Research on Fourth Generation 4G Mobile Communication Industry Spillover Effect

Empirical Case Study of Beijing

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Abstract—Along with the development of information technology, the impact of information on global economic and social has become more and more profound. Mobile communication (4G) industry has brought huge spillovers to the economic and social benefits. This paper combines theoretical analysis and empirical research to analyze it's spillovers effect. It uses the input-output model to carry an empirical study of mobile communications (4G) spillovers effect. At last, from the perspective of both qualitative and quantitative, it analyzes the contribution of mobile communication (4G) industry to the economy and society.

Keywords- mobile communications (4G); spillovers effect; empirical research

I. INTRODUCTION

With the accelerating informatization all around the world, the application of information technology not only promote the optimal allocation of global resources and innovation of development model, but also profoundly affect the politics, economy and culture of society. National Twelfth Five-Year Development Plan proposes to speed up the upgrading of industrial restructuring to cope with the increasingly fierce international competition, which presents new challenges to industrial technological innovation. Information and communication industry as a support, high permeability basic industries, the development of the whole economy and society has a considerable contribution rate. As a supportive and high permeability basic industry, telecommunication industry makes a considerable contribution to the development of the whole economy and society.

4G technology is an important component of the next generation of information technology, which has become a new growth point of world economy. The world's major telecom operators will or have started to deploy 4G commercial network. By 2015, the global industry scale of communication, including 4G, will reach 1.5 billion Yuan. China has the largest number of the world's mobile communications market is one of the communications and network equipment manufacturing base of the world's largest, China's leading TD-LTE standard ITU organizations recognized as one of the two major international technical standards for 4G mainstream. China is the mobile communication market with largest number of people and is also one of the largest communication and network equipment manufacturing base of the world. TD-LTE standard, led by China, is recognized by ITU organizations as one of the two major international technical standards for 4G. Currently, mobile communication (4G) industry is still at its embryonic phase, there is a hope that China will occupy the commanding heights of global technology in the 4G era. Mobile Communication (4G) industry can provide comprehensive information services, and play a significant role in promoting information technology development of the country. Especially, mobile communication industry is an important driving force for the rise of China's information industry, its spillover effects on economic development of the whole society is particularly evident.

Spillover effects are externalities of economic activity or processes that affect those who are not directly involved. Kenneth Joseph Arrow [1] first explained the role of external spillover effects on economic growth. He believes that new investment has spillover effects, not only the investing firms can increase productivity through the accumulation of experience in production, other manufacturers can also learn that experience to improve productivity.

There are many literatures research Spillover Effect home and abroad, many of which are doing empirical research using statistical methods. Greenstein et al [2] use Cobb-Douglas production function to measure the impact of fiber-optic cable investment on local economic activity. Roller et al [3] use 21 OECD countries data of 20 years to build systematic structural equations, analyze the impact of the need of telecommunications infrastructure on economic development.

Jianqiu Zeng [4] (1997) used input-output model of telecommunications industry, came to a conclusion that the relationship between telecommunications and national economy and people's lives are getting closer, and telecommunication has brought enormous social and economic benefits. Xiaoli Zhao [5] (2007) applied Distributed Lag Models, regression model with dummy variables estimated the multiplier effect, spillover effects and diffusion effects on the economic development of telecommunication development. Combining econometric method and input-output technology, Wenqing Pan [6] (2011) construct variables measured inter-industry technology spillover, and integrate them into industrial production function.

This paper combines theoretical analysis and empirical research. First, it explains stimulating effect of mobile communication (4G) industry on the entire economy and society, taking Beijing as an example. Then it uses the input-output model to carry an empirical study of mobile communications (4G) spillovers effect. At last, from the perspective of both qualitative and quantitative, it analyzes the contribution of mobile communication (4G) industry to the economy and society.

II. MOBILE COMMUNICATION (4G) INDUSTRY WILL DRAMATICALLY PROMOTE THE ECONOMIC DEVELOPMENT

At present, the world is accelerating information technology, industrial pattern after the global financial crisis also began a new round of restructuring, and many countries have increased investment in emerging strategic industries. Developed countries have taken advantage of technology to open up a new field of sunrise industries. Emerging market countries have gradually adjusted over the previous reliance on traditional industries and the development model of the simple pursuit of GDP and enhance support efforts in low-carbon economy, green economy, digital economy these areas of fashion [7]. Application of information technology has promoted the optimal allocation of global resources and innovative development model. The impact of information technology on the political, economic, social and cultural has become greater. Competition around the new generation of mobile communications technology and its applications has become increasingly fierce. During the construction of mobile communication (4G) networks, the government’s support has become the most important driving force to deploy LTE network, especially Japan, whose government have the most obvious influence on the communication industry investment in fixed assets. The main reason is 4G construction industry can indeed become a catalyst to stimulate economic development.

A. Promote the transformation of industrial structure

Since the 1990s, with the information technology innovation and the wide spread of information networks, the impact of informatization on the development of the global economy and society is increasingly profound and it gradually penetrated into every aspect of social life. The industry characteristics of high-speed mobility, broadband and multimedia of mobile communication (4G), and the deepen fusion with mobile communication and information networks, profoundly influence the world economy and cultural exchange, human social association and life-style, as well as time and space channels people exchange information and share knowledge.

Construction and development of the 4G network will first benefit the global communications industry and its related upstream and downstream industry chain significantly. Communication network planning and consulting, communication equipment manufacturers, network operation & maintenance and engineering services, transmission equipment manufactures and other related industries will get a lot of orders at first in the planning stage and network construction period. With the maturity of the network, mobile terminal, content providers and operators will also get opportunities. Development of 4G networks construction will greatly promote the new video applications development, which make network operators providers transform to "experience providers".

B. Enhance the quality of life

The development of information networks not only promote the transformation of economic structure, but also significantly reduce the cost of information communication and enhance the efficiency of communication between each other. In the global information industry digitization process, more and more content information is in digital form. Among of the form of future consumption, the information consumption will occupy an increasingly important position. Mobile Communications (4G) will greatly promote the development of the demand of information consumption and growing size of entire industry.

The launch of 4G network has built a platform for innovation. Based on this platform, innovations improve production efficiency and people's quality of life will emerge accordingly. Its development will pave the way for future development of other new technologies. Research of 4G network application will be carried out in fields including public safety, education, energy, health, transportation, and economic, which make real sense.

C. Promote investment in industry chain

The promotion to investment of the industry chain by mobile communications (4G) industries is reflected in every link of the industry chain, each link consists of numbers of enterprises, and operating scope of each enterprise covers more than one link. For example, corporations of network layer contain Huawei, ZTE, Ericsson, Putian, Datang, COMBA, etc. Work operations of Huawei, ZTE are involved in all the four layers and corporations related to two or three layers are more common [8]. Taking into account the fact that statistics on capital expenditure and disclosure of these enterprises mostly emphasize the total amount, which covers various aspects of the fixed network upgrades, broadband, housing construction, mobile communication services, etc.,[9] In this part, only data of China Mobile and China Unicom's are analyzed.

According to China Mobile's mobile services (including 3G) total investment from 2006 to 2012, it can be found that the total investment reveal a pattern of rapid growth followed with slow decline until stability. Since 3G communication industry finish trial test in 2008, and then it was formally put into large-scale commercial, gradually

replacing 2G, became a power source and core strength of the mobile communication industry.

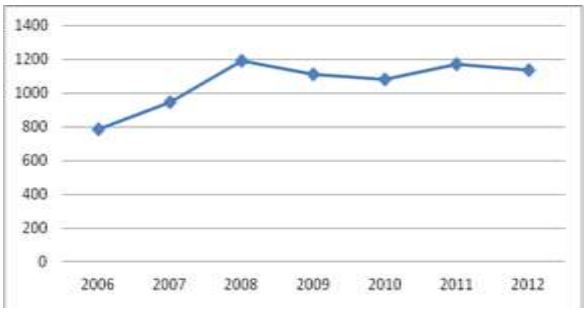

Figure 1. China Mobile capital expenditure amount curve from 2006 to 2012 Source: CCID Consulting 2013, 10

Consider to the development of 3G mobile industry, the projected course of development of 4G is: 2011-2013 is preparation phase, 2014-2016 will be start-up phase, 2016-2018 will be development phase, 2018-2020 will be mature phase, and 2020 will slide to recession. By 2016-2020, it is speculated that the boost to the investment by 4G mobile industry will be at least 200 billion Yuan.

III. Empirical Analysis of Spillover Effect in Mobile Communications (4G) Industry - A Case Study of Beijing Social Development Data

As same as 3G industry, mobile communication (4G) industry belongs to technological innovation. China is still in the preparation period of mobile communications (4G) industries, for which 4G research can be referred to 3G experience, which is, assuming the industry change from 4G to 3G will be similar to the change from 3G to 2G.

From the perspective of development cycle of 3G mobile communications industry, 2000-2005 was preparation phase, 2006-2008 was start-up phase, 2008-2010 was development phase, and 2010-2012 was mature phase, then came with recession phase. In analogy to 3G industry development cycle, considering the similarity between 4G and 3G, it can forecast that 2014-2016 will be start-up phase, 2016-2018 will be development phase, 2018-2020 will be mature phase, and by 2020 it will slide to recession. Based on the life cycle of the mobile communications (4G) industry, the stimulating effect to Beijing will be discussed in economic and social perspectives.

A. Methodology and Method

According to the input-output theory, gross regional production is closely related to input production factors [10]. The study refers to Hui Liu's practice [11], divide the production factors into two kinds of material consumption and information consumption, then build the production function.

$$G_t = KM_t^{\alpha} I_t^{\beta} \qquad (1)$$

of which, G_t is the GDP of t year, M_t is the material consumption of t year, It is information consumption of t year. K、α、β are parameters. Logarithm on both sides of this formula, get:

$$\ln G_t = \ln K + \alpha \ln M_t + \beta \ln I_t \quad (2)$$

In this model, material consumption uses numbers of asset investment, information consumption use numbers of the business volume of post and telecommunications. Through the model, Formula 3-4 can calculate marginal contribution to GDP for each 100 million Yuan investment in fixed assets / information investments. For further study of the contribution to GDP by mobile communications (4G), it should first calculate its stimulating effect on the business volume of post and telecommunication, and then multiplied by the marginal contribution of information consumption to obtain the total contribution. When calculating the stimulating effect of mobile communication (4G) on the business volume of post and telecommunication of Beijing, it's recommended to use autoregression model with inflection point (3) or regression models with inflection point (4) to analysis.

$$y_t = c + \sum_{i=1}^{p} \left(\varphi_i + d_i \varphi_i'\right) y_{t-p} + \varepsilon_t \qquad (3)$$

$$y = c + \left(\varphi_0 + d_0 \varphi'\right) t + \sum_{i=1}^{q} \left(\varphi_i + d_i \varphi_i'\right) x_i + \varepsilon \quad (4)$$

Of which, y_t and y_{t-p} are dummy variables that present the business volume of post and telecommunication of Beijing at time t and t-p (p<t) respectively. When t >2005, y=1, or y=0, x_i presents the i_{th} explanatory variable (i = 1,⋯,q), t presents the year, Φ presents the regression coefficient

B. Data requirement

This part need to base on data of 2G and 3G, analyze and predict the stimulating effect of mobile communication (4G) industry to business volume of Post and Telecommunication and regional economy (GDP). In order to get more accurate forecasting results, it must first ensure the consistency of statistical data. So the statistical indicators are selected from 2004 to 2011, which the specific indicators are: Beijing telecom business volume and the Beijing fixed investment value.

C. Measurement of stimulating effect on the GDP by mobile communication (4G) industry in Beijing

1) Marginal contribution of Beijing's GDP by information consumption

According to (2), calculate the least squares estimation value for each parameter using data from 2004-2010, then get the final model:

$$G_t = 5.11 \times M_t^{-0.0006} I_t^{0.6242} \qquad (5)$$

Which means, for each 1 billion investment in fixed assets, the marginal contribution to GDP is only exp(-0.0006) = 0.9994 billion Yuan, for each 1 billion investment in information, the marginal contribution to GDP was 1.87 billion Yuan.

2) Stimulating effect of mobile communication (4G) industry to Beijing's GDP

The stimulating effect of mobile Communications (4G) to Beijing information consummation embodies specifically on the increment of telecommunications services. By variable selection and model selection, (4) ultimately is used for analysis. Calculate the least squares estimation value for each parameter using data from 2004-2010, then get the final model:

$$y = \left(178.79 - 492.64d\right) + \left(45.94 + 109.08d\right) t + \varepsilon \quad (6)$$

It reveals that since 3G mobile communications industry in 2006 entered into start-up phase, Beijing telecom business volume increased 10.908 billion on average every year. In analogy to 3G industry development law, it can be predicted that Beijing communications industry (4G) from 2014 will enter into start-up phase. By 2020, telecom business volume will increased nearly 300 billion Yuan, multiplied by the marginal contribution of information consumption, it can be predicted that the stimulating effect of Beijing mobile communication (4G) industry to GDP will be nearly 600 billion Yuan.

IV. CONCLUSIONS

From the above, it indicates that the mobile communications industry innovation has played a significant role in promoting Beijing's economic development, embodied in:

A. Mobile Communications (4G) industry start a new growth source

All along, the telecom industry occupied a dominant position in the post and telecommunication industry, the estimated data model can infer that the contribution to post and telecommunication industry growth rate by telecommunication industry fluctuated between 2005 and 2010. From 2008, it increased significantly from 59.02 to 85.80. This is mainly because mobile communications (3G) industry entered into development stage in 2008, which brought new economic growth point to telecommunication industry. By analogy, mobile communication (4G) industry will enter into development phase in 2016, which will substantially stimulate the development of telecommunication industry and make contribution to the high commercial value return of communication industry.

B. Mobile Communications (4G) promote the industrial upgrading of tertiary industrial structure

Although the telecommunication industry is not a large proportion of tertiary industrial industry, the contribution to the tertiary industry growth has reached 10% or more. With the 3G mobile industry had entered to mature stage in 2010, the effect of telecommunications industry to tertiary industrial structure can’t be ignored more than ever. Combined with the analysis of stimulating effect on the industry chain by 4G mobile industry, it can speculated that, the development of mobile communications (4G) industry will play a greater role in the tertiary industry structure upgrading.

C. Marginal effect of information consumption is more significant

By building production function model and analyzing, it indicates that for each 1 billion investment in fixed assets, the marginal contribution to GDP is only exp (-0.0006) = 0.9994 billion Yuan; for each 1 billion investment in information, the marginal contribution to GDP was 1.87 billion Yuan.

D. Mobile communications (4G) industry will stimulate over GDP of 600 billion Yuan in the future

By construction of the linear regression model with inflection point, it shows that since 3G mobile communications industry in 2006 entered into start-up phase, Beijing telecom business volume increased 10.908 billion on average every year. In analogy to 3G industry development law, it can be predicted that Beijing communications industry (4G) from 2014 will enter into start-up phase. By 2020, telecom business volume will increased nearly 300 billion Yuan and the stimulating effect of Beijing mobile communication (4G) industry to GDP will be nearly 600 billion Yuan.

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