Chapter 40
Effects of Information Services on Economic Growth in Jilin Province

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Abstract Information services constitutes an important part of the modern service industry. In consideration of the value-added accounting of information services in Jilin province in this article, the contribution rate and the pull rate of information services to GDP growth are calculated for the period 1993–2012; then the cointegration theory is adopted to carry out a cointegration test and Granger causality test to determine the relationship between the information services industry and the economy in the province, thereby establishing the corresponding error correction model. The research results show that the information services industry in Jilin Province is on a smaller scale with a limited pulling function in economic growth; in addition, a long-run equilibrium relationship with economic growth is available, although its correction capability during periods imbalance is weak. The progress of the information services industry constitutes the Granger cause of economic growth, while economic growth does not constitute the Granger cause of the information industry development.

Keywords Information services • Economic growth • Cointegration test • Granger causality test • Error correction

40.1 Introduction

Information services (INS), as a synthesis of specialized industries, utilizes modern science and technologies, such as computers and network communication, to produce, collect, handle, process, store, transfer, retrieve, and exploit information and provides services for society via information products [1]. With the integration of the global economy and the further advancement of the information process, INS has come to be regarded as the commanding height of participation in global

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economic competition. In China, nevertheless, the rapid development of modern information technology has gradually become a new growth point and powerful engine of China's economic development, and its development is of great significance to the economy and society. Therefore, this paper will focus on the growth of the INS industry in Jilin province for nearly 20 years to carry out quantitative analysis and study the effects of INS on economic growth.

The concept of INS was first put forward by American scholar Porat [2]. Later, American and other scholars studied the modern INS industry from various perspectives. Braunstein used translog and ECS functions instead of the c-d function to extend the conclusions of Hayes and Erickson to further confirm Hayes and Erickson's analysis [3]. Engelbrecht focused on the emerging industrialized countries and regions as well as the fledgling developing countries only to find that the process of economic transition from a national economy to an information economy greatly depends on the growth of the information sector [4].

Two Chinese economic scholars, Wu and Xie, concluded, from analyzing the effects of information technology on industrial restructuring and research on how information promotes the development of technology, that information technology had promoted industrial restructuring and economic growth [5]. Li and Zhu analyzed the effects of the information industry on economic growth in Hubei province using the two-sector model of economic growth of Frederick. They believed that the information industry should receive support at all levels of government [6].

40.2 Contribution of INS to Economic Growth in Jilin Province

For the purpose of studying how the INS industry promotes economic growth in Jilin province, this paper first explains the added value of Jilin INS from 1993 to 2012 and then analyzes the contribution of the INS industry to economic growth in Jilin province.

40.2.1 Accounting for Added Value of INS Industry in Jilin Province

Given the availability of data and the necessity of empirical research, the sample data used in this article are related to Jilin INS and gross national product (GDP) from 1993 to 2012. The basic data used mainly originate from the Jilin statistical yearbook (1994–2013) with the data selection and processing shown as follows [7]. To avoid heteroscedasticity in time series data, we perform log processing on the sequence.

Table 40.1 Added value of information services industry and its contribution to GDP

Year	Growth of INS (billion)	Growth rate of INS (%)	Contribution rate to GDP (%)	Pulling function to GDP (%)
1993	13.44		–	–
1994	18.94	40.92	2.02	0.62
1995	25.16	32.84	2.21	0.47
1996	31.97	27.07	2.37	0.44
1997	42.2	32	2.88	0.25
1998	43.19	2.35	2.74	0.21
1999	44.38	2.76	2.64	0.18
2000	38.87	−12.42	1.99	0.32
2001	42.13	8.39	1.99	0.17
2002	45.34	7.62	1.93	0.21
2003	58.43	28.87	2.19	0.29
2004	71.52	22.4	2.29	0.4
2005	84.84	18.62	2.34	0.37
2006	108.45	27.83	2.54	0.46
2007	130.29	20.14	2.47	0.58
2008	136.62	4.86	2.13	0.46
2009	172.88	26.54	2.38	0.32
2010	193.58	11.97	2.23	0.43
2011	235.16	21.48	2.23	0.49
2012	250.25	6.42	2.1	0.27

40.2.2 Direct Contribution of INS to Economic Growth

According to the statistical definition, the direct contribution of INS to economic growth can be expressed as the percentage of the added value of the INS industry to that of GDP. The formula is

$$\omega_i = \frac{\mathrm{INS}_i - \mathrm{INS}_{i-1}}{\mathrm{GDP}_i - \mathrm{GDP}_{i-1}}, \tag{40.1}$$

where INS_i is the added value of INS in year 1, and GDP_i is the GDP of year 1. The contribution rate is shown in Table 40.1.

We can see that as an independent industry classification, INS makes statistically significant differences and leads to a brief fluctuation in the growth of information services. Taking on the other hand, the contribution rate of Jilin INS industry to GDP growth has always been maintained around 2 %, compared with the Chinese average rate (7–10 %) for the same period, there is still a large difference. After 2000, digital quantity is relatively lower, slightly less than 2 %.

40.2.3 Pull Rate Analysis of Effect of INS Industry on Economic Growth

The contribution rate may reflect the functional degree of INS factors in economic growth; in addition, there is another dynamic index that can reflect the pulling effect on GDP growth, that is, the pull of the INS industry to GDP growth. The calculation method is as follows: $\theta_i = \omega_i * \eta_i$ θ_i is the pull rate of the information service industry to GDP growth, and η_i is the growth rate of GDP. From Table 40.1 we know that, since 1996, the pull function has shown a slow upward trend in volatility, up to a maximum of 0.58 % by 1997. After this year, it shows volatility in the process of slowing down, with an average pull rate of INS to GDP growth of 0.37 %. The change illustrates that the Jilin province INS experienced a period of short transition to maturity.

40.3 Empirical Analysis of INS Industry and Economic Growth in Jilin Province

40.3.1 Variable Selection and Sample Data Determination

To avoid heteroscedasticity in time series data, we carry out log processing on the sequence of data from 1993 to 2012. We use LnGDP and LnINS to represent the natural log values of GDP and INS, respectively.

Twenty samples of processed data are drawn into the time series of the scatter charts (Fig. 40.1). It can be seen that each variable has a growing tendency and there is a strong correlation between the two series, with a correlation coefficient of 0.9805.

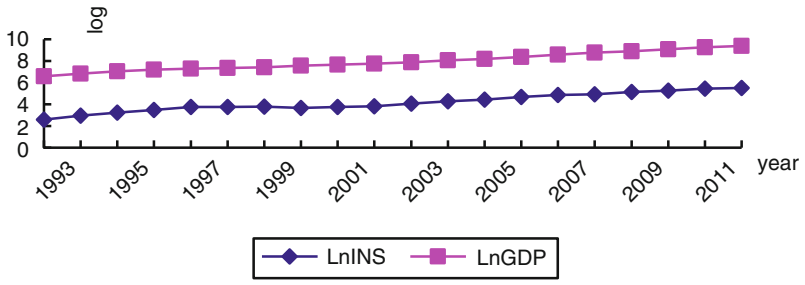

Fig. 40.1 Scatter chart of LnINS and LnGDP time series

Table 40.2 Augmented Dickey–Fuller unit root test of LnGDP and LnINS in Jilin province

Null Hypothesis		*D*(LnGDP-2) has a unit root		*D*(LnINS-2) has a unit root	
		t-Statistic	Probability*	*t*-Statistic	Probability*
Augmented Dickey–Fuller test statistic		−3.1073	0.0463	−5.8781	0.0002
Test critical values	1 % level	−3.9203		−3.8867	
	5 % level	−3.0655		−3.0521	
	10 % level	−2.6734		−2.6665	

40.3.2 Unit Root Test of Time Series Variables

Before we perform a cointegration analysis of the data, we must carry out stationary tests on the variables; otherwise, spurious regression problems may occur. We used the Augmented Dickey-Fuller (ADF) test law on variable LNGDP and LNINS for unit root tests in this paper; After test, the first-level difference of LnGDP and LnINS are nonstationary time series, because the two series are refused zero assumed under the validation 5% of significantly refused level; the results also show that LNGDP, LNINS, and their first-level difference are a nonstationary time sequence; from Table 40.2 we conclude that as a result of the second-level difference of LNGDP and LNINS unit root tests, the null hypothesis is rejected. Then we refuse to unit root hypothesis; so the second-level difference of the LnGDP and LnINS are the stationary sequences [8].

40.3.3 Cointegration Tests on Time Series

The objective of the cointegration test is to determine weather there is a stable equilibrium between the set of linear combination of nonstationary sequences precisely because cointegration establishes a long-run equilibrium relationship. If we can find a dependable link between several variables that seems to have a separate random trend, then by adjusting the model we can exclude the unit root that leads to randomness of trends brought about by the unit root, the so-called error-correction model. Using the E-G two-step testing method, the cointegrated regression model for INS industry development and economic growth in Jilin province are as follows (Table 40.3):

$$\text{LNGDP} = 3.9002 + 0.9734\,\text{LNINS}\ \ R^2 = 0.98\ \ \text{DW} = 0.773\ \ \text{SSE} = 0.118.$$

Then we should do the unit root test to the residuals by Eviews 6.0 with the results shown in Table 40.4

Table 40.3 Cointegrated regression model of LNGDP and LNINS

Variable	Coefficient	Standard error	*t*-Statistic	Probability
C	3.90027	0.13757	28.3508	0.0000
LNINS	0.97335	0.03236	30.0704	0.0000

Table 40.4 ADF test series residuals

		t-Statistic	Probability*
Augmented Dickey–Fuller test statistic		−7.411652	0.0000
Test critical values	1 % level	−3.886751	
	5 % level	−3.052169	
	10 % level	−2.666593	

Table 40.5 Granger causality test result

	Null hypothesis: Lags: 1		Null hypothesis: Lags: 2	
	F-Statistic	Probability	*F*-Statistic	Probability
LNINS does not Granger-cause LNGDP	7.44832	0.0149	5.82712	0.0156
LNINS does not Granger-cause LNGDP	1.53316	0.2335	1.12692	0.3537

The test results in Table 40.4 shows that under the significant level of 10 %, the ADF value is less than the threshold of 10 %; series residuals are smooth sequences of residuals. This means that a cointegration relationship existed between LNINS and LNGDP. From this we can see that the INS industry has a long-run positive equilibrium relationship with GNP in Jilin province. If the INS industry increases by 1 unit, the economy will increase by 0.9734 units, which indicates that progress in the INS industry plays a positive a role in boosting economic growth.

40.3.4 Granger Causality Test

The cointegration test results show that the long-run equilibrium relationship between LNINS and LNGDP has been established; but whether the relationship can be identified as a causal link must be tested further using credible Granger-causality analysis.

From Table 40.5 it can be concluded that the development of the INS industry has always been the Granger cause of economic growth, but economic growth is not the Granger cause of services [9]. In addition, economic growth lacks internal demand for INS in Jilin province; economic growth mainly relies on factors, such as the substantial input of resources, other than the development of information technology or related science and technology.

40.3.5 Error-Correction Model

By cointegration analysis, we have discovered a long-run equilibrium relationship between GDP and INS industry, but short-run deviation from the state cannot be learned from cointegration analysis, and the error-correction model is needed to effectively address this problem [10]. By Eviews 6.0, error correction is treated as an explanatory variable model to study models of short-run dynamics and long-run adjustment. The model reflects the short-run dynamic balance of the relationship between the LNINS and LNGDP error-correction model with the following outcomes:

$$\begin{aligned} D(\text{LNGDP}) &= 0.067 + 0.244D(\text{LNINS}) + 0.101D(\text{LNINS}(-1)) \\ &\quad + 0.139D(\text{LNGDP}(-1)) - 0.197\text{ECM}(-1) \\ R^2 &= 0.646,\ \text{DW} = 1.685,\ \text{SSE} = 0.016. \end{aligned}$$

Based on these equations, economic growth in short-run movements can be broken down into two parts: the impact of short-run fluctuations in the INS industry and the effect of a partial deviation from the long-run equilibrium on GNP. Short-run fluctuations in INS will give rise to increases in economic growth and transformation. Changing one unit of the INS industry in the short term will cause GDP growth to change by 0.224 units. The error-correction coefficient indicates that changes to the long-run equilibrium of the GDP adjustment speed is 19.68 %, which means that the long-run imbalance has little impact on GDP.

40.3.6 Result

The results indicate that there is a long-run stable relationship between INS development and economic growth in Jilin province. In the short-run, the effect of INS on economic growth is significant; the long-run balanced relationship between INS and economic growth has a weak self-correcting effect on nonbalanced error adjustment in this period.

Conclusion
Using an analysis of the contribution of the Jilin province's INS industry to the region's economic growth, a common conclusion has been reached in this paper: in Jilin province, the INS sector does not play a positive role in promoting economic growth; the emergence of a mutually reinforcing virtuous development model between informatization and economic growth also needs time and support of government. In the era of big data, efforts should be

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made to focus on economic growth and cointegration between progress in the INS industry and progress in the INS industry in development policy; timely raise the informatization level of economic growth in Jilin province; promote the overall development of the INS industry; and ultimately promote the INS industry and economy interaction in Jilin province.

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