Empirical Study on the Impact of Digital Economy on High-Quality Economic Development

--Based on OLS regression model

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Abstract: With the development of social science and technology, the term “digital economy” has become a hot topic. The development of the digital economy has had an important impact on the high-quality development of the economy. Use the econometric software EViews, select indicators of economic development from three aspects:effectiveness,coordination and sustainability,to analyze high-quality economic development. After unit root test and co-integration test are performed on the selected data, an OLS regression model is established to empirically analyze the contribution of the digital economy to various high-quality development indicators, and to explore the impact of the development of the digital economy on the high-quality economic development.

1. Introduction

Digital economy is a new economic form following traditional economies such as agricultural economy and industrial economy[1]. In 2016, the G20 Hangzhou Summit passed the “G20 Digital Economy Development and Cooperation Initiative”,and proposed that the digital economy refers to a series of economic activities that use digital knowledge and information as key production factors, modern information networks as an important carrier, and effective use of information and communication technologies as an important driving force for efficiency improvement and economic structure optimization.

Under policy guidance, the rapid development of the digital economy has played an important role in stimulating consumption, creating jobs, enhancing innovation and competitiveness, and providing new momentum for promoting high-quality economic development[2].Especially under the new crown epidemic, the digital economy has played a unique role in fighting and mitigating the epidemic, creating conditions for the government, residents and other industries to fight the epidemic, alleviate the epidemic, and alleviate the economic recession.Digital economy empowers economic development and the effect of improving quality and efficiency is outstanding.

2. Literature Review

2.1 Current Status of Research on Digital Economy

The term “digital economy” was first proposed by Canadian economist Don Tapscott[3].Since the 19th National Congress of the Communist Party of China proposed to vigorously develop the digital economy, the academic community has shown extremely high research enthusiasm for this rapidly developing new economic form, mainly focusing on: The connotation, characteristics and system composition of the digital economy; Evaluation indicators for the development of the digital economy; Governance of the digital economy, etc. Jing Wenjun et al. believe that the digital economy is the sum of economic activities based on the Internet and corresponding emerging technologies, including the digital transformation of traditional industries[2]. The China Academy of Information and

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Communications Technology introduced the Digital Economy Index (DEI) to study the development of the national digital economy[4]. Li Yi believes that the integration of digital technology and industry should be accelerated, the coordination of governance capabilities and digital technology applications should be promoted, the government's governance capabilities in response to the digital economy should be improved, and the global consensus on the development of the digital economy should be actively promoted[5].

2.2 Current Status of Research on High-Quality Development

Many scholars have interpreted and elaborated on high-quality economic development from different perspectives, mainly concentrated on:The connotation and characteristics of high-quality development; Indicators for measuring high-quality economic development; Problems and solutions for high-quality economic development. From the perspective of quality improvement, Ren Xiao believes that high-quality development means higher-level, more efficient, fairer, and more sustainable development[6].Jin Bei, Wang Yongchang et al. explained high-quality development from the perspectives of economics and new development concepts[7-8]. Zheng Yuxin believes that using only a single indicator to study economic quality may produce a large deviation[9].Liu Shucheng believes that the quality of economic development should cover four aspects: stability of growth, sustainability of growth mode, coordination of growth structure, and harmony of growth benefits[10].Shi Bo believes that high-quality economic development has problems such as irrational industrial structure and incoordination of the three industries. A modern industrial system should be constructed and a modern system should be improved to ensure high-quality development[11].

Although there are many research documents on the digital economy and high-quality economic development, the definition and measurement indicators of its connotation have not yet formed a unified theory and indicator system. Therefore, drawing on the existing academic achievements, using EViews econometrics software, through the establishment of OLS classic regression model, to explore the extent of the impact of the development of the digital economy on the high-quality economic development, in order to provide decision-making reference for accelerating the rapid development of the digital economy and promoting high-quality economic development.

3. Research Hypothesis

The three indicators of the effectiveness, coordination and sustainability of economic development (Table 1) are selected to analyze the degree to which the digital economy affects the high-quality economic development. Research hypothesis:

H1: The scale of the digital economy is positively correlated with GDP.

H2: The scale of the digital economy is positively correlated with the tertiary industry's share of GDP.

H3: The scale of the digital economy is negatively correlated with energy consumption per unit of GDP.

Table 1 Indicators, Codes and Nature of High-Quality Economic Development

High-quality economic development	Indicator	Indicator code	Indicator nature
Effectiveness	GDP	GDP	+
Coordination	The proportion of tertiary industry in GDP(%)	TI	+
Sustainability	Energy consumption per unit of GDP (10,000 tons of standard coal/100 million yuan)	EC	-

4. Data Source and Data Verification

4.1 Data Source

The historical data of the scale of the digital economy comes from the China Academy of Information and Communications Technology, and other data comes from the Statistical Yearbook of the National Bureau of Statistics (Table 2). When dealing with missing values: the scale of the digital economy in 2006 is calculated by taking the average growth rate of the data in the previous two years; the data in 2007, 2010, and 2012 are based on the average of the two years before and after the data.

Table 2 the Scale Of the Digital Economy and Data on Various High-Quality Economic Development Indicators

Years	Digital economy scale (100 million yuan)	GDP (100 million yuan)	The proportion of tertiary industry in GDP (%)	Energy consumption per unit of GDP (10,000 tons of standard coal/100 million yuan)
2001	10000.00	110863.10	41.20	1.40
2002	10790.55	121717.40	42.20	1.39
2003	13484.63	137422.00	42.00	1.43
2004	18449.19	161840.20	41.20	1.42
2005	26161.00	187318.90	41.30	1.40
2006	36444.46	219438.50	41.80	1.31
2007	42268.23	270092.30	42.90	1.15
2008	48092.00	319244.60	42.90	1.00
2009	61479.00	348517.70	44.40	0.96
2010	78187.50	412119.30	44.20	0.88
2011	94896.00	487940.20	44.30	0.79
2012	116005.73	538580.00	45.50	0.75
2013	137115.46	592963.20	46.90	0.70
2014	161640.00	643563.10	48.30	0.67
2015	186301.00	688858.20	50.80	0.63
2016	225823.00	746395.10	52.40	0.59
2017	271737.00	832035.90	52.70	0.55
2018	312934.00	919281.10	53.30	0.51
2019	358402.00	986515.20	54.30	0.49
2020	392000.00	1015986.20	54.50	0.49

Data source: China Academy of Information and Communications Technology, Statistical Yearbook of the National Bureau of Statistics.

4.2 Data Verification

4.2.1 Unit Root Test

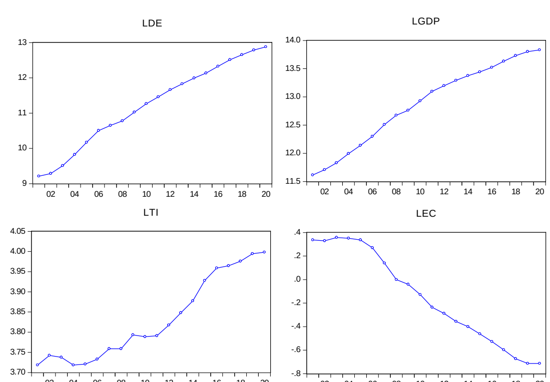

Fig.1 Sequence Diagram of Each Indicator Data

Note: DE represents the scale of the digital economy, and L represents the logarithm.

According to the sequence diagram (Fig.1), the overall trends of LDE, LGDP, and LTI are all increasing, while the overall trend of LEC is decreasing, showing the instability of these sequences. The ADF test results of the four series and their first-order and second-order difference series (all with intercept term and trend term) are shown in Table 3.

Table 3 Adf Test Results of Each Sequence and Its First-Order and Second-Order Difference Sequence

Sequence	ADF t-statistic value	Prob.	5% significance level	Conclusion
LDE	-1.59394	0.7459	-3.759743	Do not reject the null hypothesis, non-stationary series
LGDP	0.16633	0.9951	-3.710482	Do not reject the null hypothesis, non-stationary series
LTI	-1.73784	0.6938	-3.673616	Do not reject the null hypothesis, non-stationary series
LEC	-2.52248	0.3148	-3.673616	Do not reject the null hypothesis, non-stationary series
D(LDE,1)	-6.29671	0.0008	-3.759743	Reject the null hypothesis, stationary series
D(LGDP,1)	-3.71342	0.0497	-3.710482	Reject the null hypothesis, stationary series
D(LTI,1)	-3.28818	0.0998	-3.690814	Do not reject the null hypothesis, non-stationary series
D(LEC,1)	-2.15897	0.4800	-3.710482	Do not reject the null hypothesis, non-stationary series
D(LDE,2)	-4.03551	0.0299	-3.733200	Reject the null hypothesis, stationary series
D(LGDP,2)	-5.74567	0.0016	-3.733200	Reject the null hypothesis, stationary series
D(LTI,2)	-5.44052	0.0023	-3.710482	Reject the null hypothesis, stationary series
D(LEC,2)	-3.82761	0.0427	-3.733200	Reject the null hypothesis, stationary series

From the test results in Table Ⅲ we can see that the t value of the ADF test of the sequence LDE, LGDP, LTI and LEC are all greater than the critical value, and the adjoint probability is also greater than 0.05, indicating that when the significance level is 5%, does not reject the null hypothesis that LDE, LGDP, LTI and LEC have unit roots, that is, their series are non-stationary time series. The results show that LDE and LGDP are first-order single integral time series, LTI and LEC are second-order single integral time series. These four sequences become same-order single integral time series after second-order difference.

4.2.2 Cointegration Test (Eg Two-Step Method)

Use D(LDE,2) to do OLS regression with D(LGDP,2), D(LTI,2) and D(LEC,2) respectively, and perform ADF test on the regression residual (without intercept item and trend item), the results are shown in Table 4.

Table 4 Unit Root Test Results of Residual Series

Regression residual	ADF t-statistic value	Prob.	Conclusion
D(LDE,2) to D(LGDP,2) regression residual	-5.144390	0.0000	Reject the null hypothesis, stationary series
D(LDE,2) to D(LTI, 2) regression residual	-5.975214	0.0000	Reject the null hypothesis, stationary series
D(LDE, 2) to D(LEC, 2) regression residual	-3.443182	0.0018	Reject the null hypothesis, stationary series

The results show that the three regression residual series are all stationary. It shows that there is a long-term and stable co-integration relationship between the volatility of GDP, tertiary industry's share of GDP, energy consumption per unit of GDP and the volatility of the digital economy. Therefore, regression analysis can be performed using OLS estimation.

5. Establish the Ols Classic Regression Model

Establish a unary regression model of LGDP and LDE:

$$LGDP = C + \beta_0 * LDE + \mu$$

Among them: LGDP is an exogenous variable in the model; LDE is an endogenous variable; C and β_0 are parameters in the model,β_0 represents elasticity; μ represents the residual term in the model. Perform classic regression OLS estimation on this model, and the regression results are shown in Fig.2.

Dependent Variable: LGDP
Method: Least Squares
Date: 05/26/21 Time: 18:56
Sample: 2001 2020
Included observations: 20

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.970501	0.116600	51.20496	0.0000
LDE	0.614667	0.010334	59.48279	0.0000

R-squared	0.994938	Mean dependent var	12.86926
Adjusted R-squared	0.994657	S.D. dependent var	0.735265
S.E. of regression	0.053744	Akaike info criterion	-2.914541
Sum squared resid	0.051991	Schwarz criterion	-2.814968
Log likelihood	31.14541	Hannan-Quinn criter.	-2.895103
F-statistic	3538.202	Durbin-Watson stat	0.809115
Prob(F-statistic)	0.000000		

Fig.2 Regression Results of Lgdp and Lde Unary Regression Model

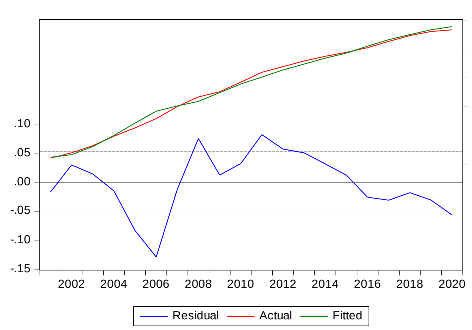

Fig.3 Trend of Residuals, Actual Values, and Fitted Values

Obtain the unary regression equation of LGDP and LDE:

$$LGDP = 5.97050072085 + 0.614667085872 * LDE$$

The regression results show that every 1% change in the explanatory variable LDE will cause an average change of 61.47% in the explained variable LGDP, and when the significance level $\alpha = 0.01$, the confidence level of the unary regression model is above 99% and passes the variable significance test, that is, the impact of LDE on LGDP is significant. From the adjusted determination coefficient AR^2, it can be seen that LDE explains 99.47% of LGDP. It can also be seen from the trend chart in Fig.3 that the residuals present the characteristics of random fluctuations, and the fitted values are relatively close to the actual values. The fitting effect of the model is better.

Similarly, the unary regression models between LTI, LEC and LDE can be obtained respectively:

$$LTI = 2.93759029914 + 0.079621952317 * LDE$$

$$LEC = 3.49484879492 - 0.324822499863 * LDE$$

Dependent Variable: LTI				
Method: Least Squares				
Date: 05/26/21 Time: 19:13				
Sample: 2001 2020				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.937590	0.087552	33.55263	0.0000
LDE	0.079622	0.007759	10.26167	0.0000
R-squared	0.854017	Mean dependent var		3.831233
Adjusted R-squared	0.845907	S.D. dependent var		0.102802
S.E. of regression	0.040355	Akaike info criterion		-3.487581
Sum squared resid	0.029313	Schwarz criterion		-3.388008
Log likelihood	36.87581	Hannan-Quinn criter.		-3.468143
F-statistic	105.3019	Durbin-Watson stat		0.255636
Prob(F-statistic)	0.000000			

Dependent Variable: LEC				
Method: Least Squares				
Date: 05/26/21 Time: 19:14				
Sample: 2001 2020				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.494849	0.186945	18.69456	0.0000
LDE	-0.324822	0.016568	-19.60573	0.0000
R-squared	0.955267	Mean dependent var		-0.150820
Adjusted R-squared	0.952781	S.D. dependent var		0.396539
S.E. of regression	0.086167	Akaike info criterion		-1.970414
Sum squared resid	0.133646	Schwarz criterion		-1.870841
Log likelihood	21.70414	Hannan-Quinn criter.		-1.950977
F-statistic	384.3845	Durbin-Watson stat		0.400418
Prob(F-statistic)	0.000000			

Fig.4 Regression Results of Lde with Lti and Lec Respectively

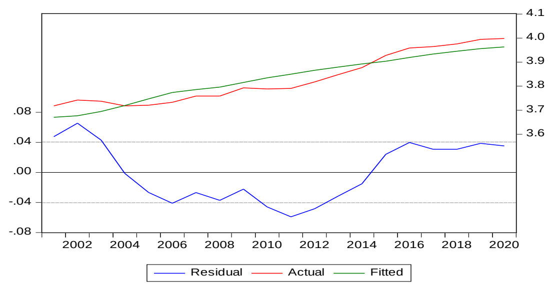

Fig.5 Fitting Effect of Lde and Lti Regression Models

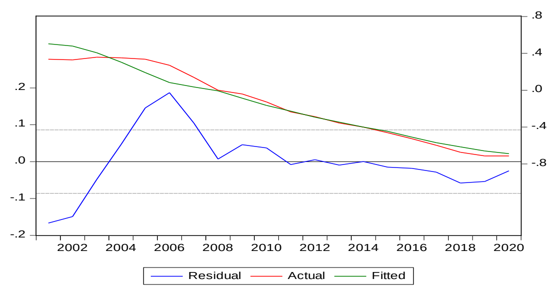

Fig.6 Fitting Effect of Lde and Lec Regression Models

It can be seen from the regression results in Fig.4 that every 1 % change in the explanatory variable LDE will cause an average change in the explained variable LTI by 7.96%, and an average change in the explained variable LEC by-32.48%, and when the significance levelα= 0.01, the impact of LDE on LTI and LEC is significant.LDE explained 84.59% of LTI and 95.28% of LEC. It can also be seen from the fitting effects of Fig.5 and Fig.6 that the fitting effect of LDE and LTI regression models is slightly worse, but in general, the fitting effect of the two models is good.

6. Conclusions and Recommendations

The empirical results show that every 1% change in the scale of the digital economy will cause an average change of 61.47% in GDP, an average change of 7.96% in the tertiary industry's share of GDP, and an average change of -32.48% in energy consumption per unit of GDP, and the confidence level is above 99%, indicating that the scale of the digital economy is positively correlated with GDP, positively correlated with the tertiary industry’s share of GDP, and negatively correlated with energy consumption per unit of GDP, and the impact of digital economy is significant, which verifies the above research hypotheses H1, H2, and H3.

Research shows that the digital economy can effectively promote high-quality economic development from three aspects: the effectiveness, coordination, and sustainability of economic development. In the follow-up, the digital transformation of the three industries should be accelerated, and the penetration rate of the digital economy in agriculture, industry, and service industries should be enhanced, so as to provide a broad development space for the digital economy, and at the same time strengthen digital governance to escort high-quality economic development.

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