Research on the Types of Technological Progress in China

Pei Yuan[1], Mingzhen Shao[2*]

[1]School of Management, Henan University of Urban Construction, Pingdingshan, 467036, China
[2]School of economics, Henan University, Kaifeng, 475004, China
*Corresponding Author

Abstract:

Based on the literature review, this study analyzes the impact of different types of technological progress on economic growth in China. First, check the embodiment of the different sources of technological progress to economic influence. For independent innovation of the technology progress, this article adopts the Solow residual to measure. And second,we verified the effect of different source technology for industry investment using the data during 2001-2020 in China.uses the linear regression model to regression analysis.Based on the empirical analysis,we find that China does not have the advantage of the independent innovation and that independent research and development technical effects is limited and the tendency is decline.

Keywords: technological progress, independent innovation, Solow residual.

I. INTRODUCTION

Relying on its strong economic growth since reform, China's influence in the world market continuously strengthen, but recently lost some momentum, which makes many people begin to reflect on China's future economic growth pattern. As is known to all, in the early days of   reform and opening up, China promoted its technical improvement through introducing and imitating foreign advanced machinery and equipment combined with relatively low labor costs and made full use of scale economy benefits, which made it the world's factory. According to the endogenous economic growth theory, it is believed that technological progress is the ultimate driving factor of economic growth, while technological progress is mainly comes from the enterprise or the state of research and development activities, so in general the cost of the technology progress of research and development spending as a share of GDP is between technological progress and should be related to the investment, the more research and development is, the greater the chance of success, in turn,   research and development expenditure and economic growth are related. However, if these two kinds of growth theory directly be used to analyze and explain China's growth path, there are obvious defects, for their assumptions are not completely suitable for the development of China faces. On the one hand, the above theory doesn't fully consider the heterogeneity of the machine equipment investment, China's advanced machinery and equipment relies mainly on the introduction, and it

is the repeated introduction, materialized in the machinery and equipment, advanced technology has become the main form of technological progress in China. Endogenous economic growth theory, on the other hand, mainly refers to the issues about the growth of the developed countries, and it considers the main form of independent research and development to promote technology progress, ignoring the possible problems during the imitation to innovation that China faces. Generally, less developed countries technology progress path will, in turn, roughly experienced the following three stages: imitation stage, transition stage from imitation to innovation and innovation stage. When some conditions cannot be met and may not be able to accomplish technology progress path transformation from imitation to innovation, the countries will, therefore, be mired in economic stagnation, also can be called a mimic trap. In this paper, based on such thinking, the author tries to explain the problem of economic growth through the analysis of the characteristics of China's technological progress.

Generally speaking, the connotation of technical progress can be divided into two parts: hardware part and software part. Hardware part is a delegate with machines sediment of human technology, the level of the technique is derived from the new design and new inventions produced by the research and development department; Software part is acquired from the education and research and development to raise the level of human capital, including laborer's quality, professional skills, management skills and management level, etc., which embodies the efficiency of production and management level beyond the general labor's and the efficiency is derived from human capital and education and training. The hardware and software part of technical progress are closely linked, which work together to promote the productivity and increase the economic growth. The hardware part of the technological progress here is defined as narrow sense of technological progress, and the integration of hardware and software part is called general technological progress. Research of this paper is based on the generalized connotation of technological advances, and technological progress refers to a comprehensive factor that is to increase the service efficiency of all kinds of factors of production, it includes not only the renewal of the production equipment, production process and method of perfect management system, the improvement of quality of workers, and the improvement management system and level, but also the new organization structure and management method, etc., this paper defines this technology progress as embodied technical progress

From the perspective of industry, the application of advanced machinery and equipment of some companies will push factor (resources) flow between industries and achieve reconfiguration; the mechanism of this type of technological progress to promote industrial structure adjustment is realized through the flow of factors of production between different industries and the intrinsic relationship between different sectors. To be specific, (1)For the industries that have bigger elasticity of output demand, the new industry of technological progress tends to attract the flowing of production factors by creating new market demand. This is because the new industrial sector output has just been introduced to the market, the response of the price to the cost and demand to the price is sensitive (elasticity of demand is small), so as to improve the quantity of output and is likely to gain higher returns. Therefore, when the industry gains higher profits than the average level of all industries, social factor will successively flow into this industry from other industries, which leads to the rise of emerging industries. (2) For the industries that have smaller elasticity of output demand, due to the new output brought by the technical progress which tends to cause the flowing out of

production factors as the demand turns relatively narrow. This is because for the industry whose output elasticity of demand is smaller, its output has entered the mature stage, the response of demand to price is no longer sensitive (elasticity of demand is larger), as a result, technological advances in these industries output dramatically increased, often more dynamically narrow the difference between prices and costs, causing revenue reduction. Further results in the production factor flowing out from the industry, thus cause the elimination of backward industries. (3) Technological progress will pull the other industry labor productivity by the forward link (spread) and backward link (spread) between industries, so as to achieve the goal of industrial structure adjustment.

II. Literature review

Scholars' study of the embodied technical progress is mainly from two aspects, on the one hand, it is the identify problems of embodied technical progress which mainly includes: First, is measured by the same quality price index method reflects technology progress, representative literature including Greenwood (1988) and Gordon (2000), domestic scholars have also done related research in this aspect, such as zhao (2007), straight dong (2010), song dong Lin (2011), etc., by building the equipment and building capital investment of endogenous economic growth model, find out the equipment investment relative prices and the relationship between technological progress and to extract the embodied technical progress; Second, is the core machine method is adopted, it is using the core machine contains the core technology to reflect the method of technical level. Such as Timmer (2001) using this method to estimate the embodiment of the Indonesian textile industry type technology progress contribution rate is 28%; And the third is the production function estimation method, namely the use of technology in economic growth model of biochemical, using mathematical method to deduce reflect technological progress, and USES the measurement method is verified. Such as licandro (2001) using two departments such as endogenous growth model to explain the contribution of technological progress. Southeast (2011) based on endogenous growth accounting framework to estimate the Chinese capital reflects a 11.5% increase in technological progress.

On the other hand, the study is to establish a measuring model to analysis the function of embodied technical progress on economic growth. Griliches (1984) through the empirical study of American manufacturing, analysis results show that the investment in science and technology is an important factor to improve enterprise productivity. Coe and Helpman (1995) through the data of the multinational in 22 countries studies the relationship between the input and total factor productivity of science and technology. The research results show that the investment in science and technology become the important factor of a nation's productivity growth. ZhuYun, BiZhengCao (2007) by using co-integration test theory research china fiscal expenditure on science and technology and economic growth from 1978 to 2005, the relationship between the empirical results show that the investment in science and technology plays an important role in economic growth. Zhi-jian zhao (2008) use of government investment in science and technology in 1978-2004 GDP and three industrial output value respectively through regression analysis, the result shows that the government investment in science and technology and long-term stable relationship between the second industry, and there is no long-term co-integration relationship with first between industry and tertiary industry .

Although previous studies made some progress, but it Can not better reflect the source problem of technological progress, which will determine the vital problem that China's future Whether or not fall into the trap of imitation. So, to distinguish the contribution of different sources of technology for China's growth is particularly important.

III Analysis based on China's date

The empirical analysis of this paper is divided into two steps.

First, check the embodiment of the different sources of technological progress to economic influence. For independent innovation of the technology progress, this article adopts the Solow residual to measure. For the introduction of equipment technical progress, according to song dong Lin (2011) the price index method to calculation. This method is through the adoption of the consumer price index and the ratio of equipment price index calculated.In this paper, the data from China statistical yearbook from 2000 to 2020, the calculation results are shown in figure 1, which embody to said the introduction of advanced equipment included in the technical progress, expressed in zhong to independent research and development of technological progress.
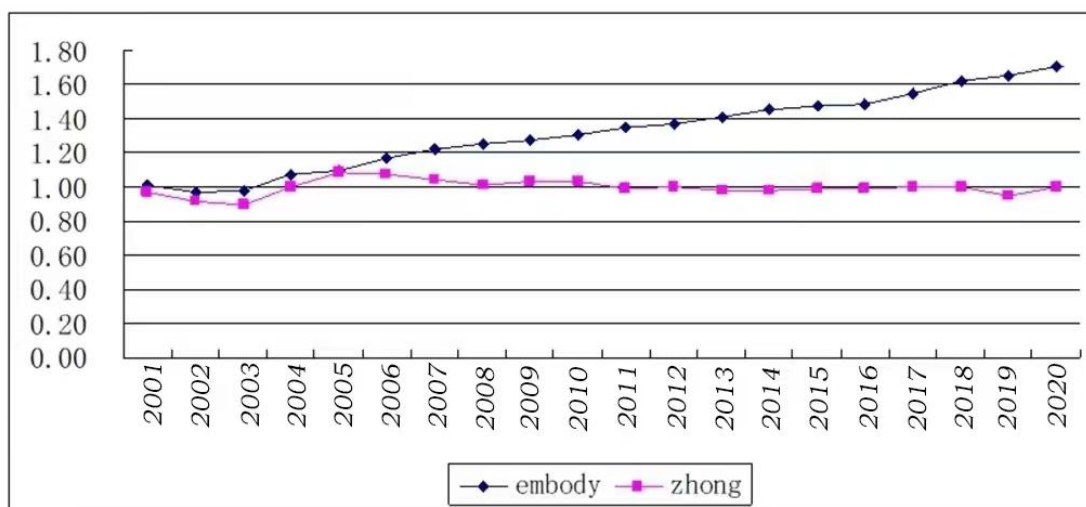

Figure 1 two kinds of China's technological progress

It 's can be seen from the figure 1, the technological progress from introducing mechanical equipment is significantly higher than that of independent research and development, it also conforms to the fact that China's reform and opening up bring the the high level technology of introduction of equipment to improve domestic technology.

In second step, we verified the effect of different source technology for industry investment using the data during 2001-2020 in China.The investment data are from the annual China statistical yearbook which with the consumer price index for the deflation. The statistics of embodied technical progress mining on

figure 1 results and this paper uses the linear regression model to regression analysis.

Table 1 data support the results of our analysis above.We can find out that the current import machinery and equipment for enterprise investment progress is larger, the influence of coefficient is 4.23814. The independent research and development technology for investment scale plays a significant role in the influence of lag effect, the lag of the phase I and phase ii coefficient is 2.877438 and 2.877438, respectively, after the third phase of the lag effect is not significant. It shows that independent research and development technical effects is limited and the tendency is decline.

TABLE I. The impact of different types of technological progress on investment

Dependent Variable: I

Method: Least Squares
Sample (adjusted): 2001 2020
Included observations: 18 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EMBODY	4.238140	0.117425	36.09222	0.0000
ZHONG(2)	2.517291	0.776852	3.240374	0.0059
ZHONG(1)	2.877438	0.588619	4.888457	0.0002
C	-0.519934	0.882313	-0.589285	0.5651

R-squared	0.993644	Mean dependent var	10.29901
Adjusted R-squared	0.992283	S.D. dependent var	0.827366
S.E. of regression	0.072684	Akaike info criterion	-2.212275
Sum squared resid	0.073960	Schwarz criterion	-2.014414
Log likelihood	23.91047	F-statistic	729.5965
Durbin-Watson stat	1.672797	Prob(F-statistic)	0.000000

IV The further discussion

Based on the empirical analysis above, China does not have the advantage of the independent innovation.If the government want to change the present situation,the following measures should be taken into account:

1. The government should strengthen the financial science and technology investment and improve the efficiency of capital operation. The increasing investment ought to be meet the needs of the development of science and technology to improve the overall level of science and technology. Meanwhile the fund management mechanism must also be established. This will ensure that the limited scientific and technological resources are able to enter the field of scientific research and technological innovation, which is full of vigor and efficiency. Then it will help to improve the efficiency of the use of scientific and technological resources, and ultimately to promote the development of scientific research and technological

innovation, and truly become an important factor in promoting economic growth.

2. Financial investment in science and technology will also need further innovation. As a kind of innovative production input, investment in science and technology should be established by the diversification of investment subject which include the government, enterprises and non-governmental organizations . In terms of output, the solution contains set up transformation of scientific and technological achievements project, using the mechanism of venture investment and attract social capital investment in science and technology achievements transformation projects. For the public welfare activities of science and technology, the government should give priority to invest. And for the other activities of science and technology, should be to encourage investment in enterprises and private as the main body.

ACKNOWLEDGEMENTS

REFERENCES

[1] Christoel, K., Coenen, G., and Warne, A. (2011). Forecasting with DSGE Models. In Clements, M. and Hendry, D., editors, Oxford Handbook on Economic Forecasting.Oxford University Press.

[2]Albonico, A., Kalyvitis, S., and Pappa, E. (2014) Capital Maintenance and Depreciation over the Business Cycle. Journal of Economic Dynamics and Control 39: 273-286.

[3]Boucekkine, R., D. de la Croix and Licandro, O. (2011). Vintage Capital Growth Theory: Three Breakthroughs. Economic Growth and Development 11, 87-116

[4]Alvarez, A. and J. del Corral. 2009. "Identifying Different Technologies Within a Sample Using a Latent Class Model: Extensive Versus Intensive Dairy Farms." Forthcoming, European Review of Agricultural Economics.

[5]Boucekkine R., N. Hritonenko and Y. Yatsenko (2011), "Scarcity, regulation and endogenous technical progress," Journal of Mathematical Economics 47, 186–199.

[6]Attfield, C. and Temple, J. R. W. (2010). Balanced growth and the great ratios: New evidence for the US and UK. Journal of Macroeconomics, 32:937–956.

[7]Huh, H.-s., 2011, "Testing the Uncorrelatedness of Aggregate Supply and Aggregate Demand Shocks in VAR Models", The Journal of the Korean Economy, Vol.12(2), PP181-209.

[8]Kogan, L., and D. Papanikolaou, 2010, "Growth opportunities and technology shocks", The American economic review, Vol.100(2), PP532-536.

[9]Mandelman, F. S., P. Rabanal, J. F. Rubio-Ramirez, and D. Vilan, 2011, "Investment-specific technology shocks and international business cycles: An empirical assessment", Review of Economic Dynamics, Vol.14(1), PP136-155.