and e-commerce. Several academics viewed the digital economy as a dynamic process as opposed to one of static efficiency [11].

According to earlier research, the digital economy is thought to be the primary force behind economic growth in developed as well as developing countries [12], [13], [14], [15], [16]. The digital economy, which is mostly centered on ICT, contributes to decreased costs for goods and services as well as increased productivity of labor and capital [17], [18]. In order to investigate the positive correlation between ICT investment and economic growth in 29 countries, Seo et al. [19] created a cumulative growth model. They discovered that, by leveraging the knowledge spillover effects of ICT, countries with relatively low levels of productivity could catch up to developed nations. Additionally, Vu [20] discovered that ICT can boost productivity by promoting technological innovation, enhancing decision-making quality, and cutting production costs. Moreover, some scholars found social benefits of the digital economy in the case of Uzbekistan [21]. To be more specific, regarding the findings of the scholars, modern technologies can provide a number of opportunities for the visually impaired to engage in small business in the economic sectors, contribute to local businesses, and deal with several social issues.

Furthermore, Jiang [22] discovered that while digital technologies improved pandemic response plans in the near run, they also provided the technological backbone for Internet-based business and consumption in the long run. In addition, Abrorov S. et al. [23] studied the role of Islamic fintech instruments as new opportunities in the digital economy of Uzbekistan and found that it can be one of the ways to increase the potential of the financial market of the country.

Others, on the other hand, have hypothesized that the digital economy would be harmful to economic expansion, particularly in the absence of an economic shift [24].

As we have given some findings of researchers in the field above, there are various views and arguments among scientists as to whether there is a link between digital economy development and economic growth. Therefore, our study's main objective is to examine to what extent digital economy has impacted Uzbekistan's economic development. Our study differs from prior studies in terms of additional different factors and methodology.

## 3 DATA AND METHODOLOGY

We have employed a quantitative approach using a multi-factor time-series model in order to determine whether there is the nexus between digital economy and economic development.

In order to conduct this hypothesis test, the following variables were selected:

- Communications, computer, etc., (% of service exports), (CCSE), ICT service exports (% of service exports), (ICTSEP), Industrial design applications, (resident, by count), (IDAR), have been selected as an independent variable in our model;
- GDP per capita (GDPPC) has been chosen as a dependent variable. This indicator serves to determine the living standards of the population.

The following is our hypothesis:

$H1_0$: There is no relationship between economic development (GDPPC) and digital economy (CCSE);

$H1_1$: There is a relationship between economic development (GDPPC) and digital economy (CCSE).

$H2_0$: There is no link between economic development (GDPPC) and digital economy (ICTSEP);

$H2_1$: There is a link between economic development (GDPPC) and digital economy (ICTSEP).

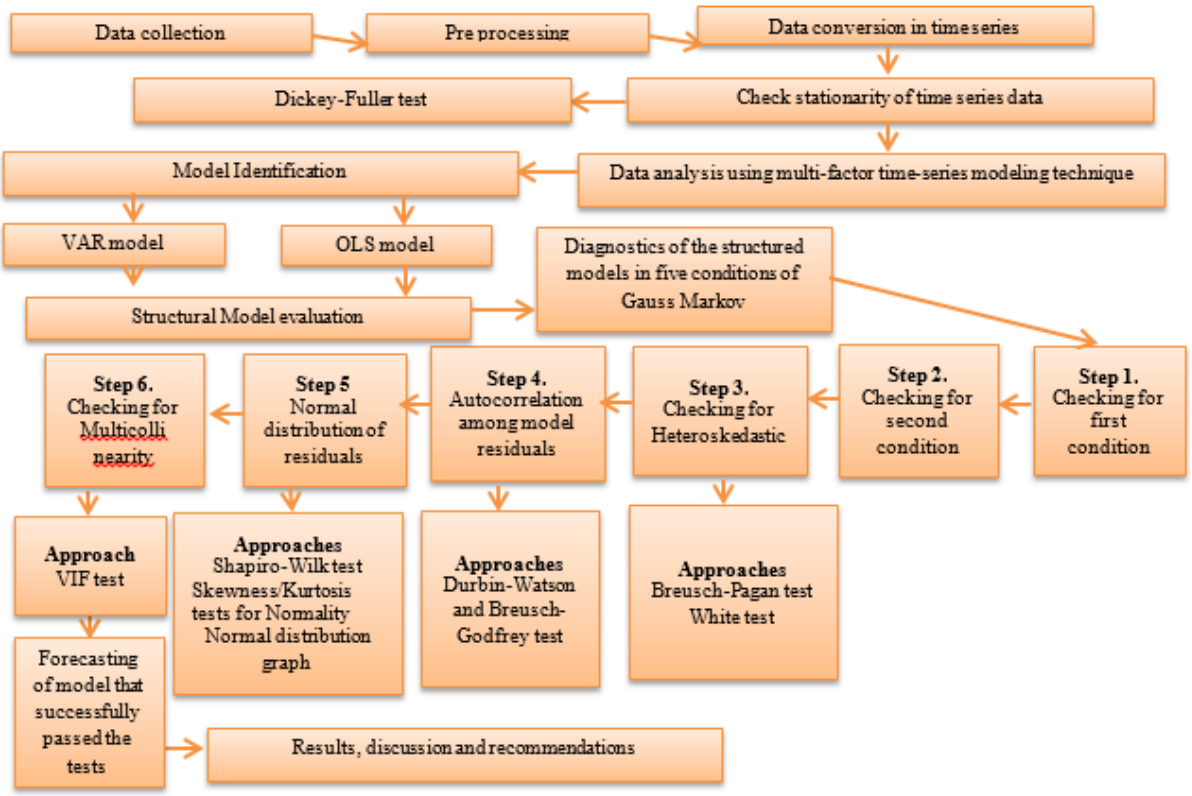


**Figure 1: Research steps**

$H2_0$: There is no link between economic development (GDPPC) and digital economy (IDAR);

$H2_1$: There is a link between economic development (GDPPC) and digital economy (IDAR).

$$H_0 - \textit{our null hypothesis and } H_1 - \textit{is the alternative hypothesis.} \quad (1)$$

The following models have been developed in order to investigate the interaction between the shown independent variables above and economic development (GDPPC), which is our dependent variable:

Linear model

$$GDPPC_i = \beta_0 + \beta_1 CCSE_i + \beta_2 ICTSEP_i + \beta_3 IDAR_i + \varepsilon_i \quad (2)$$

Where:

$\beta_0$: the intercept of the model

$\varepsilon_i$ : error term.

The VAR model specification is given as follows:

$$Y_t = a + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \ldots + \beta_p Y_{t-p} + \varepsilon_i \quad (3)$$

where $\alpha$ is the intercept, a constant and $\beta 1$, $\beta 2$ till $\beta$p are the coefficients of the lags of Y till order p.

Order 'p' means, up to p-lags of Y is used and they are the predictors in the equation. The $\epsilon$_{t} is the error, which is considered as white noise.

Furthermore, we developed a forecast for chosen indicators by applying model, namely VAR in multi-factor time series. We have used Stata 17 software to model and forecast.

Stationary Test

A unit root is tested with Augmented Dickey-Fuller (ADF) test. Do the variables observed have a tendency to return to the long-term trend following a shock or the variables follow a random walk? If the variables follow a random walk after a temporary or permanent shock, the regression between variables is spurious. Hence, the OLS will not produce consistent parameter estimates. All series should be stationary at the same level. ADF test is can be determined as in Equation [25].

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + a_i \sum_i^m \Delta Y_{t-1} + \varepsilon_t \quad (4)$$

The hypothesis tested:

H0: $\delta = 0$ (contains a unit root, the data are not stationary)

H1: $\delta < 0$ (does not contains a unit root, the data are stationary).

Johansen [26] and Johansen and Juselius [27] produced the maximum likelihood approach using the VAR model to estimate the cointegration relationship among components in vector $k$ variable $Y_t$. Consider VAR model for $y_t$:

$$A\,(L)\;\; x_i = \;\; \varepsilon_t \quad (5)$$

The parameter can be presented in the form of Vector Autoregressive Error Correction Mechanism:

$$\Delta Y_t = \sum_{i=1}^{p-1} \Pi_i \Delta Y_{t-1} + a\beta Y_{\,t-p} + \varepsilon_t \quad (6)$$

**Table 1: Results of the Dickey-Fuller test on GDPPC**

| Test Statistic | 1% Critical Value | 5% Critical Value | 10% Critical Value | Obs | P-value |
|---|---|---|---|---|---|
| -4.333 | -3.750 | -3.000 | -2.630 | 15 | 0.0004 |

**Table 2: Results of the Dickey-Fuller test on Independent variables**

| Independentvariables | Test Statistic | 1% Critical Value | 5% Critical Value | 10% Critical Value | Obs | P-value |
|---|---|---|---|---|---|---|
| CCSE | -7.152 | -3.750 | -3.000 | -2.630 | 15 | 0.0000 |
| ICTSEP | -4.018 | -3.750 | -3.000 | -2.630 | 16 | 0.0013 |
| IDAR | -5.142 | -3.750 | -3.000 | -2.630 | 15 | 0.0000 |

Where vector $\beta = (-1, \beta_2, \ldots, \beta_n)$ that contain r cointegration vectors, and speed of adjustment parameter is given as $\alpha = (a, a_2, \ldots, a_n)$ when rank $\beta = r < k$, $k$ is the number of endogenous variables. If the number of cointegration relations is known, hypothesis testing on $\alpha$ and $\beta$ can be performed. Lag length specification for the model can be determined by VAR equation using the AIC and SC criteria.

Moreover, before conducting the model's forecast, Gauss-Markov's six conditions have been utilized to determine the direction and density of the indicators: the heteroskedastic problem, the model's residual autocorrelation problem, and regression models.

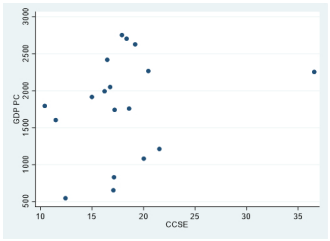


**Figure 2: The relationship between GDPPC and CCSE has been represented by a scatter plot**

## 4 RESULTS AND DISCUSSION

Communications, computer, etc., (% of service exports), (CCSE), ICT service exports (% of service exports), (ICTSEP), Industrial design applications, (resident, by count), (IDAR), have been selected as an independent variables in our model, while GDP per capita (GDPPC) has been chosen as a dependent variable.

The reason we decided to use these variables is that they reflect the amount of growth of digital economy in a country, whereas GDP per capita shows the country's economic progress due to World Bank methodology.

That is why these variables were chosen to prove our hypothesis.

The data has been taken from the World Bank's official website (worldbank.org) for both dependent and the independent variables in this investigation.

In order to use the multi-factor time series criterion, the variables' data must first be examined using the Dickey-Fuller test to identify if they are stationary or non-stationary.

stationary or non-stationary.

Regarding the Dickey-Fuller test (table 1), the statistical test value for the GDPPC is -4.333, which is less than all critical values. Further evidence of stationary distribution is provided by the p-value of 0.0004, which is smaller than 0,05. However, this result has been achieved after twice differentiating.

Table 2 illustrates independent indicators that have already successfully passed through the Dickey-Fuller test but, after differentiating, have reached a p-value less than 0.05.

In this case, the chosen all variables weren't stationary initially, but after integration, all dependent and independent variables turned into stationary.

The next step is to investigate the scatter plot's correlation between the two variables and the observations to determine how well they stand on line or approach a straight line.

From figure 2, we can also analyze the impact of digital economy on economic development in Uzbekistan according to the scatter plot. In addition, we can see that a number of observations have stood on line or have approached the straight line.

The next step is to investigate the correlation among the all variables using Matrix of correlations.

Since the model has a multifactorial nature, we need to determine the interrelationships among the variables. In this regard, when we checked the matrix of correlation coefficients of all variables during the research, the following result was noted: according to it, there are positive correlations among all the variables except negative correlation between CCSE and IDAR (Table 3).

The next step of our study's major objective is to develop a regression model to examine to what extent digital economy impacted on economic growth in Uzbekistan.

The factor influencing GDP per capita (GDPPC) is expressed in the following simple regression econometric formula:

$$GDPPC_i = \beta_0 + \beta_1 CCSE_i + \beta_2 ICTSEP_i + \beta_3 IDAR_i + \varepsilon_i \quad (7)$$

In the study, we used the "ordinary least squares" model. From the OLS model shown in the table above, the following multifactor

**Table 3: Matrix of correlations**

| Variables | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| (1) GDPPC | 1.000 | | | |
| (2) CCSE | 0.240 | 1.000 | | |
| (3)ICTSEP | 0.874 | 0.144 | 1.000 | |
| (4) IDAR | 0.756 | -0.399 | 0.672 | 1.000 |

**Table 4: Results of simple regression analysis. Linear regression**

| GDPPC | Coef. | St.Err. | t-value | p-value | [95% Conf | Interval] | Sig |
|---|---|---|---|---|---|---|---|
| CCSE | 62.639 | 10.241 | 6.12 | 0 | 40.674 | 84.604 | *** |
| ICTSEP | 61.08 | 21.495 | 2.84 | .013 | 14.978 | 107.182 | ** |
| IDAR | 3.966 | .572 | 6.93 | 0 | 2.739 | 5.193 | *** |
| Constant | -515.862 | 204.716 | -2.52 | .025 | -954.935 | -76.79 | ** |

| | | | |
|---|---|---|---|
| Mean dependent var | 1789.948 | SD dependent var | 688.693 |
| R-squared | 0.950 | Number of obs | 18 |
| F-test | 88.284 | Prob > F | 0.000 |
| Akaike crit. (AIC) | 239.456 | Bayesian crit. (BIC) | 243.018 |

*** p<.01, ** p<.05, * p<.1

**Table 5: Breusch-Pagan test result**

| | Chi2(1) | Prob >chi2 |
|---|---|---|
| GDPpercapita | 0.01 | 0.9293 |

regression model has been developed:

$$GDPPC_i = -515.9 + 62.6\ CCSE_i + 61\ ICTSEP_i + 3.96\ IDAR_i + \varepsilon_i \quad (8)$$

According to Table 4, a 1% change in CCSE and ICTSEP results leads to 62.6 % and 61 % increase in GDPPC respectively, while a 1% change in IDAR results leads to 3.96 % growth in GDP per capita. It also shows a strong correlation between the volume of CCSE, ICTSEP, IDAR and GDPPC. The independent variables are able to express 95 percent of GDPPC, according to the created model's coefficient of determination. In general, a greater R-squared denotes a better model fit. Our findings also indicated that the probability of the P-value for the Fisher F-statistic in the developed regression model is less than 0.05, indicating that the independent variables have an impact on GDPPC.

Before determining and making a forecast, we have to do the following step, where we will do a diagnostic study of the structured model's reliability. Having regard to Gaus Markov's conditions, which are widely used globally, we will perform diagnostic analysis on this model.

Regarding the Gaus Markov's third condition is that the residue does not need to be connected to the model. If the residuals and model are associated, it is considered to be a heteroskedastic state. We have used the Breusch-Pagan test to evaluating our model.

The Breusch-Pagan test results show that the residues are not connected to the model because the test's p-value is greater than 0.05, which is regarded as the homoscedastic state according to this test requirement.

We have also examined our model in the White test in the following step. This test requires that the p value has to be greater than 0.05, as in the Breusch-Pagan test above.

Table 6 shows that the White test's p value is higher than 0.05, which disqualifies the heteroskedastic state by this test's criteria and allows us to accept alternative hypothesis 1.

The fourth Gauss-Markov requirement for model evaluation states that there should be no autocorrelation problems with the model residuals. Using the Durbin-Watson test as our first test technique, we'll put the model to the test.

Regarding the test's criteria, the Durbin-Watson test result ranges from 0 to 4. There is no autocorrelation if the test result in the model is from 2 to 3. The result of this test is 2.34, allowed us to run our model, which showed that the residuals were unconnected.

The Breusch-Godfrey test will be used in the following step to check for autocorrelation issues in the residuals (Table 7).

From table 8, we can conclude that there is no autocorrelation between the residuals based on the findings of the Breusch-Godfrey test. The possibility that there is no autocorrelation among the residuals is accepted since the R-square probability value is greater than 0.05.

The residuals in our model must follow a normal distribution in accordance with the fifth Gaus Markov criterion. There are three different ways to check this. These are graph method, correlation

**Table 6: White test results (Cameron & Trivedi's decomposition of IM-test)**

| Source | chi2 | Df | p |
|---|---|---|---|
| Heteroscedasticity | 11.45 | 9 | 0.2464 |
| Skewness | 5.25 | 3 | 0.1541 |
| Kurtosis | 0.75 | 1 | 0.3857 |
| Total | 17.45 | 13 | 0.1794 |

**Table 7: Breusch-Godfrey autocorrelation test result**

| lags (p) | chi2 | Df | Prob>chi2 |
|---|---|---|---|
| 1 | 0.898 | 1 | 0.3434 |

**Table 8: Shapiro-Wilk test results**

| Variable | Obs | W | V. | z | Prob>z |
|---|---|---|---|---|---|
| residual | 18 | 0.94604 | 1.186 | 0.342 | 0.36624 |

**Table 9: Skewness/Kurtosis tests for Normality**

| Variable | Obs | Pr (Skewness) | Pr(Kurtosis) | adj chi2(2) | Prob>chi2 |
|---|---|---|---|---|---|
| residual | 18 | 0.6213 | 0.7245 | 1.22 | 0.5435 |

table, and test method. For the tests, we have used Shapiro-Wilk test. Firstly, we started to check the normal residual distribution through Shapiro-Wilk test.

The Shapiro-Wilk test resulted in a value of 0.36, which is larger than p> 0.05 and fulfills Gauss Markov's fifth criteria (Table 8).

As it can be seen from table 9, the residuals are normally distributed and the residuals have a normal vibration. The results of Skewness and kurtosis are nearly the same, which are 0.62 and 0.72. Furthermore, the value of the probability is 0.54, and given that this value is also greater than p>0.05, we can see that the normal residual distribution criteria have been successfully fulfilled in the test as well.

There has to be no association between the independent variables, according to the last Gaus-Markov criterion. Table 10 shows that one independent variable did not effect to the another independent variable due to their VIF are smaller than 10.

Last but not least, we tested our model in Gauss Markov conditions. These tests showed that our model satisfied all of the Gauss-Markov conditions, allowing us to accept OLS model and using in our study after completing the evaluation phases.

**Table 10: VIF (Variance inflation factor) test**

| | VIF | 1/VIF |
|---|---|---|
| IDAR | 3.368 | .297 |
| ICTSEP | 2.892 | .346 |
| CCSE | 1.884 | .531 |
| Mean VIF | 2.714 | . |

In the following step, we have used VAR model.

The VAR model specification is given as follows:

$$Y_t = a + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \ldots + \beta_p Y_{t-p} + \varepsilon_i \tag{9}$$

where $\alpha$ is the intercept, a constant and $\beta 1$, $\beta 2$ till $\beta$p are the coefficients of the lags of Y till order p.
Order 'p' means, up to p-lags of Y is used and they are the predictors in the equation. The $\epsilon$_{t} is the error, which is considered as white noise.
Since our model is VAR, we can ensure the maximum lag by selecting the lag order using lag exclusion tests and lag order selection criteria.

Based on the information from our VAR regression table above, we formulated the following VAR model formula:

$$\begin{aligned} Y_t = {} & 479.5 - .757 L2GDPPC_{t-2} + 110 L1ICTSEP_{t-1} \\ & + 85.6 L2ICTSEP_{t-2} + 2.578 L1IDAR_{t-1} + \varepsilon_t \end{aligned} \tag{10}$$

In our following step, in terms of the results of VAR model, we have forecast of GDP per capita for the period from 2023 to 2027.

From figure 3, it can be seen that the forecast of the dependent variable is from 2023 to 2027.

Additionally, forecasts indicate that by 2027, GDP per capita growth in Uzbekistan will reach $ 2764 due to an increase in digital economy factors used in our model.

The article's aim was to bring attention to the effects of Uzbekistan's developing digital economy on the country's economic growth from 2005 to 2022. Therefore, we have used the World

**Table 11: VAR model regression indicators of digital economy and economic development**

| | | | | | | |
|---|---|---|---|---|---|---|
| Sample:2007 – 2022 | | | | Number of obs = 16 | | |
| Log likelihood=-211.891 | | | | AIC = 30.98638 | | |
| FPE=6.09e+08 | | | | HQIC = 31.0754 | | |
| Det(Sigma_ml)= 3741033 | | | | SBIC = 32.72471 | | |
| Equation | Parms | RMSE | R-sq | chi2 | P>chi2 | |
| GDPPC | 9 | 176.73 | 0.9551 | 340.6981 | 0.0000 | |
| CCSE | 9 | 5.77224 | 0.5198 | 17.31725 | 0.0270 | |
| ICTSEP | 9 | 1.33865 | 0.8794 | 116.6716 | 0.0000 | |
| IDAR | 9 | 106.727 | 0.6703 | 32.52343 | 0.0001 | |
| GDPPC | Coef. | Std. Err. | T | P>\|t\| | [95% Conf. | Interval] |
| GDPPC | 0.235 | 0.247 | 0.95 | 0.34 | -0.249 | 0.720 |
| L1. | | | | | | |
| L2. | -0.757 | 0.259 | -2.92 | 0.003 | -1.264 | -0.249 |
| CCSE | 24.506 | 25.892 | 0.95 | 0.34 | -26.241 | 75.253 |
| L1. | | | | | | |
| L2. | 7.884 | 18.789 | 0.42 | 0.67 | -28.942 | 44.710 |
| ICTSEP | 110.150 | 26.443 | 4.17 | 0.000 | 58.323 | 161.978 |
| L1. | | | | | | |
| L2. | 85.652 | 35.883 | 2.39 | 0.017 | 15.321 | 155.982 |
| IDAR | 2.578 | 1.110 | 2.32 | 0.020 | 0.403 | 4.754 |
| L1. | | | | | | |
| L2. | -0.009 | 1.104 | -0.01 | 0.994 | -2.173 | 2.155 |
| _cons | 479.522 | 310.793 | 1.54 | 0.123 | -129.621 | 1088.665 |

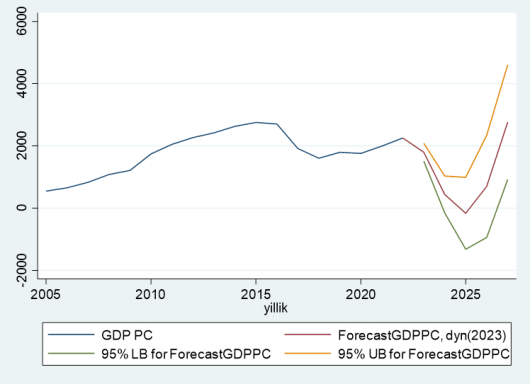


**Figure 3: The amount of GDP per capita from 2011 to 2026 (a forecast from 2022 to 2026).**

Bank's methodology to determine the level of economic development of countries in order to identify specifically to what extent digital economy can impact on economic development of Uzbekistan.

We have used a multi-factorial time series to investigate to what extent digital economy can effect economic development in the case of Uzbekistan in long and short-term. Our models have been tested in all Gauss Markov conditions, and all of our models passed successfully through all evaluation tests.

In the case of Uzbekistan, the research using the multi-factor time series model revealed that the impact of digital economy on economic growth is significant. According to the result of OLS model, excluding other factors, a one percent increase in digital economy leaded to 62.6 (CCSE), 61.08 (ICTSEP), and 3.96 (IDAR) increase in GDPPC. Moreover, it was 110 (L1 ICTSEP), 85.6 (L2 ICTSEP), and 2.57 (L1 IDAR) respectively, according to the VAR model. As a result, we can conclude that digital economy supports economic growth both in the long and short term.

However, although our study shows the great achievements of our research, there are a few limitations to our investigation. Firstly, the variables selected as independent factors are mainly communications, computers, etc. (% of service exports), (CCSE), ICT service exports (% of service exports), (ICTSEP), and industrial design applications (IDAR). Because it was not possible to include the other variables as independent variables related to the digital economy in our econometric model due to not available data on these factors or not covering enough years (there was mainly 5-year data on other factors). Secondly, we could only find 18-year data on the included variables in our model, which is not enough time to investigate the link between dependent and independent variables, according to the views of some scholars. Therefore, they recommended using quarterly data in panel data models in this case. Nevertheless, we were not able to find whether quarterly data on independent variables or data across regions of the country. To avoid the potential issues that come from the limitations, we have used the VAR model. On the other hand, we think that the above-mentioned shortcomings will never reduce the quality of our paper.

We also think that it would be better to survey the field to cover potential other factors and build a cross-sectional model, but we

could only investigate short-term in this case, not long-term. For this reason, we think that every model and approach can have limitations. Although cross-sectional models are only able to find short-run relationships among factors, we are going to use the latter approach to involve other external factors in our future research.

## 5 CONCLUSION

Based on the outcomes of our research, we are able to conclude that digital economy has played a positive short-run and long-term role in economic development in Uzbekistan. In context with this, it has shown useful to development of digital economy as a way to increase GPD per capita, which is a symbol of economic development in countries due to the methodolgy of World Bank. We can infer from this finding that one of the most important policy options for stimulating economic development in Uzbekistan is the expansion of digital economy.

According to the positive findings of this study, further research is being conducted on the outstanding problems, which will be tackled in later investigations.

## REFERENCES


[1] Y. Tu, R. et al. 2022. The Development of Digital Economy and the Future of the Trade Union Law of the People's Republic of China. Journal of Chinese Human Resources Management, 13 (2) (2022), pp. 76-85

[2] F. Hu, L. et al. 2022. Has COVID-19 Changed China's Digital Trade?—Implications for Health Economics. Frontiers in public health (2022), 10.3389/fpubh.2022.831549

[3] B. Guo, Y. *et al.* 2023. Impact of the digital economy on high-quality urban economic development: Evidence from Chinese cities. Economic Modelling, 120 (2023), Article 106194

[4] The leaders of the G20 adopted a declaration on the digital economy. 2019. The site of the Federal State Unitary Enterprise "International Information Agency" Russia Today ". [Electronic resource]. URL: https://ria.ru/20190628/1556007543.html. (Date of treatment 1.07.2019).

[5] OECD Digital Economy Outlook. 2017. (Summary in Russian) Paris: OECD Publishing, 2017. DOI: 10.1787/4657a930-ru.

[6] Mirziyoev Sh. 2019. Message from the President of the Republic of Uzbekistan Shavkat Mirziyoyev to the Oliy Majlis. Official website of the President of the Republic of Uzbekistan. [Electronic resource] URL: https://president.uz/ru/lists/view/2228. (Date of treatment 09.10.2019).

[7] Bobokhujaev Sh.I. 2015. Information economy: global trends and specificity of development in Uzbekistan // "Innovation andisodiot va Izhtimoy Infratusilma". Collection of scientific articles, 2-part, Toshkent, 2015, 242 p.

[8] Pan WR, *et al.* 2022. Digital economy: an innovation driver for total factor productivity. *J Bus Res.* (2022) 139:303–11. doi: 10.1016/j.jbusres.2021.09.061

[9] Tapscott D, McQueen R. 1996. The Digital Economy: Promise and Peril in the Age of Networked Intelligence. New York, NY: McGraw Hill (1996).

[10] Mesenbourg TL,. 2018. Measuring the digital economy. Suitland, MD: US Bureau of the Census. (2001)1:1–19.Availableonline at: https://www.census.gov/content/dam/Census/library/workingpapers/2001/econ/umdigital.pdf (accessed June 1, 2018).

[11] Carlsson B. 2004. The Digital Economy: what is new and what is not? *Struct Change Econ Dyn.* (2004) 15:245–64. doi: 10.1016/j.strueco.2004.02.001

[12] Pradhan RP *et al.* 2018. Short-term and long-term dynamics of venture capital and economic growth in a digital economy: a study of European countries. *Technol Soc.* (2019) 57:125–34. doi: 10.1016/j.techsoc.2018.11.002

[13] Cheng CY, *et al.* 2020. ICT diffusion, financial development, and economic growth: an international cross-country analysis. *Econ Model.* (2021) 94:662–71. doi: 10.1016/j.econmod.2020.02.008

[14] Khamdamov, S. J. 2021. Calculating Share of Factors of Intensive Economic Growth in Uzbekistan. In The 5th International Conference on Future Networks & Distributed Systems, December 2021, 393-397.

[15] Pulatovich Eshov M., *et al.* 2021. DEVELOPMENT PROSPECTS FOR DIGITAL ECONOMY DEVELOPMENT IN UZBEKISTAN. International Conference Proceeding Series. 738-742. 10.1145/3508072.3508216. https://www.scopus.com/inward/record.uri?eid$=$2-s2.0-85128633048&doi$=$10.1145%2f3508072.3508216&partnerID$=$40&md5$=$15dbd4f451a6ec0f8cb4fbf923590130

[16] Peng G., *et al.* 2022. Economic growth, technology, and CO2 emissions in BRICS: Investigating the non-linear impacts of economic complexity. Environmental Science and Pollution Research. 29-45. 10.1007/s11356-022-20647-7. https://www.scopus.com/inward/record.uri?eid$=$2-s2.0-85129635639&doi$=$10.1007%2fs11356-022-20647-7&partnerID$=$40&md5$=$a3440f5686a1a8bcd911fa3e1eb72be6

[17] Dahlman C, *et al.* 2016. *Harnessing the Digital Economy for Developing Countries.* OECD Development Centre Working Papers, No. 334, OECD Publishing, Paris (2016).

[18] Kalandar Abdurakhmanov, Aziz Zikriyoev *et al.* 2022. Limits and challenges of human resource technological talents in AI age. ICFNDS '22, December 15, 2022, Tashkent, TAS, Uzbekistan. ACM ISBN 978-1-4503-9905-0/22/12. https://doi.org/10.1145/3584202.3584232

[19] Seo H, *et al.* 2009. Does ICT investment widen the growth gap? *Telecomm Policy.* (2009) 33:422–31. doi: 10.1016/j.telpol.2009.04.001

[20] Vu MK. 2011. ICT as a source of economic growth in the information age: empirical evidence from the 1996–2005 period. *Telecomm Policy.* (2011) 35:357–72. doi: 10.1016/j.telpol.2011.02.008

[21] Ismailova N., Isaev K., Zayniddinov R., *et al.* 2020. Opportunities for the visually impaired persons to engage in small business in the economic sectors. Journal of Advanced Research in Dynamical and Control Systems. 156-159. 10.5373/JARDCS/V12SP2/SP20201055. https://www.scopus.com/inward/record.uri?eid$=$2-s2.0-85079871960&doi$=$10.5373%2fJARDCS%2fV12SP2%2fSP20201055&partnerID$=$40&md5$=$d18f6192f88035f0a004175fe0cc9dcd

[22] Jiang X. 2020. Digital economy in the post-pandemic era. *J Chin Econ Business Stud.* (2020) 18:333–9. doi: 10.1080/14765284.2020.1855066

[23] Abrorov S., Imamnazarov J. 2021. ISLAMIC FINTECH INSTRUMENTS: NEW OPPORTUNITIES FOR DIGITAL ECONOMY OF UZBEKISTAN. ACM International Conference Proceeding Series. 663-667. 10.1145/3508072.3508203. https://www.scopus.com/inward/record.uri?eid$=$2-s2.0-85128624172&doi$=$10.1145%2f3508072.3508203&partnerID$=$40&md5$=$c0da3f62bca467701ce48b36848368f7

[24] Nchofoung TN, Asongu SA. 2022. ICT for sustainable development: global comparative evidence of globalization thresholds. *Telecomm Policy.* (2022) 46. doi: 10.1016/j.telpol.2021.102296.

[25] Chu, A.C., *et al.* 2016. Do stronger Patents Stimulate Of of Stifle Innovations? The Crucial Role of Financial Development. Working paper *(Munich Personal RePEc* 84803, 1-33.

[26] Johansen, S. 1991. "Estimation and hypothesis of cointegrating vectors in Gaussian vector autoregressive models". *Econometrica,* 59(6), 1551-1580.

[27] Johansen, S., and Juselius, K. 1990. "Maximum likelihood estimation and inference on cointegration with application to the demand for money". *Oxford Bulletin of Economics and Statistics,* 52, 169-210.