

A Research on the Momentum of China's Economic Growth——Based on the Data of 1978-2014

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Abstract. On the basis of the trans-log production function model, the paper analyses the economic data during 1978-2014 through the labor, capital and technical factors, and delivering a conclusion on the sources of China's economic growth within this period. This paper adds the time trend variable ($t = T - 1978$) into trans-log production function model and neutral technical progress in economic system considered into the production function. Based on all parameters of production function calculated through Eviews, labor input-output elasticity, capital input-output elasticity and technology input-output elasticity are work out. The conclusion of the specific sources of China's economic growth has drawn from the three elasticity indicators.[1] Furthermore, the differences indicators of labor and capital technology progresses have obtained as well, so as to analyzing the growth rate of labor technology and capital.

Background and Significance

China's economy has made great progress since the economic reform and opening up in 1978. The per capita GDP had grown from less than 1,800 yuan before the 1978 to around 46,612 yuan in 2014, and the proportion of China's GDP in the world's GDP has increased from less than 1% in the late 1970s to about 10%. Today, China has become the world's second largest economy after the United States. Great changes have taken place in China in the recent years. Although China's economic is growing at a high speed, the characteristics of its extensive economic growth has become increasingly obvious. A number of studies have shown that the economic growth of China is mainly driven by the investment on factors of production while the contribution of total factor productivity(TFP) to the economic growth is rather low, which concluded that this kind of growth is unsustainable. The environmental problems caused by China's economic growth have arousing highly attention at home and abroad, especially many Chinese cities has hit by the haze in the recent years. Chinese government and enterprises are facing increasing pressure to reducing emissions. In the context of resources and environment has constrained human activities, it is significant to review and search for the new sources of China's economic growth so as to realize the dual transformation on its pattern and sources.

Literature Review

To explore the growth dynamics of Chinese economy, the top priority should be to given to choose the suitable model to represent economic growth. In 1975, Solow creatively proposed that TFP should be the incorporated into driving force of economic growth beside the input factors. After that, many economists began to add the TFP in the study of dynamic economic growth model. With the development of mathematics and econometrics, many scholars are using mathematics and quantitative methods which based on production function to improve the model and solution, so as to draw conclusions [1, 2].

The article *Trans-log Production Function and its Application in China* written by Zheng

Zhaoning and Liu Deshun(2004) proposed that establish the trans-log production function and utilize ridge regression method to estimate the model parameters. Furthermore, they suggest that labor input-output elasticity, capital input-output elasticity, technology input-output elasticity should be used to analyze China's economic growth. Over the past three years, many economists have put forward various models to analyze Chinese economic growth, while mostly just made some improvements on the production function [3]. In the paper *Semi-parametric Varying- Coefficient Estimation of the Trans-log Production Function*, Zhang Shangfeng and Gu Wentao (2013) have put forward semi-parametric varying coefficient estimation for the Trans-log production function model. The function coefficients of output elasticity were estimated by profile least square method with the local polynomial estimates for the nonparametric part. Through the conditional bootstrap method, they used the GLP to test the Tans-log model against the semi-parametric varying coefficient model. Under constant returns to scale constraints, China's empirical results on 1953-2008 reject the null hypothesis of the trans-log production function model, and the output elasticity is a nonlinear function of log capital per labor rather than a linear one. From their research model, the time-varying elasticity of capital shows an inverted U-shape trend, and the time-varying elasticity of labor shows a U-shape trend [4]. Dong Minjie and Liang Yongmei (2013) points out a nonparametric analysis framework to estimates economic growth sources which covered in their paper named *The Sources of China's Economic Growth from 1978 to 2010: A Non-parameter Framework*, and drawing a conclusion that the TFP, labor and capital factors have contributed 10.9%, 3.7% and 85.4% relatively in 1978-2010 [5]. Besides, Cui Junfu, Miao Jianjun and Chen Jinwei (2015) was used multiple linear regression model and the random forest model to estimate the importance of "the troika (investment, consumption and import-export trade)" for China's economic growth in their paper *Research on the Tmprtus of china's Economic Growth Based on Random Forest*. After the comparative analysis, it is found that the simulation results of random forest simulation model is superior to the multiple linear regression model [6].

Research Methods and Data Sources

Research Method. Based on the trans-log production function, this paper analyses the economic data during 1978-2014 through the labor, capital and technical factors, and delivering a conclusion on the sources of Chinese economic growth within this period. Taking the gross domestic product (GDP) to represents the output and the labor input (L), capital stock (K) and time trend variable($t=T-1978$) to represent the input.

The established trans-log production function as follows:

$$\begin{aligned} \ln gdp = & A + \beta_t t + \beta_{tt} t^2 + \beta_k \ln k + \beta_l \ln l + \beta_{kl} \ln k \ln l \\ & + \beta_{kk} (\ln k)^2 + \beta_{ll} (\ln l)^2 + \beta_{kt} (\ln k) t + \beta_{lt} (\ln l) t \end{aligned} \quad (1)$$

Data Sources. GDP (Unit: 100 million yuan). Represented by the real GDP of 1978 which taken as the base period.

L (Unit: 10,000 person). Adopting the annual employment population published by National Bureau of Statistics of China.

K (Unit: 100 million yuan). Estimated by employing perpetual inventory method, the specific formula is: $K_t = K_{t-1}(1 - \delta_t) + I_t$, of which the K_{t-1} and K_t mean the fixed capital stock that during $t-1$ and t period, δ_t means the depreciation rate during t period, I_t means evaluate the new investment which increased during t period by using constant price. This formula is mainly involved in four variables, as indicated below: (1) The annual new investment. Fixed capital formation is taken as the nominal investment, the same as two representative domestic research literatures about fixed capital stock which respectively written by Zhang Jun(2004) and Shan Haojie(2008)[7]. (2) Investment goods price index. Due to the lack of price index deflation statistics,

the paper temporarily simplify the process of building the index and assuming the investment goods price index as 1[8]. (3) Capital stock in a base period K_0 . Zhang Junkuo (1991), Perkins(1988) and He Fengdeng(2003) all assumed the capital - output ratio of 3, accordingly reckon out the capital stock in a base period-1978 $K_0=1216.733$. (4) Economic depreciation rate. This article will use the finding of Shan Haojie (2009) that suppose the economic depreciation rate of 10.96% [9].

After using the above index to figure out the capital stock, then with the simple arithmetic average of in the beginning of the year(the end of last year) and the capital stock at the end of this year, the result can be taken as the capital stock investment. At last, the amount of the fixed capital stock investment can be drawn [10].

Model Estimation and Analysis

Analyzing the model by using Eviews, it is found that not all squares can pass the T-test, so the three squares which fail the examination might be the irrelevant variables. After excluding the three squares, all variables can pass the T-test. The unit root test is given to all variables included in the model, then variables of lngdp, ln l , ln k , kl, kt, lt are found to be non-stationary variables.

All sequences can pass the unit root test after conducting first-order difference to lngdp, ln l and using second-order difference to ln k , kl, kt, lt. By the reason of the Trans-log production function including many different forms of the same variable and cross-product terms between variables, there is a serious collinear problem in these variables of the model. To address the multicollinearity in the trans-log production function, the Ridge Regression Analysis method can be applied to solve this issue: determining the value of the ridge through the variance inflation factor (VIF), then estimating it through SPSS software, Stata software and other softwares or using Eviews. However, this paper removes the collinear problems between variables by differencing the variables. While variable ln k can't pass the T-test after differencing it, therefore ln k is the irrelevant variable and discard it. Finally, the following revised model is figure out:

$$\ln gdp = A + \beta_t t + \beta_l \ln l + \beta_{kl} \ln k \ln l + \beta_{kt} (\ln k) t + \beta_{lr} (\ln l) t \quad (2)$$

Estimated results of the model as follows:

Table 1 Estimated results of the model

Variable	Coefficient	Std.Error	t-statistic	Prob.
A	-1.231528	0.742272	-0.1659134	0.1107
t	0.003829	0.001335	2.868160	0.0087
D(ln l ,1)	1.768100	0.837157	2.111778	0.0458
D(kt,2)	0.072731	0.015359	4.735403	0.0001
D(lt,1)	0.113541	0.067056	1.693218	0.1039
D(lk,1)	0.076190	0.014293	5.330457	0.0000
AR(1)	0.227409	0.175308	1.297199	0.2074
AR(2)	-0.511761	0.137707	-3.716320	0.0011
AR(3)	0.351419	0.153970	2.282393	0.0320

According to the estimated results of the model, various output elasticities are calculating as follows:

Labor input-output elasticity is $N_l = 1.77 \ln l + 0.11 t$

Capital input-output elasticity is $N_k = 0.07 t + 0.08 \ln l$

Technology input-output elasticity is $N_t = 0.004 + 0.11 \ln l$

Through the above three formulas, it is known that labor input-output elasticity, capital

input-output elasticity and technology input-output elasticity having the growth trend. The result means that with China's economic development, the effect of various elements to promoting economic growth has improved.

After getting differential correction, the variable $\ln k$ still fails to pass the T-test in processing the model, which means $\ln k$ is the irrelevant variable. Therefore, the contribution of capital to economic growth is rather low from 1978 to 2014. Drawing a comparative indicator of the three variables, it can be seen that labor input-output elasticity was the largest investment among this period, independent technology input-output elasticity was larger than capital input-output elasticity before 1993, capital input-output elasticity was larger than independent technology input-output elasticity after 1992. The results show that, from 1978 to 2014, labor input was the largest sources of Chinese GDP growth and the contribution of capital and technology was relatively low. In accordance with the research results, China's economy has the need to make transformation based upon the current condition. China must transform itself from the growth pattern of dependent on labor input into the pattern of relying on technology to promote economic growth gradually.

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