Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2014, 6(6):119-124

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Go left or right-dilemma which China telecommunications industry reform are facing?

[1]Jing-song Liu*, [2]Qiang Yan, [1]Khizer Hayat Khuhawar and [1]Hua-yingShu

[1]Business School, Beijing University of Posts and Telecommunications (BUPT), P.R. China
[2]Business School, University of California, Los Angeles, USA

ABSTRACT

Since 1998, the telecommunications industry in China have undergone great growth. But behind those success, what are key drivers of this growth? Did the 3 significant reforms play positive roles on the growth? The paper researches the time sequence characteristics of total factor productivity(TFP) variation by Using Malmquist Index Method.And basing on 12 years successive dataduring 2001-2012, the paper analyzes the effects of 3 significant reforms during that periods. It finds technical progress is the main driver for this growth and 3 reforms result positive influence on productivity growth, but always delays. It also finds the productivity growth speed is slowing down and the "ceiling" appears. After analyzing the new treats from OTT business etc., the paperpresents further comments on the "dilemma" which China government are facing: go left to oligopoly or go right to privatization. The paper innovatively studies more than 10 years TFP growth of China telecommunications as whole and firstly research the effects of year 2008's reform. The paper also innovatively studies the development of new OTT business and firstly comments on that the new business from private sector already highly treats on traditional state own carriers and why hide and consider to go left?

Keywords: TFP; privatization; OTT; technical progress; technical efficiency; telecommunication reform

---

INTRODUCTION

Since the 1998, 3 strategic reforms,includingthe Spilt-off Program[1], the Price Cap Regulation and the "5 in 3" restructuring[2],China telecommunications industry achieved great success: lower tariffs, fast growth of users and business revenues, services innovation, and better network with most cutting edge technique. As of September 2013, the users of fix-line and mobile were 269 million and 1.207 billion respectively and the first half year of total business revenues reached RMB 564.2 billion[3]. However, behind the rapid development and progress is the tremendous capital and human input. What is the production efficiency in China's telecommunications industry? What are the effects of 3 significant reforms? Is there any roof ceiling in China telecommunications industry after more than 10 years fast growth?

Over recent years, some literatures have analyzed the TFP and effects of reform on the TFP in telecommunications sector. Eria[1] researched the TFP in the telecommunications industry of Uganda during 2001-2006 via the input Malmquist and pointed out that the main factor for promotion of TFP was technical progress but not technical efficiency. Basically, according to the current empirical research conclusions, competition and privatization have remarkable positive effects on the TFP in the telecommunications industry. Meanwhile, according to the research

---

[1] *the separation of government functions from enterprises and post and telecommunications split-off in 1998, thetelecommunications division and restructuring in 1999, the South-north Division Program in 2002*
[2] *5 carriers merged into 3 carriers: China Mobile, China Telecom and China Unicom in 2008*
[3] *http://www.cnii.com.cn/statistics/2013-10/22/content_1237318.htm*

conducted by Lam and Shiu[2] on the TFP by virtue of telecommunications development data from 105 countries during 1980-2006, those countries that have competition and privatization may better promote the growth of TFP in the industry than those countries without competition and privatization.

The effects of economic system reform in China's telecommunications industry have been preliminarily researched in some literature. Liu Jiejiao[3] conducted a comparative analysis based on the operation data about 20 years after the reform and opening-up in the telecommunications industry (1981-2000), and found that the economic efficiency in China's telecommunications industry was not high, that the economic benefits in the telecommunications industry before and after the reform were almost the same, and that the operation enterprises were in a meager-profit or even loss state, which triggered that discussion on whether the reform in China's telecommunications industry developed towards the reform expectation of efficiency improvement. Zhang Donghui[4] made use of DEA to analyze the data in China's telecommunications industry during 1999-2004 and found that the current governmental regulation in China did not have conspicuous effects on efficiency in the telecommunications industry. More literature, however, testifies that the de-monopolization reform has facilitated the technical progress, improved the TFP, lowered the service price, and enhanced the social benefits. Chen Jie [5] analyzed the reform effects in China's telecommunications industry during 1990-2003 via the Solow Model from the perspective of TFP and pointed out that reform facilitated the growth of TFP. Wang Yeping [6] reckoned the TFP in China's telecommunications industry during 1990-2006 via Solow residual value method and pointed out that the telecommunications reform had made great contribution to the growth rate of TFP.

The research conclusions in the above literature are not uniform, especially the reform effects on the TFP. In particular, the author has not found any literature that researches the telecommunications restructuring in 2008 in an overall and standard manner. For this purpose, the paper will reckon the variation of TFP in China's telecommunications industry during 2001-2012 by virtue of non-parameter Malmquist index method, further empirically analyze the effects of 3 significant reforms on the growth in the telecommunications industry based on the analysis of time sequence characteristics.

2. Analysis f TFP based on Malmquist Index

2.1 DEA based Malmquist index model

The data envelopment analysis (DEA) is an effective method to reckon the relative efficiency of several systems or departments (Decision-making Unit, DMU) with the same input and output. In essence, the mathematical programming model is adopted to estimate the effective production frontier based on a group of input and output observed values and then each DMU is compared with the frontier so as to measure the efficiency. DEA affirms the input-output combination of the DMU in the frontier most efficient and sets the efficiency index at 1; DEA affirms the DMU beyond the frontier inefficient and gives a relative efficiency index (0<index<1), namely, (pure) technical efficiency, based on the efficient point at the efficiency frontier as benchmark.

As the data processed by DEA is the cross-sectional data, the (pure) technical efficiency reckoned is to measure the distance from DMU actual production point to the production possibility frontier, and can not describe the frontier variation in the panel data, namely the productivity change caused by technical progress. However, Malmquist index solves this problem. Such index was originally put forward by Malmquist[7]. Caves[8] applied such index to the reckoning of productivity change for the first time. Afterwards, such index was combined with DEA theory established by Charnes[9] and widely applied in the productivity reckoning increasingly.

Fare etal [10] raised the output based Malmquist TFP change index (TFPch) model:

$$M_0(x_{t+1}, y_{t+1}, x_t, y_t) = \left[\frac{d_0^{\,t}(x_{t+1}, y_{t+1})}{d_0^{\,t}(x_t, y_t)} \times \frac{d_0^{\,t+1}(x_{t+1}, y_{t+1})}{d_0^{\,t+1}(x_t, y_t)} \right]^{1/2} \quad (1)$$

Where: (x_{t+1}, y_{t+1}) and (x_t, y_t) represent the input and output vector at t+1 and t respectively; $d_0^{\,t}$ and $d_0^{\,t+1}$ represent the distance function at t and t+1 when technology T^t acts as reference at t. If such index is greater than 1, the TFP grows from t to t+1.

Malmquist index in the above has good property and may be decomposed into the technical efficiency change index (efficiency change, Effch) and technical progress index (technical change, Techch) under the assumption of constant returns to scale. The decomposition process is as follows:

$$M_0(x_{t+1}, y_{t+1}, x_t, y_t) = \frac{d_0^{\,t+1}(x_{t+1}, y_{t+1})}{d_0^{\,t}(x_t, y_t)} \left[\frac{d_0^{\,t}(x_{t+1}, y_{t+1})}{d_0^{\,t+1}(x_{t+1}, y_{t+1})} \times \frac{d_0^{\,t}(x_t, y_t)}{d_0^{\,t+1}(x_t, y_t)} \right]^{1/2} \quad (2)$$

Eq2 is established based on the constant returns to scale (CRS) assumption. If the CRS assumption is loosened, the technical efficiency change index (Effch) in the above may be further decomposed into pure technical efficiency change index (pure efficiency change, Pech) and scale efficiency change index (scale efficiency change, Sech). Namely

$$Effch = \frac{d_0^{t+1}(x_{t+1}, y_{t+1})}{d_0^{t}(x_t, y_t)} = \frac{SE_0^{t+1}(x_{t+1}, y_{t+1})}{SE_0^{t}(x_t, y_t)} \times \frac{d_0^{t+1}(x_{t+1}, y_{t+1}|V)}{d_0^{t}(x_t, y_t|V)} \quad (3)$$

Thus:

$$M_0(x_{t+1}, y_{t+1}, x_t, y_t) = \text{TFPch} = \text{Techch} \times \text{Sech} \times \text{Pech} = \text{Techch} \times \text{Effch} \quad (4)$$

The technical efficiency is the product of pure technical efficiency and scale efficiency, and TFP (TFPch) is the product of technical efficiency and technical progress. Compared with the simple cross-sectional data DEA analysis, Malmquist index analysis strips the technical progress factor. Therefore, the pure technical efficiency of cross-sectional data includes technical progress and management. However, the pure technical efficiency in the Malmquist index analysis reflects the management, so the results are more precise.

2.2 Data description

The data in this paper is the balanced panel data of telecommunications industrial development in 31 provinces, municipalities and autonomous regions in mainland China during 2001-2012. The variable index in this paper is divided into two types, namely telecommunications output index and input index. These variables are described in detail as follows:

(1) Telecommunications output index: among the indexes to measure the output in the telecommunications industry, the total volume of telecommunications services and users are adopted for measurement in this paper so as to represent the economic and social benefits, and two patterns are designed for reckoning respectively. The unit of total volume of telecommunications services is RMB 100 million, the unit of telecommunications users is 10,000, and the telecommunications users are the sum of mobile and landline telephone users. Besides, the deflation is carried out based on the year-by-year telecommunications price index with the year 2000 as the constant price in the China Statistical Yearbook so as to ensure the index comparability.

(2) Telecommunications input index: the input index mainly includes capital input and labor input. The capital input not only includes telecommunications equipment input but also the raw material input. The major equipment in the telecommunications industry is local switch, long-distance telephone switch, and mobile telephone switch. However, there is no specific numerical value of equipment but only the switch capacity in the China Statistical Yearbook. Hence, the capacity of three switches is used in this paper to measure the equipment input. The unit of local switch is 10,000-channel, that of long-distance telephone switch is terminal and that of mobile telephone switch is 10,000-user. The raw material input is mainly measured by the length of long-distance cable and the unit is km. In the aspect of labor input, the telecommunications staff is adopted for measurement in this paper and the unit is 10,000 persons.

RESULTS AND DISCUSSION

3.1 Analysis of Empirical Results

In this paper, the TFP from 2001 to 2012 of two different kinds of output is calculated and decomposed. After that, the calculation results of 4 different periods are summarized to analyze the effects of China telecommunications industry reforms. Refer to Tables 3-1 to 3-2 for the results.

Table 3-1 Malmquist Productivity Indexes in China's Telecommunications Industry and Their Decomposition (2001-2012)

	Service Volume as output					Service Users as Output				
YEAR	EFFCH	TECHCH	PECH	SECH	TFPCH	EFFCH	TECHCH	PECH	SECH	TFPCH
2001-2002	1.117	1.069	1.108	1.008	1.194	1.056	1.108	1.028	1.027	1.171
2002-2003	1.064	0.901	1.062	1.002	0.959	1.011	0.964	1.019	0.992	0.975
2003-2004	0.939	1.213	0.943	0.995	1.138	1.016	1.012	1.012	1.004	1.028
2004-2005	1.047	1.058	1.036	1.01	1.108	1.012	1.008	1.002	1.01	1.02
2005-2006	0.967	1.136	0.967	1	1.098	0.979	1.005	0.976	1.003	0.983
2006-2007	1.083	0.993	1.078	1.005	1.076	1.01	0.937	1.011	1	0.947
2007-2008	0.947	1.107	0.954	0.992	1.048	0.989	0.979	0.993	0.996	0.969
2008-2009	1.039	1.013	1.037	1.002	1.052	1.001	1.013	1.005	0.996	1.014
2009-2010	1.015	1.057	1	1.015	1.073	0.993	1.087	0.99	1.003	1.079
2010-2011	1.001	1.060	0.997	1.004	1.061	0.989	1.083	0.982	1.007	1.070
2011-2012	0.993	1.058	0.989	1.004	1.051	0.933	1.079	0.968	0.963	1.007
AVERAGE	1.019	1.060	1.016	1.003	1.078	0.999	1.025	0.999	1.000	1.024

According to Table 3-1, the average growth rate of TFP in China telecommunications industry with the telecommunications service volume as output during 2001-2012 was 7.8%. This is the result of technical progress and

efficiency improvement in the telecommunications industry. The average growth rate of technical progress is 6.0%, the average growth rate of technical efficiency is 1.9%, the average growth rate of scale efficiency is 0.3% (the slight economies of scale), and the average growth rate of pure technical efficiency is 1.6%. It is clear that the pure technical efficiency is the major reason for technical efficiency improvement. Generally speaking, the technical progress is the major driving force for TFP growth in China's telecommunications industry, the technical efficiency plays an important role in facilitating the TFP growth, and development in the telecommunications industry presents the characteristic of economies of scale overall.However, the TFP data of 2010-2012 shows the acceleration speed slowing down, from 7.3% to 6.1%, then to 5.1%. This is the hint that shows the growth of China telecommunication industry will reach the ceiling in the near future.

According to the decomposition of growth rate of TFP in China's telecommunications industry with the telecommunications users as output, except that the average growth rate of scale efficiency is the same as that with the telecommunications service volume as output, other average growth rate is less than the corresponding average growth rate with the telecommunications service volume as output, the technical progress is the direct driving force for TFP growth.

In the aspect of the change trend, the change of TFP, technical efficiency and technical progress in China's telecommunications industry with the telecommunications service volume as output presents great differences during the research period. During different research periods, the major driving force for TFP growth is different. For instance, the improvement of technical efficiency was the major driving force for the TFP growth while the technical progress restrained the TFP growth to some extent during 2002-2003. The technical progress became the root cause for the TFP growth while the technical efficiency hindered the TFP growth to some extent during 2003-2004. The technical progress and technical efficiency jointly facilitated the TFP growth during 2001-2002 and 2004-2005. An obvious alternate phenomenon existed in the composition of TFP variation in the telecommunications industry. In other words, the technical efficiency growth and the technical progress improvement presented an obvious negative correlation. If the technical progress was improved, the technical efficiency would be reduced accordingly, viceversa. It shows that technical progress moves the production frontier upward while the technical efficiency is reduced due to failure of mastering advanced technology by the managers. In the aspect of the composition of technical efficiency, an obvious negative correlation exists between the pure technical efficiency & scale efficiency and technical progress while an obvious positive correlation exists between technical efficiency and scale efficiency. The change difference of TFP, technical efficiency and technical progress in China's telecommunications industry with the telecommunications users as output during the research period is also great. The major driving force for the TFP growth is different during different periods. For instance, the TFP growth during 2002-2003 and 2006 -2007 was mainly caused by the promotion of technical efficiency while the technical progress restrained the growth to some extent. The TFP growth during 2005-2006 and 2009-2012 was mainly caused by the growth of technical progress while the technical efficiency restrained the growth to some extent. The efficiency growth rate during 2007-2008 was negative, the promotion of technical progress and technical efficiency in other years jointly facilitated the TFP promotion, and the technical progress was decisive to the TFP growth. Besides, the technical progress and technical efficiency were reduced during several years after the reform measures were taken, such as 2002-2003 after the division and 2006-2008 of price-cap implementation. In other years, the technical progress was promoted to some extent, and the growth rates of technical progress, technical efficiency, pure technical efficiency, and scale efficiency presented the positive correlation.

Table 3-2 Malmquist Productivity Indexes at Different Growth Stages and Their Decomposition

YEAR	Service Volume as output					Service Users as Output				
	EFFCH	TECHCH	PECH	SECH	TFPCH	EFFCH	TECHCH	PECH	SECH	TFPCH
2001-2002	1.117	1.069	1.108	1.008	1.194	1.056	1.108	1.028	1.027	1.171
2002-2005	1.017	1.057	1.014	1.002	1.068	1.013	0.995	1.011	1.002	1.008
2005-2008	0.999	1.079	1	0.999	1.074	0.993	0.974	0.993	1	0.966
2008-2010	1.027	1.081	1.019	1.009	1.11	0.997	1.05	0.998	1	1.047
2010-2012	0.997	1.059	0.993	1.004	1.056	0.961	1.081	0.975	0.985	1.039

The growth in China's telecommunications industry in the past 12 years may be divided into four stages and refer to Table 3-2 for details. At the first stage (2001-2002), after the "Spilt-off" the competition in the telecommunications industry intensified, the TFP was improved overall, the TFP average growth rate with the telecommunications service volume as output was 19.4%, the technical efficiency increased by 11.7%, the technical progress promoted by 6.9%, the technical efficiency promotion mainly due to the promotion of pure technical efficiency was 10.8%, and the scale efficiency also made 0.8% contribution. Meanwhile, the TFP with the users as output also promoted by 17.1%, and the technical progress made the largest contribution (10.8%). This period witnessed the rapid development in China's telecommunications industry and was a golden period . At the second stage (2002-2005), the South-north Division Program for China's telecommunications industry was formulated in 2002, a new “5+1” pattern was formed after the

division and restructuring, but the "monopoly pattern" was not broken. As a result, the efficiency growth was reduced to some extent. The TFP with the telecommunications service volume as output increased by 6.8%, which was due to the 5.7% promotion of technical progress; the TFP with the users as output increased by 0.8%, which was due to the 1.4% promotion of technical efficiency, but the technical progress restrained the growth to some extent. At the third stage (2005-2008), after the implementation of price-cap regulation in China's telecommunications industry, the competition in the telecommunications industry intensified, and the productivity changed to some extent. The TFP growth rate with the telecommunications service volume as output was 7.4%, which was due to the 7.9% promotion of technical progress, but the growth rate of slight technical inefficiency and scale inefficiency was about -0.1%; the TFP growth rate with the telecommunications users as output was -3.4%, in which -2.6% was mainly caused by the recession of growth rate of technical progress; the growth rate of technical efficiency and pure technical efficiency was -0.7% either. The main reasons: with the implementation of price-cap regulation, the telecommunications carriers had better independent pricing right, the competition was fierce, and the mobile telephone started to replace the landline telephone. The growth rate of mobile telephone outnumbered the landline telephone in 2007 for the first time and the growth rate of landline telephone users was negative for the first time. The common voice communication requirement was saturated but the cultivation of users having requirements for new businesses including mobile internet was insufficient, which led to the decrease of TFP with the users as output to some extent. At the fourth stage (2008-2012), after the telecommunications restructuring in 2008, China Mobile, China Telecom and China Unicom became the all-business comprehensive telecommunications carriers, the competition in the telecommunications industry was fiercer and the productivity was overall promoted due to competition. The TFP with the telecommunications service volume as output promoted by 11%(2008-2010) and 5.6%(2010-2012), the growth rate of technical progress was 8.1%(2008-2010) and 5.9%(2010-2012), and the growth rate of technical efficiency was 2.7%(2008-2010); the TFP growth with the users as output was 4.7%(2008-2010) and 3.9% (2010-2012), which was mainly caused by technical progress. Due to the fierce competition for users, the pure technical efficiency decreased by -0.2% and -0.5% respectively. According to the above four stages, it is clear that the productivity in China's telecommunications industry is shifted from rapid growth to stable promotion due to the rapid technical progress and a series of reform measures in the past years in the telecommunications industry. The scale efficiency increases slowly, and the pure technical efficiency and technical progress have made great contribution to the productivity.

3.2 Discussion on the Impact from OTT business

Remarked by the innovation of "Wechat", which was debuted by Tencent company in 2011, the OTT[4] business flourished in the past 3 years. From table 3-3, it shows "Wechat" have had clear impact on carrier's users and business revenue. The active mobile users after using "Wechat" decreased roaming call by 21% and SMS by 14% monthly. And more significant hint is that it is only a snapshot of new business from private company. More value added service innovated by private sectors, such us mobile payment, mobile medical, internet finance etc., will have greater threats to traditional carriers in future.

Table 3-3 Impact Analysis from OTT Business by Service Volume and Users ("Wechat" as an example)

	Service Volume Comparison				"Wechat"UsersGrowth,Tencent	
Service Type	before "Wechat"	After"Wechat"	Growth Rate	Date	Amount(millions)	Growth Rate
MOU of Outgoing Calls	377.2	363.2	-4%	Jan, 2011	0	
MOU of Incoming Calls	392.8	371.1	-6%	Mar. 2012	100	
MOU of Longdistance Calls	128.7	120.3	-7%	Sept. 2012	200	100%
MOU of Local Calls	641.3	614	-4%	Jan. 2013	300	50%
MOU of Roaming Calls	48.6	38.3	-21%	Jul. 2013	400	33%
MOU of Non Roaming Calls	721.4	696	-4%	Oct. 2013	600	50%
Short Message	193.5	166.2	-14%	Users Growth	595000 per day	

Source: Provincial internal report from China Telecom, China Mobile and China Unicom;

From 2011-2012 data in table 3-1, we also can see the clues of the new business impact. The TFP growth slowed down from the peak of 13.8% to 5.1%, the technical progress decreased from peak of 21.3% to 5.8%, and with the scale efficiency remain stable, the pure technical efficiency was negative by -1.1%. These are evidences which shows that china telecommunication is approaching the ceiling and walking to the crossroad. Small scale reforms in the future can be predicted that it will have very tiny effects on the growth for the entire industry. China government will face the dilemma: go left to oligopoly, or go right to privatization?

[4] *OTT: Over The Top business. For example, "Wechat" from Tencent Company.*

CONCLUSION

China's telecommunications industry has undergone fast TFP growth, which was the result of combined action of technical progress and efficiency improvement, but mainly by technical progress.In the aspect of telecommunications reforms course, the productivity in China's telecommunications industry is shifted from rapid growth to stable promotion due to the rapid technical progress, which is stimulated and liberated by a series of reforms in the past years, but the effects is always delay.

With the slowing down and "ceiling" appears after 2011 from TFP data angel, there are many arguments on future reforms, especially on privatization reform, which is very hot now in many state owned company in China. Very clearly, the TFP growth data in the paper shows that slowing down is inevitable. And the new OTT business from private sectors already highly treats business of the traditional state owned carriers. Privatization may be considered as one of solutions. Kwoka[11] researched the effects of privatization on the TFP of dominant telecommunications carriers in UK. According to the results, since the 1980s, the company privatization contributed 25% growth in the TFP of BT. Actually, China government also made progress and tentative reform. China MII issued 11 licenses of Virtual Network Operator(VNO)to private company in December 2013. Sinopec announced the joint venture proposal with private company in February 2014. Sinopec was allowed to sell shares under 30% to social capital in exploring, conduit and Sales&marketing sectors. Let market answer the questions of "social benefit", "common service" and "social welfare" maybe good choice.

Acknowledgment
The helpful comments of the editor and anonymous referees are gratefully acknowledged. Even though the work was not funded by any projects, but this work was supported by many staffs in Business School of University of California, Los Angeles and Business School of Beijing University of Posts and Telecommunications (BUPT).

REFERENCES

[1] Hisali Erica, Yawe B. *Telecommunications Policy*, **2011**, 35(1): 12-19
[2] Lam P L, Shiu A. *Telecommunications Policy*, **2010**, 34(4): 185-199
[3] Liu Jiejiao, Hao Chongxi. *Fujian Forum*[J]. **2002**, 13(2): 12-18
[4] Zhang Donghui, Chu Jiayin. *Fiscal Research*,**2008**, 16(4): 52-55
[5] Chen Jie, Lu Tingjie. *BUPT Journal*. **2006**, 6(2): 37-40
[6] Wang Yeping. *Social Science Forum*[J]. **2009** (12): 91-96
[7] Malmquist S. *Trabajos de Estadistica y de Investigacion Operativa*, **1953**, 4(2): 209-242.
[8] Caves D W, Christensen L R, Diewert W E. *Journal of the Econometric Society*, **1982**: 1393-1414
[9] Charnes A, Cooper W W, Rhodes E. *European journal of operational research*, **1978**, 2(6): 429-444.
[10] Fare R, Grosskopf S, Lovell C A K. Production frontiers[M]. Cambridge University Press, **1994**:65-259.
[11] Kwoka Jr J E. *Review of Industrial Organization*, **1993**, 8(1): 49-61.