Linear Analysis of the Promotion of Economic Growth by the Digital Economy

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Abstract: The study employs panel data spanning 30 Chinese provinces, from 2012 to 2020, to assess the comprehensive index reflecting the level of digital economy development in China. Employing fixed effects model, the empirical analysis examines how China's digital economy influences regional economic growth, yielding the following conclusions: (1) The advancement in digital economy development significantly fosters economic growth; (2) Results from regressing the explained variable subdivided into the value-added of three major industries indicate that digital economy exerts the greatest impact on the added value of tertiary industry, followed by primary industry, which has no significant impact on the secondary industry; (3) Heterogeneity analysis reveals regional disparities in the promotion of economic growth by the digital economy, with a more pronounced impact in the central and eastern regions of China compared to the western region of China, where the effect is not significant.

***Keywords*:** digital economy, economic growth, digitalize

1. Introduction

Amidst the rapid advancement of digital technology, the digital economy has emerged as a pivotal economic force within contemporary society. Academia has achieved many results in theoretical and empirical research on the impact of the digital economy on economic growth. In terms of theoretical research, Zhao T (2020) argue that the economies of scale, scope, and long tail effects generated by digital technology are conducive to efficient matching of supply and demand[1]; Jing W J (2019) suggest that the digital economy promotes economic growth through new factor inputs, improving factor allocation efficiency, and enhancing total factor productivity[2]. In empirical research, Wang R Q (2022) use panel data from 265 cities in China from 2011 to 2018 finds that the digital economy has both positive and negative effects on the real economy, with the promotion effect significantly stronger than the inhibition effect[3].

2. Theoretical Analysis

From the supply side, continuous advancements in digital construction, characterized by digital infrastructure (such as internet infrastructure construction), improvement in digital service levels (such as internet and telecommunications services), and further expansion of digital applications characterized by digital resource utilization, continuously generate and disseminate new knowledge. This promotes technological and organizational innovation throughout the entire process of economic and social development. From the demand side, due to the strong positive externalities of the digital economy, through digital construction, digital services, and digital applications, not only can production and operating costs be reduced, but consumer demand can also be increased through precise analysis of consumer demand. Based on the above analysis, propose Hypothesis 1: The level of digital economy development significantly promotes economic growth.

3. Empirical Analysis

The assessment of the digital economy encompasses two primary methodologies: the direct and indirect approaches. However, due to the fact that the digital economy includes not only the digital industrialization part but also the part of industrial digitalization that is currently difficult to measure accurately using the direct method, there are limitations to the direct method. Therefore, the main method currently used is the indirect method, which involves constructing a system of indicators to indirectly reflect the level of digital economy development.

3.1 Model Specification

This paper adopts the comprehensive index of digital economy development proposed by Zhao Tao (2020) as a reference, based on panel data from 30 provinces from 2012 to 2020, specifies the econometric model as follows:

$$Y_{it} = \alpha_0 + \alpha_1 Dige_{it} + \eta_k X_k + \delta_i + u_{it} \quad (1)$$

Where i and t represent provinces and years, respectively; Y_{it} represents the dependent variable, regional GDP; $Dige_{it}$ represents the core explanatory variable, the comprehensive index of digital economy development; α_0 is the intercept term; X_k represents the control variable group; δ_i represents individual fixed effects; u_{it} represents the random disturbance term.

3.2 Indicator Selection

The relevant original statistical data selected are from the annual "China Statistical Yearbook" and provincial statistical yearbooks, with some digital economy indicator data derived from the "Peking University Digital Inclusive Finance Index".

3.2.1 Dependent Variable

Economic growth (Y_{it}) is mainly represented by regional GDP (GDP_{it}). Additionally, to conduct a more specific analysis, the components of regional GDP, including value-added of the primary industry (Pri_{it}), value-added of the secondary industry (Sec_{it}), and value-added of the tertiary industry (Ter_{it}), are also analyzed as dependent variables.

3.2.2 Explanatory Variable

The comprehensive index of digital economy development ($Dige_{it}$), referring to the research by Zhao Tao (2020). Through principal component analysis, indicators which in Table 1 are standardized and dimensionally reduced, with a KMO value of 0.764, to obtain the comprehensive index of digital economy development.

Table 1. Composition of the comprehensive index of digital economy development

Primary Indicators	Secondary Indicators	Tertiary Indicators
The comprehensive index of digital economy development	Internet Penetration Rate	Number of Internet Users per 100 People
	Number of Employees in Internet-related Fields	Proportion of Employees in Computer and Software Services Industry
	Internet-related Output	Per Capita Telecommunications Service Volume
	Number of Mobile Internet Users	Number of Mobile Phone Users per 100 People
	China Digital Inclusive Finance Index	China Digital Inclusive Finance Index

3.2.3 Control Variables

Building on existing research, this study selects regional fixed asset investment (Inv_{it}), foreign trade dependence ($Fore_{it}$), number of patents granted ($Pate_{it}$), and level of fiscal expenditure (Exp_{it}) as control variables. Table 2 shows the descriptive statistics of the main variables.

Table 2. Descriptive Statistics of Variables

Variable	N	Mean	Min	Max	Std. Dev.
GDP	270	24185	1894	92439	18678
Primary	270	1928	71	4725	1250
Secondary	270	10425	804.5	37945	8446
Tertiary	270	11817	624.3	52196	9843
Dige	270	1.93e-08	-2.533	6.945	1.485
Pate	270	61914	502	709725	92420
Fore	270	0.246	0.00716	1.357	0.257
Exp	270	0.253	0.118	0.643	0.104
Inv	270	17337	1920	51341	11860

3.3 Analysis of Benchmark Regression Results

This study employs fixed effects model and cluster-robust standard error tests. Based on examining the linear relationship between the digital economy and regional GDP, we separately discuss the linear relationship between the digital economy and the value-added of the primary, secondary, and tertiary industries. The regression results are presented in Table 3.

Table 3. Regression results

	(1)	(2)	(3)	(4)
Variable	GDP	Pri	Sec	Ter
Dige	1,583.84***	91.99***	0.87	1,495.60***
	(4.58)	(2.79)	(0.01)	(5.54)
Pate	0.03***	0.001	0.01*	0.03***
	(4.64)	(1.12)	(2.00)	(4.66)
Fore	-17,197.75***	224.72	-5,975.38**	-11,626.20***
	(-3.73)	(0.70)	(-2.56)	(-4.03)
Exp	-36,836.13***	-1,818.12	-19,692.84***	-15,097.97**
	(-5.33)	(-1.55)	(-6.17)	(-2.56)
Inv	0.41***	0.01***	0.18***	0.22***
	(4.38)	(2.96)	(5.08)	(3.02)
Constant	28,607.43***	2,072.44***	13,334.30***	13,133.65***
	(10.91)	(6.05)	(8.69)	(6.73)
Obs	270	270	270	270
R-squared	0.861	0.433	0.698	0.861

Note: Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

From the regression results in column (1), we observe that the coefficient of the comprehensive index of digital economy development is 1583.84, and it is statistically significant at the 1% level. This indicates that the level of digital economy development significantly promotes economic growth. Specifically, for every 1 unit increase in the comprehensive index of digital economy development, regional GDP increases by 1583.84 billion yuan, thus validating hypothesis 1. The regression results in columns (2), (3), and (4) reveal that the digital economy significantly promotes the value-added of both the primary and tertiary industries, with significance levels at 1%. Comparing the coefficients of 91.99 and 1495.60, we observe that the impact of the digital economy on the tertiary industry is much greater than that on the primary industry. Additionally, although the coefficient for the value-added of the secondary industry is positive, it is not statistically significant.

Regarding the control variables, apart from the results in column (2), the regression results across all models are generally consistent. Total fixed asset investment and number of patents granted have significant positive effects on economic growth, but their impact on the value-added of the primary industry is not significant.

3.4 Heterogeneity Analysis

As shown in Tables 4, following convention, the analysis of regional heterogeneity divides China's 30 provinces into eastern, central, and western regions for further examination. Columns (5), (6), (7), and (8) in Table 4 present the regression results for the Eastern region samples. From the results, we observe that the regression coefficients of the digital economy with regional GDP, value-added of the primary industry, and value-added of the tertiary industry are generally consistent in direction, magnitude, and significance level with those in Table 3, and the goodness of fit is higher. Columns (9), (10), (11), and (12) present the regression results for the Central region samples. The regression coefficients of the digital economy with regional GDP and value-added of the tertiary industry are similar to those in Table 3. However, in column (10), the coefficient of the comprehensive index of digital economy development for the Central region is 4.71 but not significant, while in column (11), the coefficient is 551.83 and significant at the 10% level. This indicates that the level of digital economy development in the Central region significantly promotes economic growth, although its effect on the primary industry is not significant but significant for the secondary industry. Columns (12), (14), (15), and (16) present the regression results for the Western region samples. The results differ from Tables 3 and 4, showing that the level of digital economy development in the Western region does not significantly promote economic growth, with only a certain promotion effect on the primary industry, with a coefficient of 85.95 significant at the 10% level. This may be due to the lower and smaller scale of digital economy development in the Western region, which has not yet fully integrated with various industries to exert its effect.

In horizontal comparison, the regression coefficients of the digital economy with regional GDP vary from the national level to the Eastern and Central regions, being 1583.84, 1603.87, and 2248.20. This indicates that the digital economy has a higher promoting effect on regional GDP in the Central region, while its effect on the tertiary industry is slightly higher in the Eastern region compared to the Central region.

Table 4. Regression results by region

	Eastern China				Central China				Western China			
	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Variable	GDP	Pri	Sec	Ter	GDP	Pri	Sec	Ter	GDP	Pri	Sec	Ter
Dige	1,603.87**	-51.26**	-126.41	1,787.31***	2,248.20***	4.71	551.83*	1,699.52***	520.91	85.95*	89.04	342.32
	(2.46)	(-2.38)	(-0.42)	(3.83)	(3.70)	(0.06)	(2.02)	(3.77)	(1.60)	(2.10)	(0.59)	(1.35)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	37,622.02***	2,035.20***	18,178.84***	17,263.36***	30,816.91***	2,007.24***	15,058.43***	13,739.88***	16,709.49***	1,854.93***	11,033.17***	3,696.77
	(8.46)	(8.85)	(5.24)	(6.50)	(8.82)	(9.29)	(5.73)	(4.73)	(5.52)	(3.98)	(6.76)	(1.61)
Obs	99	99	99	99	72	72	72	72	99	99	99	99
R-squared	0.875	0.580	0.731	0.890	0.950	0.332	0.792	0.948	0.870	0.818	0.651	0.855

4. Conclusion and Implications

In summary of the above analysis, this study draws the following conclusions: (1) The level of digital economy development significantly promotes economic growth, as an increase in the comprehensive index of digital economy development can boost regional GDP. (2) Results from regressing the explained variable subdivided into the value-added of three major industries indicate that the impact of the digital economy on the value-added of the tertiary industry is the greatest, followed by the primary industry, while there is no significant impact on the secondary industry. (3) Heterogeneity analysis reveals regional disparities in the promotion of economic growth by the digital economy, with a more pronounced effect in the central and eastern regions compared to the western region, where the effect is not significant.

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