Volume-5, Issue-3, March - 2016 • ISSN No 2277 - 8160

IF : 3.62 | IC Value 70.36

Research Paper

Economics

Impact of China's Fdi on Technological Progress And Economic Growth -- Based on Malmquist Productivity Growth Index Analysis

Xu, Lan

Business School, East China University of Science and Technology, 130 Meilong Road, Shanghai 200237, China.

ABSTRACT

This paper analyzes China's economic productivity growth and technological progress in recent 10 years for 30 provinces and directly affiliated cities using the Malmquist productivity growth index principle, and it also provides empirical analysis according to the total factor productivity accounting method, on the effect of economic growth and technological spillover. It is found that China has attracted a significant amount of high technologies through foreign direct investment, which plays a great role in promoting the development of China's economy. On the other side, a large-scale of direct investment overseas of Chinese enterprises is still in its infancy belonging to the second phase according to Dunning's multinational investment theory and also on this paper's empirical analysis. Therefore, the reverse technological spillover of overseas FDI to China is not obvious currently, or even to be negative.

KEYWORDS : FDI, technological spillover, productivity growth, scale effect, TFP

Introduction

In the situation of increasingly international and economic competition, the way that a nation or an industry can improve comprehensive competitive ability is to pursuit sustainable development. From the perspective of economists' viewpoints, the essence of comprehensive competitiveness is the level of economic efficiency or productivity. That is, an enterprise's competitiveness is embodied in its productivity capabilities. According to an analytical report on China's International Competitive Development by People's University of China, China's comprehensive competitiveness in the term of productivity remains at a low level in the world, account for only 2.11% of that of the United States. However, in recent years, China's comprehensive competitiveness grows rapidly, more than five times (or 540.48%) that of the US. Obviously, China has a great potential to increase even rapidly.

As the core of the evaluation system of comprehensive competitiveness, the economic efficiency or productivity encompasses of two major components, one is the increasing rate of productivity factors, and the other is the technological improvement. The combination of the two components promotes the development of the economy. The growth rate of production factors is referred to as the increase rate of output due to the increased input of production elements, such as labor, capital, land and other relevant input materials. On the other hand, the technological improvement is referred to as the increase rate of innovative capabilities and efficiency escalation as a result of inputs of research and development (R&D), accumulation of knowledge stock and human capital stock, and so on. The intimate linkage of the two components is finally shown by the improvement of comprehensive competitiveness that is characterized by the economic efficiency.

The new economic growth theory, rising in the 1980s and representative by economists such as P. Romer and R. Lucas, emphasizes that the capital investment and capital deepening endogenous technological progress, while the technological progress is the source of the long-term economic growth. As the world economy transforming from the traditional market system to that of an open market, many countries especially developed countries endogenous national technological progress not only by domestic production investment and capital deepening, but also through the flow configuration of international production factors, to promote technological progress, and such scale is increasingly enlarged. Thus, the capital deepening results in international direct foreign investment (FDI), and FDI in the international investment can continuously give birth to the technical innovation and technological progress, and thus in turn to promote the long-term economic growth.

Therefore, the role of FDI to the technological progress comes mainly from three aspects: one is inward foreign direct investment (IFDI). In the process of investment and production, knowledge accumulation due to the direct technical transfer and patent transfer from foreign countries leads to technological progress of the host countries; second, the IFDI leads to the technical progress of the host countries generated by imitating the foreign technology; Third, the outward foreign direct investment (OFDI) causes the technological progress of home countries due to continuously domestic capital spending in the process of investment and production that endogenous new technology and technical progress.

Literature Reviews

Traditional theories on international investment

Since 1960s, a number of different viewpoints on the international direct investment come appeared in the academia, including Japanese scholar K. Kojima's theory on comparative superiority; the theory on monopolist superiority by Stephen Hymer and C.P. Kindlebrerger; the theory on market internalization by Peter J. Buckley (a British scholar), Mark Casson, A. Rugman, and Stephen Yong, and etc.; and the product cycling theory by R. Vernon. In the late 1970s, John H. Dunning, a British economist, put forward to a compromise theory of "three advantages" that, combining and summarizing the previous theories, thought of international multinational investment and management mainly depending on the comprehensive level of three advantages, that is, the ownership advantage, internalization advantage and location advantage. In 1980s, Dunning further proposed the theory of development stages of international investment, in particular, with the development of the economy, a country's net FDI, namely the difference between the inward direct investment (IFDI) and the outward direct investment (OFDI), exhibits the change of cyclical trend. In a nutshell, these above theories focus strongly on studying the FDI activities of developed countries, overemphasizing on all sorts of premises of advantages to undertake the FDI activities, however, have some limitations in explaining the growing phenomenon of developing countries' FDI activities.

Researches of international investment on developing countries

With the continuous development of global economic integration, the foreign direct investment in developing countries develops rapidly, and its proportion of total amount of international direct investment grows steadily every year. In recent year, the academic study of developing countries' FDI also increases, which have made a great supplement for the traditional investment theory. Among them includes double gap theory by H.B. Chenery and A. M. Sturout, and Bruno, the small-scale technological theory by Louis T. Wells, the technological localization theory by S. Lall, the industrial upgrading theory of technological innovation by John A. Cantwell and Paz Estrella E. Tolentino, and etc. The main ideas of these theories emphasize that the competitive advantage of multinational businesses and management for the developing countries is that these countries can make full use of their unique characteristics of "learning experience" and "imitation capability" to grasp and develop the existing high and new technology.

Current research status of Chinese scholars in the related fields

Since reform and opening up for more than three decades, China's economy, having experienced from the absorption of foreign investment to the direct investment overseas, has implemented from passively participation in the economic globalization to actively adaption to the strategic transformation of the world economic development trend. Therefore, domestic scholars in the related fields recently carry out extensive studies on the reverse technological spillover of the international direct investment theory, which has made some remarkable achievements. In the aspect of theoretical research, Wu bin and Huang Tao proposed that the foreign direct investment in the developing countries depends on the amount of resources owned in the international context, and needs to experience two stages, so called "two stage" theory. In the first stage, the investing countries, having fewer resources than host countries, pursue experiences in the foreign direct investment; and in the second phase, the investing countries having more resources than host countries become chasing high profit in investing in the host countries. Guoming Xian and Yang Rui (1998), from different perspective of economic development, focus on the developing countries' FDI that can be divided into the backward investment from developed countries and direct investment in other developing countries, so called backward "two stage" theory. Yaming Ma and Zhang Yangui (2004) show, from the perspective of technological diffusion, that FDI in developing countries has economic rationality. Du Qunyang and Zhu Qin (2004) put forward the "three advantage theory" of obtaining technologies in the direct foreign investment for the developing countries.

Status-quo of China's Foreign Direct Investment

For over 30 years of reform and opening-up, China's foreign direct investment has experienced the developing process from scratch to full-fledged growth. Since entering the 21st century, China starts to implement the "going out" strategy, which leads to the enlarged scale of foreign direct investment, significantly increased speed and quality of FDI, account for increasingly important proportion of the total amount of global investment. In 2014, China's non-financial outward direct investment (OFDI) amounted to $107.2 billion, rose over 15.6% year-round, and total amount of foreign direct investment (OFDI) reached $123.1 billion, very close to the actually utilized amount of inward foreign direct investment (IFDI) of $128.5 billion. It means that China's outward foreign direct investment has reached the top line of billions of dollars, becomes one of the world's three biggest foreign direct investors. In addition, the level of China's domestic and foreign (two-way) direct investment has approached in balance.

The continuous expansion of China's foreign direct investment is beneficial to promote the development of domestic economy; in particular, its main impact on the economy is the effect of economic growth, technological progress, industrial structural upgrading, and the effect of trade promotion, and so on. The effect of economic growth mainly reflects in three aspects, that is, resource allocation effect, capital accumulation effect and technological improvement effect. While the technological spillover effect can promote the increase of total factor productivity, and thus enhance the output growth of domestic economy. Because the main reason for China's foreign direct investment is directly learning from advanced technology and management experiences of foreign countries, which is beneficial to improve the technological level of the investing country, and in turn to form the reverse technological spillover effect. Therefore, the technological effect of foreign direct investment can play a role in two sides, on the one hand, the change of productive efficiency or productivity reflects the size of the reverse technological spillover effect; on the other hand, it may also have an influential on domestic technological innovative activities. Accordingly, the combination of the above two factors positively impacts on the technological progress measured by the total factor productivity. In addition, foreign direct investment, by transferring domestic excess production capacity overseas, extends the industrial life cycle, helps enterprises of home country to obtain more profits and spare room to develop high-tech industry and the tertiary industry, and promote the optimization and upgrading of industrial structure in China. Finally, the foreign direct investment can circumvent the trade barriers, is more advantageous to the product export, which brings to the home investor a positive export-trading effect.

In general, the reverse technological spillover occurs to those countries' FDI of strategic asset-seeking investment in foreign countries with relatively high level of technology. For technological level of developed countries are usually higher than that of developing countries, so developing countries' strategic asset-seeking foreign investment in developed countries takes an obviously positive effect on the reverse technological spillover to promote home countries' technological level. In particular, the reverse technological spillover of foreign direct investment to the home country can be divided into two stages: in the first stage, the subsidiary branch of home country's headquarter company obtains the technological spillover through purchasing local supplies as mid-products, enjoying after-sale services, hiring skilled workers and management personnel from the host country. In the second stage, the subsidiary company of home country overseas transfer new knowledge and new technology obtained in the host country in a lawful way to domestic headquarters through internal conductive mechanism. Then, domestic parent companies spillover the new and advanced technology gained from oversea branches to other enterprises and industries in the home country, thus in turn drive the whole home country's science and technology to a higher level. As a developing country, the objects of China's outward foreign direct investment are mainly focused on developed countries, the effect of reverse technological spillover of FDI comes from host countries' technological advanced enterprises to diffuse or transfer finally to the home country. In the sense, the whole process will involve three dimensions of technological transfer, such as the level of enterprise, industry, and home country.

This paper attempts to use Malmquist productivity growth index principle to analyze the impact of China's foreign direct investment on the effect of technological progress and economic growth of China, and the decomposition effect of productivity growth.

Design of Econometric Model and Measurement

Theoretical basis of the Malmquist productivity growth index

From the perspective of economists' views, efficiency is a measure of relationship between inputs and outputs. As early as in the 1970s, the Malmquist productivity growth index, named after an American economist Stan Malmquist, was widely used to evaluate the production efficiency. Similarly, we can use the Malmquist productivity growth index to measure the macro economic efficiency.

To define the Malmquist productivity growth index, two different time periods, t and t+1, must be specified. In order to avoid choosing an arbitrary benchmark time period, the geometric mean of two output-based indexes with two consecutive time periods is defined. Then by transformation and simplification, the mathematical expression of Malmquist index can be obtained as follows:

(1)

$$M_o^{t+1}(x^{t+1},y^{t+1},x^t,y^t)=\frac{D_o^{t+1}(x^{t+1},y^{t+1})}{D_o^t(x^t,y^t)}\left[\left(\frac{D_o^t(x^{t+1},y^{t+1})}{D_o^{t+1}(x^{t+1},y^{t+1})}\right)\left(\frac{D_o^t(x^t,y^t)}{D_o^{t+1}(x^t,y^t)}\right)\right]^{\frac{1}{2}}.$$

With the above expression, Malmquist productivity growth index can be decomposed into two components: change in efficiency (EFFCH) and shift in technology (TECHCH). A ratio outside the bracket is efficiency change component, which describes relatively efficiency catch-up between two periods, t and t+1, or sometimes called the effect of catching-up. A geometric mean of two ratios inside the bracket captures the shifting effect of frontiers representing the change of technology for the given two periods, or sometimes called the effect of technological innovation. In sum, Malmquist productivity growth index can also be expressed in words as the following form:

(2)

$$M_o^{t+1}(x^{t+1},y^{t+1},x^t,y^t)=EFFCH*TECHCH.$$

Where, EFFCH represents efficiency change, while TECHCH represents technological change.

It is important to note that the total factor productivity (TFP) defined by the Solow residual identity, under the assumption that the production technology satisfy the constant return to scale and Hicks neutrality, is equal to technological change (TECHCH) component in the

Malmquist productivity growth index. Equivalently to say, the technological change in the Malmquist productivity growth index measures the productivity growth after the scale effect due to the increase of input factors, thus theoretically equals the total factor productivity (TFP) of Solow residual. However, measurement errors resulted from estimating the Solow residual cannot be eliminated, to use the measurement of TFP as a result of the Solow residual equation to represent technological progress incurs a lot of estimation bias. Thus, this paper uses the Malmquist productivity growth index to calculate the technological progress to represent for the total factor productivity.

Measurement of Malmquist productivity growth index

To maeasure the Malmquist productivity growth index of China's provinces and directly affiliated municipalities, this paper firstly uses input and output data of all covered provinces and cities to construct a benchmark production technological frontier, and then calculate the distance for each province or city by comparing its own production technology to the benchmark frontier, respectively. Afterwards, according to equation (1), the Malmquist productivity growth index for each province or city can be calculated.

In the process of estimating distance equations, this paper applies a two-stage optimization principle, firstly adopts the non-parametric linear programming technique to recover the production technology for each province or city; then takes the form of variation logarithmic (Translog) function as a parametric technique to estimate a smooth production technological frontier most conformable to the actual observations.

Through the above method to calculate the Malmquist index and estimate the distance function, both the non-parametric technology and parametric functional technology can be further decomposed into two components, the change of scale efficiency and the change of technological progress. To this end, four distance functions [(Dt(xt, yt), Dt+1(xt, yt), Dt(xt+1, yt+1), Dt+1(xt+1, yt+1)], with two adjacent time periods t and t+1 must be estimated. Specifically, the formulation of non-parametric linear programming problem for Dt(xt, yt) is presented as follows:

$$(D_o^t(x^{k,t}, y^{k,t}))^{-1} = \max \theta^k$$

s.t.

$$\sum_{k=1}^{K} z^{k,t} y_m^{k,t} \geq \theta^k y_m^{k,t} \qquad m = 1, \ldots, M$$
$$\sum_{k=1}^{K} z^{k,t} x_n^{k,t} \leq x_n^{k,t} \qquad n = 1, \ldots, N \qquad (3)$$
$$z^{k,t} \geq 0 \qquad k = 1, \ldots, K.$$

Where, z is the intensity variable; θis the reciprocal of the distance equation; x and y are input and output variables, respectively.

The advantage of the first stage of productivity analysis using parametric linear programming technology is obvious, but the constructed technological frontier is piecewise and discontinuous. However, such defection can be compensated by using the parametric form of technology in the second stage. For this purpose, the paper implements the second stage estimation using the parametric logarithmic function to re-calculate the distance function as shown in the following expression:

$$\ln D_o(x,y) = \alpha_0 + \sum_{m=1}^{M} \alpha_m \ln y_m + \sum_{n=1}^{N} \beta_n \ln x_n + \frac{1}{2}\sum_{m=1}^{M}\sum_{m'=1}^{M} \alpha_{mm'}(\ln y_m)(\ln y_{m'})$$
$$+ \frac{1}{2}\sum_{n=1}^{N}\sum_{n'=1}^{N} \beta_{nn'}(\ln x_n)(\ln x_{n'}) + \sum_{n=1}^{N}\sum_{m=1}^{M} \gamma_{nm}(\ln x_n)(\ln y_m).$$

(4)

With the usual restrictions for symmetry and homogeneity imposed, we can compute parameters by the way of linear programming optimization as discussed previously

TFP calculation and contribution of FDI to the TFP

First, assuming that the country's output (Y), capital (K), labor (L) and the international direct investment (FDI) can be expressed in a Cobb-Douglas (C-D) production function as shown in the following form:

$$Y_t = A_t K_t^{\alpha} L_t^{\beta} FDI_t^{\gamma} \qquad (5)$$

Where, A represents for the technological level of the country in period t. We usually assume that α+β=1, the production technology is constant return to scale. Further, we denote TFP as the total factor productivity, on behalf of the technological progress at time period t. Then, according to the Solow residual identity, TFP can be expressed as the following form:

$$TFP_t = \frac{Y_t}{K_t^{\alpha} L_t^{\beta}} \qquad (6)$$

Substituting equation (6) into equation (5), and decomposing the FDI in the open economy into two components, inward foreign direct investment (IFDI) and outward foreign direct investment (OFDI), and then take the natural logarithm on both sides of the equation, the basic econometric equation explaining the effect of the international direct investment on technological progress can be formulated as follows:

$$\ln TFP_{it} = \alpha_{0i} + \alpha_{1i} \ln OFDI_t + \alpha_{2i} \ln IFDI_t + \varepsilon_t \qquad (7)$$

Where, TFP_{it} represents for the total factor productivity of province i at period t, used to measure each province's technological progress; $OFDI_{it}$ is the capital stock of outward foreign direct investment; $IFDI_{it}$ is the capital stock of inward foreign direct investment.

Empirical Analysis and Discussions

Data sources and processing

This paper focuses on examining China's 30 provinces and directly affiliated municipalities, using Malmquist productivity growth index under the open economy, as well as the decomposition of scale effect and technological progress, and further to analyze the impact of international direct investment on the reverse technological spillover in the home country. Because of lacking in FDI data of autonomous region of Tibet, therefore the province of Tibet has not been included in the research scope of this paper. Considering the availability and comparability of the data, the number of years in the study is set to 2004 – 2014.

The basic economic data across the country, provinces and cities come from the Chinese Statistical Yearbook (2004-2014 edition) issued by the National Bureau of Statistics. The capital stock and flow data of foreign direct investment come from the Statistical Bulletin of the Chinese Foreign Direct Investment published by the Ministry of Commerce (former Ministry of Foreign Economic Relations and Trade), which have been converted into RMB price. Besides, all the capital stock numbers have been converted into the constant values in 2004 using the price index of investment in fixed assets, while the capital flow numbers have been converted into the constant values in 2004 using the provincial GDP price deflator.

Tests and analysis of the empirical results

First of all, this paper uses the two-stage (non-parametric and parametric) optimization technique to calculate the Malmquist productivity growth index and two components of scale effect and technological progress for 30 provinces and cities for 10 years from 2004 to 2014. Table 1 summarizes the average values of these calculations. On average, the annual productivity growth rate is positive for the ten year period, growing at 1.21% per year, which reflects the fact that the economic efficiency grows at relatively low rate, even though the absolute value is still positive. Among them, the two major decompositions of scale effect and technological progress play almost balanced roles, increasing at the average annual growth rate of 3.3% and 3.1%, respectively. However, individual result of various provinces and cities in different years diverges greatly.

Volume-5, Issue-3, March - 2016 • ISSN No 2277 - 8160

Table 1:China's Productivity Growth Index with Scale Effect and Technological Progress

Yr/Area	Malm	EffCh	TechCh	Yr/Area	Malm	EffCh	TechCh
Anhui	1.0184	1.0193	1.0270	Heilongjiang	0.9956	0.9672	1.0437
Beijing	1.0081	0.9872	1.0242	Hubei	1.0078	1.0005	1.0403
Fujian	1.0200	1.0212	1.0240	Hunan	1.0080	0.9918	1.0312
Gansu	0.9988	0.9710	1.0371	Jilin	1.0133	1.0065	1.0298
Guangdong	1.0082	0.9955	1.0337	Jiangsu	1.0230	1.0312	1.0254
Guangxi	1.0060	0.9890	1.0344	Jiangxi	1.0219	1.0235	1.0211
Guizhou	1.0144	1.0223	1.0418	Liaoning	1.0079	0.9976	1.0373
Hainan	1.0113	1.0017	1.0306	Neimenggu	1.0137	1.0032	1.0254
Hebei	1.0068	0.9909	1.0333	Ningxia	1.0279	1.0399	1.0189
Henan	1.0233	1.0287	1.0213	Qinghai	1.0303	1.0482	1.0193
Shandong	1.0135	1.0057	1.0283	2005	1.0130	1.0470	0.9710
Shanxi	1.0210	1.0218	1.0219	2006	0.8999	0.8161	1.1066
Shannxi	1.0055	0.9819	1.0266	2007	0.9836	0.9612	1.0267
Shanghai	1.0117	1.0006	1.0287	2008	0.9172	0.8552	1.0767
Sichuang	1.0095	0.9955	1.0299	2009	0.9618	0.9158	1.0516
Tianjin	1.0147	1.0099	1.0289	2010	1.3878	1.6640	0.8428
Xinjiang	0.9862	0.9450	1.0477	2011	1.0245	0.9235	1.1098
Yunnan	1.0042	0.9826	1.0317	2012	0.9375	0.8828	1.0640
Zhejiang	1.0118	1.0086	1.0368	2013	0.9832	0.9642	1.0200
Chongqing	1.0190	1.0116	1.0174	Overall	1.01206	1.00331	1.02992

Note: Figures in the table are index, calculated by the author with GAMS and SPSS, minus one are growth rates.

Second, the role of technological progress is reflected by the increase of total outputs in the economy, given fixed factor resources, including labor, capital, land and a series of tangible resource in a certain period of time, which can also be expressed as the effect of total factor productivity. So, according to the decomposition equation (7), the effect of international direct investment under the open economy on the technological progress can be estimated. As discussed earlier, the international direct investment generally is divided into two components, inward foreign direct investment (IFDI) and outward foreign direct investment (OFDI), the former is also called "forward technological spillover" of home country's technologies to the host country; while the latter is also called "reverse technological spillover" of the host country's technologies to the home country. In this paper, it analyzes both the forward and reverse technological spillover empirically, using observation data of China's 30 provinces and cities in recent 10 years.

Because of using historical datasets, this study first tests the stationary of time series variables. Detailed results are reported in Table 2. According to the Dick-Fuller stationary testing equation, the absolute t-values of estimated parameters in the first-order differential equation are smaller than the critical value at the 1% significance level, thus the integrated sequences are stable which pass the stationary test.

Table 2: Results of Stationary Test for Time-series Sequences

		Coef.	Std. Err.	t	P>t
Model1: D_ln_N_TECHCH	L_ln_N_TECHCh	-1.6360	0.1022	-16.01	0.0000
	L_D_ln_N_TECHCh	0.2859	0.0621	4.60	0.0000
	_cons	1.1565	0.0725	15.96	0.0000
Model 2: D_ln_N_Malm	L_ln_N_Malm	-1.3291	0.0907	-14.66	0.0000
	L_D_ln_N_Malm	0.3139	0.0638	4.92	0.0000
	_cons	0.9357	0.0637	14.68	0.0000
Model 3: D_ln_N_EFFCH	L_ln_N_EFFCH	-1.4407	0.0971	-14.84	0.0000
	L_D_ln_N_EFFCH	0.2837	0.0643	4.41	0.0000
	_cons	1.0021	0.0676	14.82	0.0000
Model4: D_ln_ofdi_f_r	L_ln_ofdi_f_r	-0.1234	0.0360	-3.43	0.0010
	L_D_ln_ofdi_f_r	-0.3170	0.0668	-4.75	0.0000
	_cons	0.5657	0.0832	6.80	0.0000

		Coef.	Std. Err.	t	P>t
Model 5: D_ifdi_r	L_ifdi_r	-0.0202	0.0072	-2.80	0.0060
	L_D_ifdi_r	0.1535	0.0631	2.43	0.0160

Note: Results of the table are estimated by the author with Stata.

Finally, this study uses the econometric and statistical software to estimate the effect of international direct investment on the total factor productivity (TFP) or technological progress, the scale efficiency, and the overall productivity growth, the detailed results are summarized in Table 3. From the viewpoint of statistical significance, all the t-values of parameter estimates are significant at the 5% level, only the parameter of foreign direct investment is significant at the 7% level. Plus, the Durbin-Watson values for the three estimated models are all close to 2, so there is no serial correlation among the sequential variables. In addition, the adjusted R squared values are above 90%, showing that the overall fit of measuring the statistical model is good. Because the econometric model is double logarithmic equation, the estimated parameter values measure the sensitivity of response variables corresponding to the foreign direct investment (FDI), alternatively called the elasticity for the dependent variables. From the economic sense of estimation, the effect of total capital values that China attracts the foreign direct investment in a recent decade on domestic productive efficiency and technological spillover is positive, that is, 1% increase of inward foreign direct investment promotes 0.54% and 0.52% increase of productive efficiency and technological progress, respectively; On the contrary, the outward foreign direct investment has little impact on the reverse technological spillover of the home country, or even slightly negative with the elasticity of -3.5% and -2.4%, respectively.

Table 3:Elasticities Between FDI and Economic Growth, Technological Progress and Scale efficiency

		B	SE	t	Sig.	Adj. R^2	DW
Model 1(ln_Malm)	ln_ifdi_r	0.1428	0.0054	26.4815	0.0000	0.9286	1.6757
	ln_ofdi_f_r	-0.0243	0.0114	-2.1327	0.0339		
Model 2(ln_TECH)	ln_ifdi_r	0.1494	0.0052	28.6636	0.0000	0.9348	1.8278
	ln_ofdi_f_r	-0.0354	0.0110	-3.2125	0.0015		
Model 3(ln_EFF)	ln_ifdi_r	0.1402	0.0060	23.4087	0.0000	0.9112	1.4122
	ln_ofdi_f_r	-0.0224	0.0127	-1.7664	0.0785		

Note: Results in the table are estimated by the author with Stata.

Above empirical analysis on China's international direct investment in a recent decade shows that China's FDI experiences conform to that of the traditional investment theory. That is, the international direct investment from developed countries to developing countries is often beneficial to the host country's technological progress, since the forward technological spillover is easily diffused; on the other hand, in the initial stage of international direct investment from developing countries to developed countries, the reverse technological spillover to the home country is hardly noticeable, or even has somewhat negative impact. As a developing country, China's large-scale overseas direct investment is only just started: investment in other developing countries mainly focuses on the domestically obsolete industries, while investment in developed countries focuses more on accumulating the primitive capital or fixed assets. Both of these two forms of overseas direct investment are difficult to show immediate impacts on domestic technological improvement.

Conclusions

This paper analyzes China's economic productivity growth and technological progress in recent 10 years for 30 provinces and directly affiliated cities using the Malmquist productivity growth index principle, plus it provides empirical analysis according to the total factor productivity accounting method, on the effect of economic growth and technological spillover. It is found that China, as a developing country, having experiences more than 30 years in attracting foreign direct investment, has brought a significant amount of advanced equipments, high technologies, skilled human resources and physical capitals, which plays a great role in promoting the development of China's science and technology. On the other side, since the country implements the "going out" strategy, a large-scale of direct investment overseas of Chinese enterprises is still in its infancy: overseas direct investment in other developing countries is mainly focused on domestic obsolete industries, while overseas direct investment in developed countries focuses more on the accumulation of fixed assets and primitive capitals. So, China's current situation of outward foreign direct investment (OFDI) remains in the early stage or belongs to the second phase according to Dunning's multinational investment theory with "five phases" and also based on empirical analysis of this research as well. Namely, the reverse technological spillover of overseas direct investment to the home country is not very obvious currently, or even to be negative.

Thus, the main revelation drawn from this study is that, to implement the "going out" strategy efficiently, Chinese enterprises should cross over the early stages of international direct investment rapidly, and should go to countries and regions intensified with science and technology (R&D) to set up the research institutions and hi-tech industries, and to develop enterprises with independent property rights and famous brand products, which will provide an efficient way to utilize the advanced science and technological resources of foreign countries, to spill over backward to the domestic market , and finally to increase the comprehensive competitiveness of Chinese enterprises.

References:

[1] Buckley, P., M. Casson. Analyzing foreign market entry strategies: extending the international approach [J]. Journal of International Business Studies, 1998(3).

[2] Cantwell, J.A., & Tolentino, P.E.E.. Technological Accumulation and Third World Multinationals, paper presented at the annual meeting of the European International Business Association, Antwerp, December 1987.

[3] Dunning, J. H.. The Investment Development Cycle and Third World Multinationals, in K.M. Khan, ed., Multinationals of the South, London: Francis Porter. 1986.

[4] Dunning, John H.. "Theories and Paradigms of International Business Activities", The Selected Essays of John H. Dunning, Vol.I, Cheltenham, UK: Northampton, MA, Edward Elgar, 2002.

[5] Hymer, S.. The International Operations of National Firms: A Study of Direct Investment. Ph.D. Dissertation Cambridge. MA. 1960.

[6] Lall, S.. The New Multinationals. Chichester, John Wiley & Sons. 1983.

[7] Lucas, R. E.. On the Mechanics of Development Planning [J]. Journal of Monetary Economics, 1988(22): 3-42.

[8] Romer, P. M.. Increasing Returns and Long-run Growth. Journal of Political Economy [J]. 1986(99): 1002-1037.

[9] Solow, R.M.. Technical Change and the Aggregate Production Function [J]. Review of Economics and Statistics. 1957(39): 312-20.

[10] Vernon, R.. International Investment and International Trade in the Product Cycle [J]. Quarterly Journal of Economics, 1966(80): 190-207.

[11] Wells, L.T. Jr.,. Third World Multinationals [M]. Cambridge, MIT Press. 1983.

[12] Chinese National Bureau of Statistics. China's Statistical Yearbook [Z]. Beijing: China's Statistics Press. 2004-2014.

[13] Du Qunyang, Qin Zhu. Theory and Practice of Technological Obtaining Foreign Direct Investment of Chinese Enterprises [J]. Journal of International Trade Issues. 2004 (11): 66-69.

[14] Ma Yaming, Yangui Zhang. Technical Advantages and Foreign Direct Investment: An Analysis Framework about the Technological Diffusion [J]. Nankai Economic Research. 2003(4): 10-11.

[15] Xian Guoming, Rui Yang. Technological Accumulation, Competition Strategy and Foreign Direct Investment in Developing Countries [J]. Journal of Economic Reseach. 1998(11): 56-63.