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Research on the Growth Ability to Measure China 'S Ict Industry

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Abstract: With the start of information economy, the ICT industry, with its huge economic scale and rapid development momentum, has been the focus of global technological and economic development. The scientific measurement of the growth capacity of the ICT industry is propitious to grasp the overall development of the ICT industry and optimize the policies for the industrial development, thus to achieve a sustainable development. In this study,the index system for measuring the growth capacity of ICT industry is established, the Catastrophe Series method used and the results of the empirical measurement analyzed specifically.

Key words: Catastrophe series method, ICT industry, growth ability, measurement

INTRODUCTION

Design of ict industry growth measurement index1 system: To evaluate comprehensively the growth capacity of the ICT industry, this study, based on data resources obtained (Tabel 1), probes into the growth capacity of the ICT industry from three perspectives, namely, the circulation of ICT equipment and resources, the performance level of the ICT industry, the potential development of ICT industry(Zhang *et al*., 1998*)*:

- Considering no matter in the past or in the future, information communication facilities. XinTong equipment and resources circulation affect the ICT industry growth ability, On this basis, establish the information equipment equipment level, XinTong resources development and utilization ability two level 3 indicators. First of all, good infrastructure equipment conditions can ensure the information flow and application. Information and communication technology application include XinTong network system construction quality and level (Sun *et al*., 2001). Secondly, the information as a production factor, so as to enhance the over all value of ICT industry
- Considering an industrial growth ability firstly embodies in competition strength and growth performance, mainly from the output quantity. First, the industry scale level represents the ICT industry present development status, which really reflects the ICT industry development trend, easily from Macro perspective to grasp the ICT industry development strength. Second, the proportion of industrial structure, that these indicators can be more clearly describe the degree of optimization of industrial structure and whether sophistication (Wang, 2005)
- Taking into account the healthy growth of the ICT industry needs to have the capacity for sustainable development. Therefore, this study combines the dynamic point of view, that is, based on the object's future growth potential and sustainable development capacity design evaluation indicators-ICT industry growth potential (Guo, 2008)to make a research about the ICT industry growth ability measure problem

On this basis, firstly the ICT industry high R andD investment so the potential for innovation as one of the evaluation criteria; Secondly, consumption is strong carriage driving China's economic growth in the economies in transition. The ICT industry is no exception (Ye, 2010) creating the consumption demand potential index.

ICT industry growth capacity measure: More extensive use of the evaluation method includes fuzzy evaluation, hierarchical analysis. Not only consider the relative importance of each index in establishing the hierarchy index and enhance the objectivity of the evaluation, the sample quantity requirement is not high with simple operation more appropriately and accurately (Li, 2007)

Catastrophe progression method evaluation model: Catastrophe theory emerging disciplines of qualitative change in the law is founded by the French mathematician Bene Thom. The theory evolved by the structural stability of topological concept can be used for trend analysis

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Table 1: ICT industry growth index system to measure

One level evaluation index	Second level evaluation index	Third level evaluation index	Fourth level evaluation index
ICT yield industry growth capacity A	ICT equipment and resources circulation A_1	Level of information devices and equipment B_1	Total fiber length (1000 km) C_1
			TV comprehensive population coverage (%) C_2
			Mobile phone penetration (%) C_3
			Internet penetration (%) C_4
		Resource development and utilization of ICT B_2	No. of pages (million) C_5
			Users average time spent online per week (h) C_6
			Per capita annual mobile talk time (10,000 min) C_7
	Level of performance of the ICT industry A_2	Level of industrial scale B_3	Main business income (billion) C_8
			Profit (million yuan) C_9
			Investment (million yuan) C_{10}
		Proportion of industrial structure B_4	Value added to GDP ratio (%) C_{11}
			Proportion of exports to total exports (%) C_{12}
			Proportion of employees in total employment (%) C_{13}
			Proportion of the income of the services and manufacturing industry C_{14}
	Growth potential of the ICT industry A_3	Potential for technological innovation B_5	R and D personnel strength (%) C_{15}
			R and D funding strength (%) C_{16}
			No. of patent applications (pieces) C_{17}
		Demand for consumption potential B_6	Information the consumer price index C_{18}
			Per capita GDP (yuan) C_{19}

Table 2: Common mutation model potentialfunction

Catastrophe model	Control variable	Potential function
Cusp catastrophe	2	$f(x) = x^4+ax^2+bx$
Swallowtail catastrophe	3	$f(x) = \frac{1}{5}x^5 + \frac{1}{3}ax^3 + \frac{1}{2}bx^2 + cx$
Butterfly mutations	4	$f(x) = \frac{1}{6}x^6 + \frac{1}{4}ax^4 + \frac{1}{3}bx^3 + \frac{1}{2}cx^2 + dx$

(Liu *et al*., 2011). Catastrophe progression method derived by the catastrophe model catastrophe theory can be used for complex decision-making (Yang, 2009). First the evaluation objectives tree structure decomposition, mutations potential function based on the use of the comprehensive quantitative normalized formula (Wang and Shu, 2010). The basic types of mutation model mainly controlling the number of variables is decided by numbers of N When N≤4.

Mutation model research object is the state variables and control variables of mutation potential function, which is in Table 2 of f(x).Among it, x is a state variable, which is the behavior of the system state and a, b, c, d are the control variable, which decide whether a mutation. Through f(x) to find the first derivative that f'(x) = 0, function can be obtained form a balanced surfaces critical point. Through f(x) to find the second-order derivative that f'"(x) = 0 that can be obtained the singularity set function. Merge the two equations f'(x) = 0, f(x)" = 0 to eliminate x, getting bifurcation set equation. The results would cause the system mutation shown in Table 3.

Normalized formula is used to achieve the evaluation and analysis of the bifurcation set equation, through transforming the control variable into state variables, which is concluded that the state of each control variable mutation level value. Continue upward based on comprehensive. The normalized formula expressed as in Table 4.

Table 3: Bifurcation set equation

Catastrophe model	Bifurcation set equation
Cusp catastrophe	$a = -6x^2$, $b = 8x^3$
Swallowtail catastrophe	$a = -6x^2$, $b = 8x^3$, $c = -3x$
Butterfly mutations	$a = -10x^2$, $b = 20x^3$, $c = -15x^4$, $d = 4x^5$

Table 4: Normalized formula

Catastrophe model	Normalized
Cusp catastrophe	$x_a = a^{1/2}$, $x_b = b^{1/3}$
Swallowtail catastrophe	$x_a = a^{1/2}$, $x_b = b^{1/3}$, $x_c = c^{1/4}$
Butterfly mutations	$x_a = a^{1/2}$, $x_b = b^{1/3}$, $x_c = c^{1/4}$, $x_d = d^{1/5}$

Catastrophe progression method modeling steps:

- Set up multi-level index system and index data standardization. Multi-level decomposition arranged in the limb -type evaluation purposes (Zhou, 2010). Then evaluation index data is added, taking into account the dimensions of the original data. Therefore the original data will need to be normalized value range limited within the range of 0 to 1
- Determine the mutation system type. To determine the next level indicator of the number of indicators corresponding the mutation function types: Cusp mutation system requires two lower indicators, swallowtail catastrophe system requires three subordinate indicators; butterfly mutation system requires four lower-level indicators (Zhang, 2007)
- Use normalized formula consolidated and sort. The calculated evaluation value should be calculated "complementarily" principle or " minima small layers of state variable values □□ (Di, 2007). Conversely, if there is a significant complementary relationship, in accordance with minima "principle calculation" (Luo and Xie, 2011)

ICT industry growth capacity measure: Industry growth capacity refers to the powerful energy industry which has

Table 5: ICT industry growth ability of historical data

Level 4	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
C_1	112	181.9	224.6	271	338.4	404.9	425.9	573.7	677	827	993
C_2	91	92.9	93.3	93.7	94	94.5	95	95.4	96	97	97.6
C_3	6.7	11.5	16.1	21	25.9	30.3	35.3	41.6	48.5	56.3	64.4
C_4	1.8	2.6	4.6	6.2	7.3	8.5	10.5	16	22.6	28.9	34.3
C_5	1.1	1.6	1.6	3.2	6.5	24	45	85	161	336	600
C_6	13.7	8.5	9.8	13.4	14	15.9	16.9	16.2	16.6	18.7	18.3
C_7	0.25	0.24	0.20	0.23	0.28	0.31	0.36	0.42	0.45	0.47	0.50
C_8	13721	15919	18222	23397	30371	44210	53984	63280	71140	69525	87079
C_9	1174	1373	1366	1443	2127	2572	3162	3837	3409	3521	4283
C_{10}	2585	3021	2607	2999	3233	3328	3923	4487	5552	6429	6931
C_{11}	3.5	4.2	4.4	4.9	5.2	6.6	6.6	6.3	6.1	6	5.6
C_{12}	14.8	17.6	20.8	23.5	28.7	26.5	28.5	28.7	29.6	33.7	37.5
C_{13}	1.78	1.87	2.10	2.48	3.02	3.20	3.40	3.63	4.02	3.91	4.10
C_{14}	0.180	0.204	0.358	0.331	0.259	0.151	0.390	0.394	0.388	0.355	0.374
C_{15}	2.05	2.71	2.43	2.62	1.92	2.51	2.38	2.88	2.95	4.44	4.03
C_{16}	1.06	1.29	1.23	1.01	0.99	1.02	1.04	1.02	1.10	1.35	1.23
C_{17}	2	2.3	2.9	3.1	3.2	10.8	8.5	15.6	19.1	18	13
C_{18}	0.425	0.433	0.507	0.554	0.538	0.551	0.569	0.549	0.516	0.510	0.540
C_{19}	7828	8592	9368	10510	12299	14144	16456	20117	23648	25511	29992

2011 "China statistical yearbook", the ministry of industry and information statistics bulletin

been thus beyond the life cycle of endless in a dynamic environment. Industry through the continuous innovation and explore the growth path and constantly conform to the environmental changes (Yin and Zang, 2005).

Selection of sample data: This study selects 2000~2010 years of data as raw data, including all the indexes for positive indicators, respectively, the total length of optical fiber (C_1), TV comprehensive population coverage (C_2), mobile phone penetration (C_3), Internet penetration (C_4), page number (C_5), the user a week on the average time on the Internet (C_6), mobile phone time per year (C_7), main business income (C_8), profit (C_9), investment (C_{10}), the added value of the added value of total proportion (C_{11}), total exports export proportion (C_{12}), employees accounted for the proportion of total employment (C_{13}), intra-industry services and manufacturing income ratio (C_{14}), R and D personnel strength (C_{15}), R and D funds strength (C_{16}), patent application number (C_{17}), information consumption index (C_{18}), per capita GDP (C_{19}) (Table 5).

The original data for different dimension uses the formula for standardization, thereby eliminating dimensional effect. Here use Eq. is:

$$\frac{x_i - x_{min}}{x_{max} - x_{min}}$$

Mutation series calculation: Due to the empirical research involves the number of samples is more.

For 4 index system: Level 4 indicators, C_1, C_2, C_3, C_4, C_{11}, C_{12}, C_{13}, C_{14}, constitute a butterfly mutation model. C_5, C_6, C_7, C_8, C_9, C_{10}, C_{15}, C_{16}, C_{16}, C_{17} constitute a dovetail mutation model; C_{18}, C_{19} constitute a cusp catastrophic model. C_1, C_2, C_3, C_4, indicators for butterfly mutation system, here is a complementary between index type, applicable model Eq. is:

$$f(x) = \frac{1}{6}x^6 + \frac{1}{4}ax^4 + \frac{1}{3}bx^3 + \frac{1}{2}cx^2 + dx$$

The corresponding bifurcation set equation for:

$$a = -10x^2, b = 20x^3, c = -15x^4, d = 4x^5$$

Then, get B_1 controlling variable equation as follows:

$$x_a = a^{1/2} = \sqrt{1}, x_b = b^{1/3} = \sqrt[1/3]{1}, x_c = c^{1/4} = \sqrt[1/4]{1}.,$$
$$x_d = d^{1/5} = \sqrt[1/5]{1}$$

According to the principle of complementary type, B_1 basic control variable for (1+1+1+1)/4 = 1. In a similar way, getting B_4 basic control variable is 0.9514. According to dovetail model is calculated B_2 basic control variable is 0.9956. B_3 basic control variable is 1. B_5 basic control variable is 0.8948; According to the cusp model calculation, the basic control variable is 0.9468 (Yue, 2010).

For the third level indicator system: In the level 3 indicators, B_1, B_2, B_3, B_4, B_5, B_6 constitute a cusp model, index for the complementary relationship between type. For B_1, B_2, cusp model, applicable model Eq. is:

$$f(x) = x^4 + ax^2 + bx$$

Table 6: ICT industry growth ability evaluation result

Index	2000	2001	2002	2003	2004	2005
Hinting equipment and resources circulation A_1	0.391	0.648	0.661	0.787	0.821	0.855
industry performance A_2	0.274	0.715	0.717	0.795	0.853	0.852
ICT industry growth potential A_3	0.259	0.722	0.805	0.791	0.659	0.847
ICT Industry growth ability A	0.714	0.922	0.947	0.943	0.948	0.959
Index	2006	2007	2008	2009	2010	
XinTong equipment and resources circulation A_1	0.878	0.908	0.935	0.971	0.999	
ICT industry performance A_2	0.932	0.953	0.964	0.970	0.992	
ICT industry growth potential A_3	0.856	0.886	0.912	0.972	0.964	
ICT industry growth ability A_4	0.977	0.984	0.988	0.993	1.000	

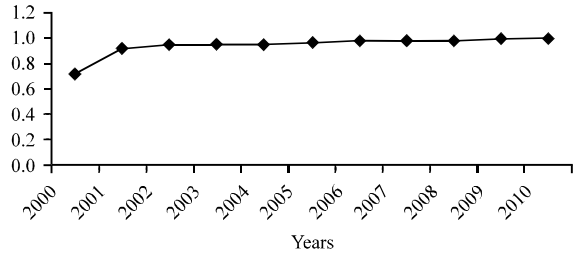

Fig. 1: ICT industry growth ability measure results

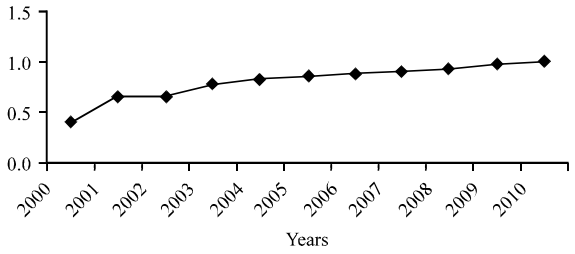

Fig. 2: XinTong equipment and resources circulation

Bifurcation set equation for:

$$a = -6x^2, b = 8x^3$$

The control variable equation computation Eq. is as follows:

$$x_a = a^{1/2},\ x_b = b^{1/3}$$

Getting A_1 basic control variable is 0.9993. By analogy, A_2 basic control variable for 0.9918. According to dovetail model, A_3 basic control variable for 0.9639 (Yang *et al*., 2006).

For the second index system: Secondary index A_1, A_2, A_3 constitute dovetail model. Indicators for the complementary relationship between type, applicable model Eq. is:

$$f(x) = \frac{1}{5}x^5 + \frac{1}{3}ax^3 + \frac{1}{2}bx^2 + cx \quad (4)$$

Bifurcation set equation for:

$$a = -6x^2, b = 8x^3, c = -3x$$

The control variable calculation is as follows:

$$x_a = a^{1/2}, x_b = b^{1/3}, x_c = c^{1/4}$$

The last layer to want to use "small in take big" method, 2010 years of industry growth ability is 0.9996. Above is the whole calculation process and the rest of the sample by the same token (Luo and Xie, 2011) this is differ one give unnecessary details. The evaluation results see Table 6.

MEASURE RESULTS

To see from Fig. 1, the ICT industry growth ability of the whole development trend has been a steady growth trend. If the total score of 0.95 for demarcation line (Wang, 2011) the ICT industry growth process is divided into two key stages: The first stage 2000 to 2004, the general idea for the sharp rise in stage, appearing in 2003, small decline mainly due to the developers investment proportion, research and development funds investment proportion reduced; The second stage is from 2005 to 2010, for smooth rise phase (Xing, 2005).

From XinTong equipment and resources circulation measure results show that our country's information equipment and resources circulation index has been in the stationary stage in China. From the chart that 2001 smaller increase, this basically is of less investment (Fig. 2).

ICT industry performance measure results show that the level of performance in 2002 fell slightly: (1) for the unknown future some business, investment caution; (2) in order to control enterprise ratio, compression cost and investment plan corresponding reduced; (3) China telecom restructuring, the new China telecom and China Netcom in phase of integration, the investment plan affected. After 2002, the ICT performance level is steady growth. 2006 performance appeared to rise sharply, then keep the more smoothly development trend (Fig. 3).

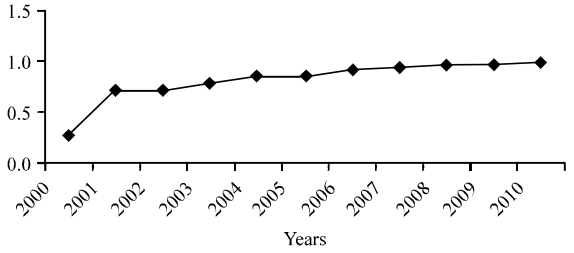

Fig. 3: ICT industry performance measure results

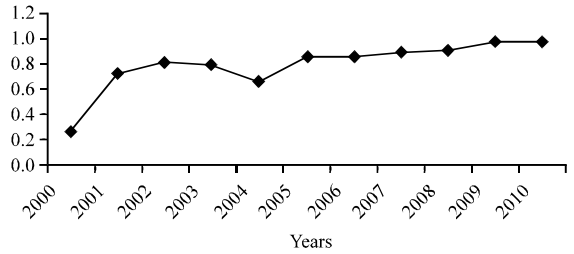

Fig. 4: ICT industry development potential measure results

ICT industry development potential measure results, show that the development trend of the most stable performance, 2003, 2004 appeared certain declines, from the actual data can see, R and D funds strength during this period appear a modest decline, so the ICT industry overall development trend pull down. R and D funds strength is the main reason of the decline. sales revenue growth rate decline, in the face of the lower income, some of the ICT enterprise can only through the corresponding to reduce R and D investment to ensure that income.

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