

## A Development Strategy and Management Model of Telecom Enterprises against the background of Industry Convergence

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**Abstract** — The paper deals with the development strategy and management model of telecom enterprises against a background of industry convergence. The least square method is employed to improve the algorithm for the model. We compare different algorithms and discuss the best way to use the least square method for curve fitting in the development strategy and management model of telecom enterprises. The results confirmed that the development strategy and management model was more accurate and reliable by using the least square method.

**Keywords** - *least square method; development strategy; management model; telecom enterprises*

### I. INTRODUCTION

Telecommunications refers to the information transmission and communication by virtue of wire, wireless or optical system. Advanced electronic communication network is one of the essential parts contributing to the country's development and comprehensive strength. History shows that the rising of big power has closely connected with the rising of the development of national telecommunication.

The U.S. government which paid much attention in the development of telecom enterprises made use of the UN multilateral mechanisms to realize its goal. On one hand, the government put the International Telecommunication Union into the United Nation's system, which can help him to influence the making of the international rules in the future; on the other hand, however, the U.S. proposed "Free Flow of Information" principle and wrote it in the UN treaty to guarantee the open market for American communication company in the long run. Reviewing the ways that the U.S. government employs to struggle for the control of international communication from 1870s to the end of world war II, a conclusion can be made as follows: the public-private partnerships (PPPs) is a key to the success of the U.S. realization of dominating international communication. While in the PPPs, the government plays facilitate but vital role. From the China's perspective, the practice of the U.S. government provides a valuable lesson for those companies who want to expand their business abroad.

As one significant element of modern telecommunication regulations, universal service plays an important role in guaranteeing the basic human rights, promoting the development of economy and enhancing the social welfare. Considering all these goals, the theory, policy and practice of universe are the common research themes of academic members, regulators and the carriers. An econometric model of main telecommunication indicators and social welfare provides evidence of the above judgment. Thus, making the universal service fund into the frame of public expenditure

and considering the impacts that all sorts of public expenditure, it may have impact on the farmer's annual mean net income and may help regulator optimize the priority of the universal service among all public policy goals.

At the same time of the change of the daily life by the traditional telecom services, the maturity and extension of the 4G service makes the telecommunications industry enter a breakthrough period. With the improvement of the network environment and the industrial chain's following of the relative implementation techniques, various types of telecommunications services bring a new life into people's lives. Meanwhile, with the promotion of these services and process of revitalization, it also plays an increasingly important role in the regional economic development and social life.

Li's [1] work is carried out major based on the current classification of the telecom industry and the business actual situation development of each class. In accordance with the requirements of the product diffusion and regional development, they will get the definition of new telecommunications business and take the international comparison of the new telecommunications business. According to the telecom business volume in all provinces, the proportion of the main business income and the regional telecommunications industry location quotient, this paper will determine the regional level of development of telecommunication development. Based on the regional survey data of VOIP and mobile phone based payment services, Lin's paper [2] obtains the basic survey information and classifies the main factors through the reliability analysis, the mean analysis and factor analysis, then by hypothesis testing and the regional differences mean results we will get the regional characters. Based on the result of the factor analysis, they take the area classified mean results of different factors to get the regional proliferation of types of business among effect of various factors.

## II. CURRENT STATUS OF TELECOM ENTERPRISES DEVELOPMENT AND MANAGEMENT IN CHINA

At continuously development, push world economy of everyone all already with is integrating into global integral whole to turn in. It is the telecommunication industry internationalization to the telecommunication industry and the telecommunication industry-based information industry is the material strength of the economic globalization. Telecommunication industry internationalization and economic globalization push mutually and speed economy of the integral whole turn progress. In the global economy, telecommunication industry and its more extensive information industry have already outstripped car industry to become the biggest industry in the world. The telecommunication industry already become the foundation industry of nation economy and lead industry and strategic industry first in our nation.

Looking back the world telecommunication development history you can discover, in 20th century early before first half hundred years, develop in the telecommunication technique and growth stage, though economy in all countries develop level not to exert a homology, all adopted on the telecommunication system nation monopoly or business enterprise monopoly mode. Because the monopoly system a little bit well adapted to telecommunication industry the technique during the period of development economic characteristics, the monopoly period of telecommunication industry is also the period that telecommunication industry in all countries acquires a little bit quickly a development. BE turned into a flourishing stage by the development stage along with the telecommunication industry, promoted under the telecommunication technique economic characteristic internality, the natural monopoly property of telecommunication industry gradually weakens and since the early part of 80's in 20th century, telecommunication industry in the world gets into competition ages from the monopoly. It is the United States, England and Japan etc. taken as the representative's nation which bring about the world telecommunication reform under the background of the technique economy characteristic change. Summarize, the total way of the world telecommunication reforms is to lead into the telecommunication competition and the telecommunication run by private capital turns and the concrete way has no exception that lead into a run by private capital competitor, dismantle the monopolizes or sale the telecommunication business enterprise state-owned ownership of a share until the complete run by private capital turns. In this process, the telecommunication market of the United States is to experience a monopoly (patent protection), competition monopoly (monopoly under the market mechanism), competition (administration monopoly) such an iterative process and the telecommunication market of England is a monopoly (state administration monopoly)-monopoly (by private capital)-monopoly competition (dismantle a cent to monopolize) -competition-monopolize (market creation of monopoly) such a process.

You can see from the development process of west developed national telecommunication market, though the

development of telecommunication market accompanies with permeating of administration strength, but has it the inside development track and promoted while being outside administration strength to agree with the development regulation of telecommunication industry internality, but when the outside administration strength repressed the exertion of the telecommunication industry inside regulation, so limited the development of telecommunication market, and finally needed the administration strength does an certain more positive. This is also the third world developing country blindly follows behind the concrete development mode of developed nation and then by all means is reasons of continuously tries mistake. The telecommunication market of China, at the past of 10 more years, experienced the stable period of high monopoly, lead to go into the competition period of uniting and lengthways dismantle the item monopoly, horizontal dismantle the unfair competition of cent of period, and finally headed for tacit understanding to match to strive for of steady period.

The purpose of Chinese telecommunication market administrators for the telecommunication development is clear, but means and result is confusion, although depend on administration strength constantly doing a various correction, currently industry formation consensus is that haven't formed an effective competition at our national telecommunication market. Our nation carries on the reform of surgical operation types to the Chinese telecommunication markets again after drawing lessons from experience precept that the developed national telecommunication market develops, but we still once walk over of curved road, which stirs up my desire of mightiness investigation.

In the thinking like this, inspired by economy development motive force, we have discovered that telecommunication technique economic characteristic still influence the telecommunication industry development process. The technique is the foundation that the market develops a form, or more norm ground say, the market is subjected to check and supervision of the technique factor. Thus, the technique constructed the encouraging and foundation of market development, the technique change comes to a decision an evolving of market structure method, as a result technique is the key to comprehend the market structure turns into. The influence of the technique upon the market results is beyond dispute, not the long-term results difference of the corresponding period market by the root under the influence of technique change degree, this also needs not to doubt.(have no information-based foundation is not likely to have an economic globalization of possibility). However, no any analysis frame is integrated into the direct factors which influence the market and the market structure, and regardless is an essentially lately classic and balanced theories or an industry histology(Industry organization) and so system school of thought cannot announce to public the function of technique to the evolve in the market structure. Its importance not only lies in we can obtains knowledge from the history, but also various continuous that the markets turn into link past and now and future at together. Now and future choices all come from past, and we just apprehend the inside decision factors of market structure evolves, and it is

important step and means to industry organization and market structure by integrate the technique to them.

III. THE FRAME OF LEAST SQUARE METHOD

Least square method is called the spirit of mathematical statistics; is one of the basic tools of data analysis in statistics. As an important method of functional approximation, least square method is widely used in physics, topography, numerical calculation, geodesy and other subjects. While, using least square method will refer to many function curves. If there is no good ability to identify each fitting curve, the fitting curve probably cannot represent the true nature of the sample in the research. As for this question, this thesis will explain in two parts. The first part discusses the applications of least square method in fitting of linear, fitting of curve and multi-variable linear fitting. The second one discusses some problems in the applications of least square method: losing necessary variables, the qualitative differences in explanatory variable, introducing unnecessary explanatory variable, linearization error in nonlinear equation, the wrong set of causal relationship, metering error and multi-linearity of explanatory variable.

In 1801, Giuseppe Piazzi [3-4], an Italian astronomer found the first asteroid Ceres through 40 days of following observation, because Ceres ran to the back of sun, Piazzi lost the location of Ceres. Later scientists used Piazzi's observation data to search for Ceres, but all of their calculated results could not find Ceres. Gauss, 24 years old, also calculated the orbit of Ceres. Heinrich Olga burns, an Austrian scientist found Ceres again with the help of the orbit of Ceres calculated by Gauss. In 1806, Legendre, a French scientist found "least square method" by himself, but he was not been known by the world. The least square method was published by Gauss's On the Revolutions in 1809. Because of the pioneer of least square method, Legendre and Gauss had conflicts. In 1829, Gauss gave a proof that optimization of least square method is better than other methods, so it is called Gauss - kraft theorem [5]. Least square method, or method of least square, is a Mathematical optimization technique. It seeks the best match function through minimizing the quadratic sum of error. With the help of least square method, we can get unknown data easily and the quadratic sum of error between this data and the real data can be the minimum. Least square method also can be used in curve fitting. Other optimization problem can be expressed by minimizing energy or maximizing least square method [6-8].

The relation between function  $y$  and independent variable  $x_1, x_2, \dots, x_s$  is  $y = f(x_1, x_2, x_3, \dots, x_s; a_1, a_2 \dots, a_s)$ . In the equation  $a_1, a_2 \dots, a_s$  are  $s+1$  parameters and should be determined. Through  $n$  experimental points  $(x_{i1}, \dots, x_{is}, y_i)$  ( $i = 1, 2, 3, \dots, n$ ), least square method will determine a group of  $(a_1, a_2 \dots, a_s)$  by which functional value

$y = f(x_1, x_2, x_3, \dots, x_s; a_1, a_2 \dots, a_s)$  will be get. And the deviation quadratic sum between this functional value and  $y_i$  is  $s(a_1, a_2 \dots, a_s) = \sum_{i=1}^n (y - y_i)^2$  which can get a minimum. When we design an experiment, in order to decrease random error, the multi-point measurement will be used which makes the number of equation is more than one of parameters that have not been given, that is  $n > s+1$ . Now the equation set is called contradiction equation set. With the least square method, statistical treatment is solved. Contradiction equation set will be changed into a normal equations system whose unknown is equal to equation. Then  $a_1, a_2 \dots, a_s$  will be worked out, and system of linear equations in Euclid space

$$\begin{cases} a_{11}x_1 + a_{12}x_2 + a_{13}x_3 + \dots + a_{1s}x_s - b_1 = 0 \\ a_{21}x_1 + a_{22}x_2 + a_{23}x_3 + \dots + a_{2s}x_s - b_2 = 0 \\ a_{31}x_1 + a_{32}x_2 + a_{33}x_3 + \dots + a_{3s}x_s - b_3 = 0 \\ \dots\dots\dots \\ a_{n1}x_1 + a_{n2}x_2 + a_{ns}x_3 + \dots + a_{ns}x_s - b_n = 0 \end{cases}$$

may have no solution. Any group of numbers  $x_1, x_2, x_3, \dots, x_s$  can make

$$y = \sum_{i=1}^n (a_{i1}x_{i1} + a_{i2}x_{i2} + a_{i3}x_{i3} + \dots + a_{is}x_{is} - b_i)^2 \quad (1)$$

The  $y$  is not equal to zero, so we try to find  $x_1^0, x_2^0, x_3^0, \dots, x_s^0$  that make (1) the minimum. Following are the detailed explanation with the concept of Euclid space.

$$A = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1s} \\ a_{21} & a_{22} & \dots & a_{2s} \\ \vdots & \vdots & & \vdots \\ a_{n1} & a_{n2} & \dots & a_{ns} \end{pmatrix}, B = \begin{pmatrix} b_1 \\ b_2 \\ \vdots \\ b_n \end{pmatrix}, X = \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{pmatrix}$$

$$Y = \begin{pmatrix} \sum_{j=1}^s a_{1j}x_j \\ \sum_{j=1}^s a_{2j}x_j \\ \vdots \\ \sum_{j=1}^s a_{nj}x_j \end{pmatrix} = AX \quad (2)$$

Considering the concept of distance, (1) is  $|Y-B|^2$ . Least square method is seeking  $x_1^0, x_2^0, x_3^0, \dots, x_s^0$  that minimizes the distance between Y and B. Because of (2), vector quantity Y is

$$Y = x_1 \begin{pmatrix} a_{11} \\ a_{21} \\ \vdots \\ a_{n1} \end{pmatrix} + x_2 \begin{pmatrix} a_{12} \\ a_{22} \\ \vdots \\ a_{n2} \end{pmatrix} + x_3 \begin{pmatrix} a_{13} \\ a_{23} \\ \vdots \\ a_{n3} \end{pmatrix} + \dots + x_s \begin{pmatrix} a_{1s} \\ a_{2s} \\ \vdots \\ a_{ns} \end{pmatrix}$$

If we mark each vector quantity  $a_1, a_2, a_3, \dots, a_s$ , their subspace is  $L(a_1, a_2, a_3, \dots, a_s)$  and  $Y$  is the vector quantity of  $L(a_1, a_2, a_3, \dots, a_s)$ . So the original question can be described as following: minimizing (1) with  $X$  means that finding a vector quantity  $Y$  from  $L(a_1, a_2, a_3, \dots, a_s)$ , which can minimize the distance between  $Y$  and  $B$ . With the conclusion above, supposing  $Y = AX = x_1 a_1 + x_2 a_2 + \dots + x_s a_s$  is a required vector quantity,  $C = B - Y = B - AX$  must perpendicular to subspace  $L(a_1, a_2, a_3, \dots, a_s)$ . So  $(C, a_1) = (C, a_2) = \dots = (C, a_s) = 0$  will happen. With operational rule of matrix multiplication, a series of equation above can be written in matrix multiplication like this:

$$a_1' C = 0, a_2' C = 0, \dots, a_{s1}' C = 0,$$

While  $a_1', a_2', \dots, a_s'$  just can be form matrix  $A'$  according to the form. So the series of equation above can be written together:  $A'(B - AX) = 0$  or  $A'AX = A'B$ .

This is the algebraic equation that is satisfied with least square solution and is a system of linear equations whose coefficient matrix is  $A'A$ . The system of linear equations whose constant term is  $A'B$  has solution all the time. Because as for any real matrix  $A$ ,  $A'AX = 0$  or  $A'X = 0$  has the same solution. Actually if  $X$  is the solution of system of linear equations  $(A'A)X = 0$ , and the left times  $X'$

$$0 = X'(A'A)X = X'A'A = (AX)'AX$$

$$\underline{Y=AX} \quad Y'Y = y_1^2 + y_2^2 + \dots + y_n^2 \Rightarrow y_1 = \dots = y_n = 0$$

that means  $AX=0$ . So we can see  $X$  is also the solution of equation set. On the contrary,  $X$  is the solution of  $AX = 0$  and the left times  $A'$   $A'AX = (A'A)X = 0$ . So  $X$  is also the solution of  $A'AX = 0$ ,  $AX = 0$  and  $A'AX = 0$  have the same solution.

Therefore,  $r(A'A) = r(A)$  also can be presented by linear  $A$  of the  $A'B$ . And  $A'B$  can be presented by linear

of  $A'A$ . So  $r(A'A) = r(A'B)$  provides  $A'AX = A'B$  a solution.

The simplest least square method is used to fit straight line. In linear fitting, the simplest and the most important is one through origin [8].

If  $y = bx$  is linear fitting,  $(x_i, y_i)$  is the array through  $n$  experiments. Least square method requires that

$$RSS = \sum_{i=1}^n (y_i - bx_i)^2 = \sum_{i=1}^n (y_i^2 + b^2 x_i^2 - 2y_i bx_i)$$

is a minimum. Besides

$$RSS = \sum_{i=1}^n (y_i - bx_i)^2 = \sum_{i=1}^n (y_i^2 + b^2 x_i^2 - 2y_i bx_i)$$

$$= \sum_{i=1}^n y_i^2 + \sum_{i=1}^n b^2 x_i^2 - \sum_{i=1}^n 2bx_i y_i$$

$$= \sum_{i=1}^n x_i^2 \left( b - \frac{\sum_{i=1}^n x_i y_i}{\sum_{i=1}^n x_i^2} \right)^2 + \sum_{i=1}^n y_i^2 \left( 1 - \frac{\left( \sum_{i=1}^n x_i y_i \right)^2}{\sum_{i=1}^n x_i^2 \sum_{i=1}^n y_i^2} \right)$$

Simple linear fitting is the simplest and the most important application of linear fitting. It is used in many fields such as biology, mathematics, economy, chemistry, physics, enterprise production, agricultural production, weather and so on. The following are the elaboration of problem analysis taking volume of high-added value product sales and development of telecom industry as example. There are nine groups of datum shown as Table 1.

In Figure 1, these points are almost near a straight line implying a linear relation between two variables which can be expressed as  $y = ax + b$ .

#### IV. DEVELOPMENT STRATEGY OF TELECOM ENTERPRISES BASED ON THE LEAST SQUARE METHOD

With the improvement of the network environment and the industrial chain's following of the relative implementation techniques, various types of telecommunications services bring a new life into people's lives. The technique is the foundation that the market develops a form, or more norm ground say, the market is subjected to check and supervision of the technique factor. Thus, the technique constructed the encouraging and foundation of market development, the technique change comes to a decision an evolving of market structure method, as a result technique is the key to comprehend the market structure turns into. The influence of the technique upon the market results is beyond dispute, not the long-term results difference of the corresponding period market by the root under the influence of technique change degree, this also

needs not to doubt.(have no information-based foundation is not likely to have an economic globalization of possibility).

The experiment chooses the 12 main quality indexes to measure the development level of telecom enterprises under the background of industry convergence. Following are the main quality index of the development strategy, the detailed

experiment data of the management model of telecom enterprises under the background of industry convergence based on the least square method is shown in the following Table 2.

TABLE I THE RELATIONSHIPS BETWEEN VOLUME OF HIGH-ADDED VALUE PRODUCT SALES AND DEVELOPMENT OF TELECOM INDUSTRY

No.	volume of high-added value product sales	development index of telecom industry
1	142.08	3.93
2	177.30	5.96
3	204.68	7.85
4	242.68	9.82
5	316.24	12.50
6	341.99	15.55
7	332.69	15.79
8	389.29	16.39
9	453.40	18.45

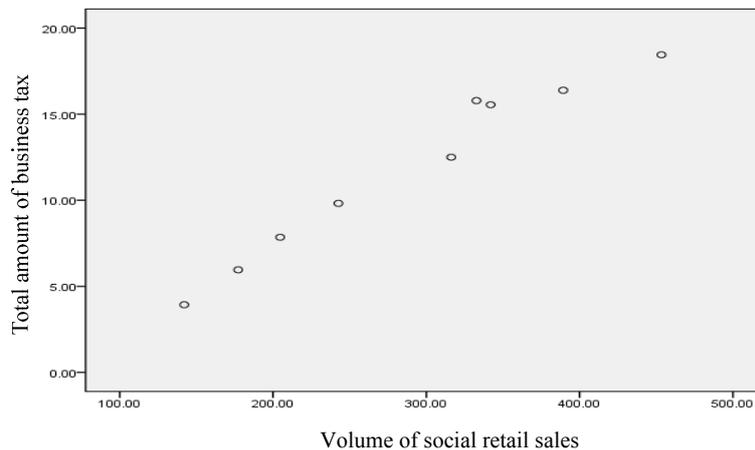


Figure 1. The coordinate of relationships between volume of high-added value product sales and development of telecom industry.

TABLE II THE CORRELATIVE RELATION BETWEEN TWO VARIABLES

Coefficient a						
Model		Nonstandardized Coefficient		standardized Coefficient		Significance
		B	standard error	Beta		
1	constant quantity	-2.258	1.108		-2.039	0.041
	volume of social retail sales	0.049	0.004	0.981	13.403	0.030
Dependent variable: he total amount of business tax						

By using least square method to fit line on the development strategy and management model of telecom enterprises under the background of industry convergence, the result of the development strategy and management

model is more accurate and reliable. The models show that the telecom companies can choose these two strategies: firstly the development strategy of non-boundary competition and integration for the boundary of telecom

industry becomes vague and the industrial value chains change from the traditional chain-shape to net shape; secondly the development strategy of differentiation for the nature of the natural monopoly of the telecom industry.

#### V. CONCLUSION

It is the telecommunication industry internationalization to the telecommunication industry and the telecommunication industry-based information industry is the material strength of the economic globalization. Telecommunication industry internationalization and economic globalization push mutually and speed economy of the integral whole turn progress. In the global economy, telecommunication industry and its more extensive information industry have already outstripped car industry to become the biggest industry in the world. To study on the development strategy and management model of telecom enterprises under the background of industry convergence, the least square method is used to improve the algorithm for the model. Least square method is one of the basic tools of data analysis, used in many subjects widely. The paper obtains the basic survey information and classifies the main factors through the reliability analysis, the mean analysis and factor analysis, then by hypothesis testing and the regional differences mean results we will get the regional characters. On this basis, the result showed that the development

strategy and management model was more accurate and reliable by using least square method.

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