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The intensive growth effects of demand structure adjustment on economic growth of China

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ABSTRACT

The intensive economic growth will contribute to solving the problem of resource and environment constraints on the economic development, whereas enhancing the productivity of production factors is the key to promoting the intensive economic growth. In this paper, we put forward that to improve the output efficiency of production factors and then realize the target of intensive growth through adjusting the demand structure, namely changing the conditions or environment of production factors on output effect. Based on this idea, we constructed the threshold cointegration model and conducted empirical research with the data collected between 1978 and 2011, the results of which show that the demand structure will have significant threshold effect on the output efficiency of production factors, and adjusting the demand structure can effectively improve the output efficiency of production factors.

KEYWORDS

Intensive economic growth; Demand structure adjustment; Resource and environmental constraints.

INTRODUCTION

Ever since the reform and opening up of China, economic and social development has entered into the fast lane. Especially after the 21st century, China economy grows at the average speed of 9.23% each year. In 2010, China's total GDP exceeded Japan for the first time, and is currently listed as the second in the world. However, China economy has achieved outstanding achievements, but the production technology restrictions and some disordered production organizations result in relatively high resource energy and environmental costs of economic growth. In 2008, the consumption of construction minerals, metallic minerals and industrial minerals, fossil fuels and biomass in China reached up to 22.6 billion tons, taking up 32% of the worldwide total, and so China has become the biggest raw material consumer in the world till now, almost four times of the United States which ranks second in the world. In 2012, the total energy consumption of China was 3.75 billion tons of standard coals; and energy consumption of each ten thousand Yuan GDP reached up to 1.517 tons of standard coal, 1.7 times of U.S. energy consumption and 2.3 times of Japanese energy consumption. The total wastewater discharge generated in the social production and life reached up to 68.48 billion tons, the total emissions of smoke/dust in the waste gas reached up to 12.343 million tons, the output of industrial solid waste reached 3.29 billion tons, the air quality was seriously polluted, and there were 542 environmental emergencies. Confronted with the challenge of sustainable economic growth caused by the extensive growth mode featured by "high consumption, high energy consumption, high pollution and low efficiency"[1], China government has paid great concerns to it and proposed the major strategic layout of "accelerating the transformation of economic development" in the new period, and required to focus the economic development on quality and efficiency.

Intensive growth is a scientific economic growth mode of extensive growth, the nature of which is to realize economic growth by improving the use quality and efficiency of production factors[2-5]. The intensive growth mode emphasizes effective and reasonable utilization of resources, and attaches importance to ecological environment[6], so it can solve the resource and environmental problems caused by China's current extensive economic growth. But how can we promote economic growth mode to quickly change into intensive economic growth mode? Lots of scholars have discussions on this issue from different perspectives. Some scholars think that the intensive economic growth is closely related to science and technology, and we should attach importance to the role of scientific and technological innovations in the process of promoting intensive economic growth[1,6,7]; another part of the scholars think that intensive economic growth is related to government functions and system reform, and we need to speed up the transformation of government functions and promote system and mechanism innovation[1,8]; some other scholars think that intensive economic growth is related to scale production, and we need to promote scale economy or appropriate intensive production[7,9]; and some other scholars think that intensive economic growth is related to industrial structure or industrial organization structure, so we need to enhance the optimization and adjustment of industrial structure or industrial organization structure[10-14]. To sum up, all these opinions have provided important theoretical guidance in promoting economy to change from extensive growth into intensive growth. While at the same time, the promotion of intensive economic growth should not be limited to this, and all internal mechanisms beneficial to the improvement of the quality and efficiency of production factors should be studied in depth and researched in details. The demand structure refers to the proportional allocation between consumption, investment and export which stimulate economic growth. Since consumption and export reflect the final demand of the society, investment is an important factor that determines social output and can reflect the inputs and uses of material resources, so the demand structure, especially the proportional allocation of investment and consumption, investment and export, investment and (consumption + export) can in a certain degree reflect the supply and demand of economy and the consumption of material resources. So, the allocation of demand structure is an important potential mechanism that affects economic operation. However, there are few studies about the demand structure allocation and intensive economic growth in the academic circle, even there are some studies[1], few have conducted in-depth discussions on the impact mechanism of the two and how to adjust demand structure so as to better promote intensive economic growth, etc. For this reason, on the basis of discussing the demand structure adjustment theory under the constraint of intensive economic growth target, we apply empirical measurement method to measure the threshold value of China's various demand structure index that affect the output efficiency of production factors, and base on changes in demand structure to have the threshold value of production factors on outputs, and propose reasonable demand structure strategies to promote intensive growth of China's economy.

THEORETICAL ANALYSIS OF THE DEMAND STRUCTURE ADJUSTMENT UNDER INTENSIVE GROWTH TARGET CONSTRAINTS

Proposal of the hypothesis that production factor has optimal contributions to outputs

The neoclassical economic growth theory assumes that in the premise of constant technology, labor and capital the two major input factors of social production, namely the social output function is assumed to be:

$$Y_t = F(L_t, K_t) \quad \textbf{(1)}$$

If it is written as C-D, we get:

$$Y_t = AL_t^{\alpha} K_t^{\beta} \quad \textbf{(2)}$$

Get logarithm of the two sides of formula (2), we get:

$$INY_t = INA + \alpha INL_t + \beta INK_t \quad \textbf{(3)}$$

Among which, A is technical progress factor, a constant; L_t is current labor; K_t is current stock of physical capital, namely capital stock of the previous period plus current investment. α and β is respectively the output elasticity of labor and capital. The output elasticity of production factor measures the contributions of various production factors to outputs. The bigger the output elasticity of production factors is, the bigger its contribution to output, meaning that the use efficiency of production factors is much higher. Furthermore, the output elasticity of various production factors reflect the contributions of various production factors to outputs, but what this kind of contribution reflects is the result of various production factors with the combined effect of economic system in particular economic environment and conditions. When particular economic environment or conditions change, the impacts of various production factors on outputs will also change, and thus change the growth mechanism of outputs, that is the inputs of the same production factors will probably have different contributions to outputs in different conditions. In the social production function, the output elasticity of different production factors will be different in different economic environment or conditions. And the comparisons about the output elasticity coefficient of the same production factors can reflect the output efficiency difference of the same production factors in different economic conditions.

The demand structure is a necessary environment or condition embedded in the economic growth process. When production factor faces changes in demand structure, it may also cause changes in the output capacity of production factors, and thus leads to changes in the output growth mechanism. In different output growth mechanisms, the output elasticity of different production factors is also different. When the demand structure is in a certain status, it can promote production factors to bring into play its maximum contributions to outputs. That is, when production factors can realize the maximization of marginal output in a certain demand structure status during economic operation process, the allocation of demand structure will cause intensive growth effect.

The idea of demand structure adjustment under intensive growth target constraints

The essential requirement of considering the demand structure adjustment under the intensive growth constraints is to adjust practical demand structure to the state that the demand structure allocation causes intensive economic growth effect in the hypothesis that production factors have maximum contributions to outputs. So, the demand structure adjustment thought under the intensive growth constraints is: first we must confirm whether or not there exists multiple output growth mechanism for various production factors in terms of time route of output growth; second, we should confirm in which output growth mechanism does current production factors play a role in outputs; third, we should compare the contributions of various production factors to outputs in different output growth mechanism; at last, according to the contribution degree of various production factors to outputs in different output growth mechanism, we should consider the adjustment of demand structure and thus cause various production factors make the largest contributions to outputs in the favorable demand structure conditions.

In production formula (3), the output elasticity coefficient of the labor element (L) and capital element (K) reflects the contribution degree of labor element (L) and capital element (K) to outputs. With comparison of the output elasticity coefficients of labor element (L) and capital element (K) in different demand structure conditions, we can infer the adjustment thinking of the demand structure in the condition that the labor element (L) and capital element (K) have maximum contributions to outputs.

(1) The demand structure adjustment in the condition that capital element has maximum contributions to outputs

In the time path of output growth, relative changes in consumption, investment and export demand quantity will surely lead to changes in the demand structure of the proportion of investment and consumption, proportion of investment and exports, and the proportion of investment and (consumption +exports), if in different demand structures (DS refers to the demand structure, $\gamma_1, \gamma_2, \gamma_3 \ldots$ and γ_n means the index value of certain demand structure from small to big, different demand structure conditions are expressed in mathematical form: $DS < \gamma_1, \gamma_1 \le DS < \gamma_2, \gamma_2 \le DS < \gamma_3, \ldots, DS \ge \gamma_n$), suppose capital element has different effect mechanisms on output growth, then the output elasticity of capital that reflects different effect mechanism must be different, namely there exist $\beta_1, \beta_2, \beta_3, \ldots, \beta_n$, and they are respectively respondent to $DS < \gamma_1, \gamma_1 \le DS < \gamma_2, \gamma_2 \le DS < \gamma_3, \ldots, DS \ge \gamma_n$. When $\beta_1 > \beta_2 > \beta_3 > \cdots > \beta_n$, it means that the capital element has the maximum contributions to outputs when the demand structure meets $DS < \gamma_1$, if the effect of current capital element on output growth is $\beta \in [\beta_2, \beta_3 \cdots \beta_n]$, then the demand structure index should be adjusted below γ_1; when $\beta_1 > \beta_2 > \beta_3 > \cdots > \beta_n$, it means that the capital element has maximum contributions to outputs when the demand structure meets $\gamma_1 \le DS < \gamma_2$, if the effect of current capital element on output growth is $\beta \in [\beta_1] \cup [\beta_3 \cdots \beta_n]$, then the demand structure index should be adjusted into the state of below γ_2 and above γ_1; similarly, we can analyze other situations.

(2) The demand structure adjustment in the condition that labor element has maximum contributions to outputs

The analysis of the demand structure adjustment in the condition that labor element has maximum contributions to outputs is roughly consistent with the analysis of the demand structure adjustment in the condition that capital element has maximum contributions to outputs, so we will not give more detailed explanations about it.

Changes in demand structure cause the threshold effect of production factors on outputs

In what state can China's demand structure promote production factors to have maximum contributions to output growth? In the paper, we build a threshold cointegration measurement model to answer this question. Meanwhile, it also provides empirical evidence for adjusting China's demand structure so as to promote intensive economic growth.

Setting of the threshold value model based on C-D production function

As stated above, classical C-D production function takes into consideration the relationships between outputs and the three input elements of production technology level, labor and capital, but it doesn't state or reflect the effects of changes in the environment or conditions of economic growth on economic growth, such as changes in demand structure.

Further, if we consider changes in demand structure in the C-D production function, the effect of production elements reflected in formula (3) on outputs may have some differences according to changes in demand structure. In order to reflect these differences, we modify formula (3) as:

$$INY_t = (\alpha_1 INL_t + \beta_1 INK_t) + (\alpha_2 INL_t + \beta_2 INK_t)(tv_t > \phi) + u_t \quad \textbf{(4)}$$

The above formula can be simply written as:

$$INY_t = \theta_1^{'} X + \theta_2^{'} XI(tv_t > \phi) + u_t \quad \textbf{(5)}$$

In formula (5), $\theta_1 = (\alpha_1, \beta_1)$, $\theta_2 = (\alpha_2, \beta_2)$, $X = (INL_t, INK_t)$. $I(\cdot)$ is an indicative function with tv_t (such as demand structure) as the threshold variable, ϕ is the threshold value. The values of indicative function $I(\cdot)$ are 1 and 0, when the condition in the bracket is met, the result is 1 and the result will be 0 when it is not met. The formula (4) can measure the significant differences of the effects of the two input elements of capital and labor on outputs due to the changes of the threshold variable tv_t, that is when the threshold variable tv_t is bigger than or equal to or smaller than the estimated threshold value $\hat{\phi}$. That is, the effect of production factors on output growth has non-linear transformation features with changes in the threshold value.

Formula (5) is a two mechanism model of single threshold value, but it can be further divided into the three mechanism model with double threshold value according to differences in threshold variable[15]. Accordingly, formula (5) can be modified as (suppose $\phi_1 < \phi_2$) :

$$INY_t = \theta_1^{'} X + \theta_2^{'} XI(\phi_1 \le tv_t \le \phi_2) + \theta_3^{'} XI(tv_t > \phi_2) + u_t \quad \textbf{(6)}$$

In formula (6), the connotation of variables is the same with formula (5). Formula (5) and formula (6) is the threshold cointegration model built in this paper. If formula (5) is right, the it means various input elements have changeable effects on output growth, when $tv_t \le \phi$, the effect of various input variables on output can be described by $\hat{\theta}_1$; when $tv_t > \phi$, the effect of various input variables on output can be described by $\hat{\theta}_1 + \hat{\theta}_2$; similarly, we can have analyses about formula (6). If in formula (5) and formula (6), various explanatory Variables are subordinated to unit root process, and the residual error $\hat{u}_t \to I(0)$, then formula (5) or formula (6) are threshold cointegration models, and we will verify them one by one in the following empirical testing process.

The purpose to build the threshold cointegration models, namely formula (5) and formula (6) is to analyze that in the C-D social production function, various production element variables especially in the mechanism that capital element takes demand structure as the threshold variable, whether or not it has different effects on output growth, from which we can judge whether or not China's demand structure allocation has intensive growth effect and proposes feasible thinking for China's demand structure adjustment.

Illustrations and definitions of variables

(1) Dependent variable

Gross output (Y): explained variable in this paper. The Gross output defined in this paper is the GDP estimated by expenditure approach.

(2) Independent variable

(1) Capital stock (K): the explanatory variable in this paper. Since there is no statistics on capital stock in current statistical data, so there are great differences about the statistics and calculations of capital stock among domestic scholars. In this paper, we follow the opinion proposed by Shan Haojie (2008)[16], which takes current fixed capital formation as the current capital inputs. The current capital stock is composed of current capital inputs and fixed capital stock net value in the previous year. So, in this paper, we define capital stock as the result that the fixed gross capital formation stock in the previous year minus depreciation and the fixed gross capital formation stock in the current year.

(2) Labor (L): the explanatory variable in this paper. Labor refers to the actual labors engaged in production in the current year. In domestic studies, most research literature takes the statistical number of national employees issued by the National Bureau of Statistics. So, in this paper, we follow the conventional practices of domestic scholars to define labors in the current year as the national employment population in the current year.

(3) Threshold variable

The demand structure (DS): refers to the allocation of the proportions between consumption, investment and export demand. In this paper, we respectively set the investment consumption ratio, investment export ratio and investment (consumption+export) ratio as the threshold variables of empirical models.

(1) Investment consumption ratio

In this paper, we define investment consumption ratio as: IC=INV/CON. Among which, INV is the investment demand. In this paper, we take the gross fixed capital formation as the proxy variable of investment demands. CON is consumption demand, and in this paper we take the final consumption demand of residents as the proxy variable of consumption demands.

(2) Investment export ratio

In this paper, we define investment export ratio as: IE=INV/EX. In which, INV is the investment demand. EX is the export demand, and in this paper it is expressed by export amount.

(3) Investment (consumption+export) ratio

In this paper, we define investment (consumption+export) ratio as: ICE=INV/(CON+EX)=INV/CEX. In which, INV is investment demand, CON is consumption demand. EX is export demand. CEX is the sum of CON and EX.

About data sources

The time span of this study is from 1978 to 2011. The explanations about data sources of the variables in the econometric model are as follows:

Gross output of economy (Y): According to the GDP and index estimated by expenditure approach in previous years which were issued by *New China 60-year Statistical Data Assembly (1949-2009)* and China Statistical Yearbook in 2012, it is converted into the GDP calculated according to the expenditure approach of constant calculation in 1978.

Capital stock (K): According to the estimation method of China’s capital stock amount at the unchangeable price in 1952 proposed by Shan Haojie (2008)[16], we estimate the capital stock amount of China after 1978 and extend it until 2011. The data of the capital stock amount in 1978 were the data publicized by Shan Haojie in Quantitative & Technical Economics in 2008. The raw data used in the estimation process originates from China’s Statistical Yearbook in 2012.

Labor (L): the statistical data of China’s employment population in the whole society come from China’s Statistical Yearbook in 2012.

Consumption demands (CON): the statistical data of residents’ final consumption expenditure in the GDP calculated by the expenditure approach come from China’s Statistical Yearbook in 2012, and meanwhile the residents’ final consumption expenditure amount calculated by the price in the current year for every year is converted into the residents’ final consumption expenditure amount data calculated by the constant calculation in 1978.

Investment demand (INV): the statistical data of gross fixed capital formation in the GDP calculated by the expenditure approach come from China's Statistical Yearbook in 2012, and meanwhile the gross fixed capital formation amount calculated by the price in the current year for every year is converted into the gross fixed capital formation amount data calculated by the constant calculation in 1978.

Export demand (EX): The data come from the exports of goods and services in China's Statistical Yearbook in 2012. Meanwhile, the gross export amount calculated by the price in the current year for every year is converted into the gross export amount data calculated by the constant calculation in 1978.

The investment consumption ratio (IC), investment export ratio (IE), and investment (consumption + net exports) ratio (ICE) of the demand structure variables in this paper can be obtained by direct calculation of relevant variables mentioned above.

Empirical testing and result analysis

(1) Empirical testing

To confirm whether or not formula (3) is the threshold cointegration model, we need to have collinearity inspection of the explanatory variable of the model, and have the unit root test of the model variables, and test the setting of model form, and use the residual of the estimated results for threshold cointegration test and other procedures. In the following part, we will complete the said steps according to requirements.

(1) Collinearity test

Time series tend to cause high collinearity, while high collinearity tends to cause the model to have singular matrix and thus there is no way for accurate estimation. In formula (3), we use correlation analysis, the results of which show that there is strong correlation among various explanatory variables, and the correlation between K and L is 0.91. By further using Chatterjee et al. (2000) to test collinearity[17], the root reciprocal sum of the principal component analysis of the explanatory variable in the model is 11.59, bigger than the standard of five times of the explanatory variables, so there is severe collinearity in the model. In order to eliminate the collinearity of the model, we use Kumar (2002) to reduce the collinearity[18], taking L as the explained variable and K as the explanatory variable, by which we got the residual representative L and expressed it as LS. After adjustment of the explanatory variables in the model by the said method, the correlation among the explanatory variables of models has become weak. In formula (3), the root reciprocal sum of the principal component analysis of the explanatory variable is 2, much smaller than 10 that is five times of the explanatory variable of the model and the collinearity of the model greatly reduces.

TABLE 1 : Collinearity Test of the Explanatory Variable in the Model

Model		Characteristics serial number		Characteristics root reciprocal sum
		1	2	
Model formula (3)	Initial variables	1.9096	0.0903	11.59
	Adjustment variables	1.0	1.00	2

(2) Unit root test

The threshold cointegration model requires that variables of the model must be stationary time series. Through ADF test of the variables in formula (3), we find that Y, K, LS are not stationary below the significant level of 5%, but after first difference method, the variable series are all stationary. So, all variables in formula (3) are about the stationary series of $I(1)$.

(3) Test of the setting of model form

In the measurement model, whether or not there is significant difference between the effects of input elements on outputs, namely the input element variable is based on formula (3) or formula (5), or it has impacts on outputs according to formula (6)? Answers to these questions need to involve test of the model setting form. So, we need two steps to test it. First, we need to test whether the model has existing threshold value effect, and then we need to test the number of threshold value ϕ of the test model.

Step 1, we need to test whether or not the model has threshold effect.

TABLE 2 : Unit Root Test of Variables in the Model

Variable	Test type	Statistics	Critical value (5%)	Probability p	Test result
Y	(c,0,0)	-0.45	-2.96	0.888	I (1)
ΔY	(c,0,0)	-3.33	-2.96	0.022	I (0)
K	(c,t,2)	-0.99	-3.56	0.931	I (1)
ΔK	(c,t,1)	-4.30	-3.56	0.0096	I (0)
LS	(c,t,0)	-0.52	-3.55	0.977	I (1)
ΔLS	(c,t,0)	-5.51	-3.56	0.0004	I (0)

Note: all variables have received logarithmic treatment; c in the test type means the item with intercept, t means the item with time trend, the third item means the item with lag; Δ means the lagged first difference.

In formula (3), if there exists threshold effect, it must exist in the form of formula (5) or formula (6). Suppose in formula (5), we assume $H_0:\theta_2=0$, if the model test accepts null hypothesis, then there is no non-linear effect, the model will be estimated according to formula (3); if the model test refuses the null hypothesis, then there exists threshold effect, namely non-linear effect. The non-linear test of the model can adopt the non-linear constraint test LM statistics proposed by Gonzalo and Pitarakis (2006)[19]. LM statistics is:

$$LM(\phi)=\frac{1}{\hat{\sigma}_u^2}u'MX_\phi(X_\phi'MX_\phi)^{-1}X_\phi'Mu \quad \textbf{(7)}$$

In formula (7), ϕ is the estimated value of formula (5), $\hat{\sigma}_u^2$ is formula (4) under the condition of the null hypothesis, the estimated value of long-term variance of residual, $M=I-X(X'X)^{-1}X'$. But Gonzalo and Pitarakis (2006) proved that LM test statistics didn't have standard distribution in the non-stationary variable condition[19]. In order to obtain the accurate critical value of LM test statistics, we adopted bootstrap simulation experiment to calculate the standard distribution of LM statistics, and realized the estimate and test of the threshold value. Bootstrap simulation experiment and threshold estimate test steps are as follows: first, use the lattice search method to respectively estimate formula (5) about each given threshold value ϕ, we get residual sum of squares labeled as $S_1(\phi)$, among which the ϕ value correspondent to the minimum residual sum of squares is the threshold value that we estimate; second, according to the ϕ value we got in the previous step to estimate formula (5), from which we got $\hat{\beta}$, $\hat{\alpha}$ and residual $\hat{u}_t$, meanwhile we standardize the residual labeled as $\hat{u}_t^*$; third, we extract circularly bootstrap samples of $\hat{u}_t^*$ and based on the second step to obtain $\hat{\beta}$, $\hat{\alpha}$ and $\hat{u}_t^*$ which generate bootstrap sample series INY_t^*; forth, we estimated the simulation data again and got correspondent estimated residual, and meanwhile we used the estimated residual to calculate the LM test statistics labeled as LM^b. We repeated the above steps for 300 times, and place the LM^b value we got each time in descending order, the corresponding p value is $P=\Pr ob(LM^b>LM)$, that is the probability it accepts null hypothesis. When $LM^b<LM$, we refuse null hypothesis, module (3) has threshold effect; and when $LM^b>LM$, we accept null hypothesis, formula (3) has no threshold effect.

Step 2, to test the number of the threshold value of the model.

Further, if we need to confirm model (3) exists in formula (5) or (6), then we need to confirm the number of the threshold value in model (3). The sequential testing ideas proposed by Teräsvirta (1994) can well solve this problem[20]. For the formula (6), we can set the null hypothesis as $H_{01}:\theta_2\neq 0,\theta_3=0$, if formula (6) passes LM constraint test, accepts null hypothesis, then the model setting form is formula (5), otherwise it will be formula (6). It is noticeable that when we are calculating LM statistics, there is consistency when we apply Sequential estimation to estimate formula (6), but Bai (1997) pointed out in his studies that the $\hat{\phi}_2$ obtained according to $\arg\min_{\phi_2} S_2(\phi_2)$ is progressive and effective[21], but the estimation of $\hat{\phi}_1$ in advance neglects the minimum of the residual sum of squares of $\hat{\phi}_2$, so the estimation of $\hat{\phi}_1$ in advance is ineffective, and we need to modify the value of $\hat{\phi}_1$ again on the basis of $\hat{\phi}_2$. The $\hat{\phi}_1$ after modification in formula (6) is also progressive and effective. Meanwhile, according to the effective modification $\hat{\phi}_1'$ and $\hat{\phi}_2$ after modification, we can calculate corresponding LM test statistics again.

In this paper, we only have 34 samples. If we further test whether there is the four-mechanism effect of three threshold values in the model, then the degree of freedom will greatly decrease, and the reliability of the test will also be seriously questioned. So, the setting formula of the final model is confirmed as two formula models of one threshold value and the three mechanism models of two threshold values, namely formula (5) and formula (6).

TABLE 3 : Formal Testing of Formula (3)

Threshold variable	The null hypothesis	LM estimated value	Probability	$\hat{\phi}$ value	Result
IC	$H_0:\theta_2=0$	1.293	0.076	0.564	Refuse H_0
	$H_{01}:\theta_2\neq 0,\theta_3=0$	7.308	0.603	0.685 1.045	Accept H_{01}
IE	$H_0:\theta_2=0$	11.982	0.045	1.648	Refuse H_0
	$H_{01}:\theta_2\neq 0,\theta_3=0$	8.503	0.281	1.663 2.647	Accept H_{01}
ICE	$H_0:\theta_2=0$	3.536	0.049	0.469	Refuse H_0
	$H_{01}:\theta_2\neq 0,\theta_3=0$	6.491	0.407	0.482 0.503	Accept H_{01}

Note: the cycle index of bootstrap is 300.

According to the said methods and steps, we conducted formal testing on formula (3), the test results of which are shown in TABLE 3. In the significant level of 5%, when formula (3) respectively takes investment consumption ratio (IC), investment export ratio (IE) and investment (consumption + export) ratio as the threshold variable, there is all a threshold value. So, we think that the threshold value in formula (3) has divided the growth effect mechanism of production factors on outputs into two mechanisms. In different output growth effect mechanism, labor (L) and capital stock (K) have significant differences effect on the gross output (Y). Especially, according to the above test process, we can also confirm the estimated value of the threshold variable in model (3)that is the specific level that the production element has effect transformation on the output growth. The realization of threshold cointegration model provides feasible thinking for the demand structure adjustment in this paper. That is, we first compare the contribution of labor and capital on outputs in different output growth mechanism, and then we further confirm the optimal status of the demand structure in the output growth process (namely to judge according to the threshold value confirmed in the measurement model), and finally combine the actual status of current demand structure to increase or decrease consumption, investment and export demands to adjust current demand structure into the level that can promote labor and capital element have maximum contributions on outputs.

(4) Test of threshold cointegration model

As stated above, formula (3) has threshold effect, and formula (3) exists in the form of formula (5). But to confirm whether or not formula (3) is threshold cointegration model, we need to have estimation and test of formula (3). According to the threshold value confirmed in TABLE 3, we have FMOLS on formula (3), and base on the residual of the model estimation to adopt the $C_{FMOLS}^{b,i}$ proposed by Choi and Saikkonen (2010) for calculation[22], if the $C_{FMOLS}^{b,i}$ statistics calculated is smaller than corresponding critical value, then the model should be threshold cointegration model. And $C_{FMOLS}^{b,i}$ statistics is:

$$C_{FMOLS}^{b,i}=b^{-2}\hat{\omega}_{i,u}^{-2}\sum_{t=i}^{i+b-1}(\sum_{j=i}^{t}\hat{u}_j)^2\Rightarrow\int_0^1 w^2(s)ds \quad \textbf{(8)}$$

Among which, b is the sample capacity of some residuals selected, $\hat{\omega}_{i,u}^2$ is the consistency estimation of the long-term variance ω_u^2 of u, i is the starting point of part of the residual, $w(s)$ is the standard Brownian motion. Since $C_{FMOLS}^{b,i}$ statistics is only calculated by part of the residual, in order to improve the test power of statistics, we select different b and i according to formula (8), and select the biggest $C_{FMOLS}^{b,i}$ statistics among them, namely:

$$C_{FMOLS}^{b,i,\max} = \max(C_{FMOLS}^{b,i}, \ldots, C_{FMOLS}^{b,i,H}) \Rightarrow \int_0^1 W^2(s)ds \quad \textbf{(9)}$$

In formula (9), H is the number of $C_{FMOLS}^{b,i}$ statistics need to be calculated when the sample capacity b is unchangeable. Furthermore, since the distribution of $C_{FMOLS}^{b,i}$ statistics is a converge to random functional, so in this paper we use Monte Carlo simulation experiment to confirm its critical value, so as to realize the threshold cointegration testing of limited samples. The test results of formula (3) are shown in TABLE 4.

TABLE 4 : Test of Threshold Cointegration Model

Model form	Threshold variable	Test statistics	Estimated value	Critical value of 5%	Result
	IC	$C_{FMOLS}^{b,i,\max}$	2.924	3.270	Cointegration
Formula (3)	IE	$C_{FMOLS}^{b,i,\max}$	3.814	4.379	Cointegration
	ICE	$C_{FMOLS}^{b,i,\max}$	2.886	3.655	Cointegration

Obviously, in TABLE 4, the estimated value of $C_{FMOLS}^{b,i,\max}$ in formula (3) is all smaller than the critical value of 5%, the formula (3) estimated in this paper is the threshold cointegration model.

(2) Analysis of experiment results

Put the threshold value confirmed in TABLE 3 into formula (5), adopt FMOLS method to estimate the model respectively, and we will get the following specific estimate results:

TABLE 5 : Estimate of Formula (3)

Basic model	Formula (3)		
Threshold variable tv_t	**IC**	**IE**	**ICE**
Constant	0.1235	0.1225	0.1268
Mechanism 1	IC≤0.564	IE≤1.648	ICE≤0.469
α_L	0.0599	0.0293	0.0673
β_K	0.9199	0.9221	0.9192
Mechanism 2	IC>0.564	IE>1.648	ICE>0.469
α_L	0.0397	0.0229	0.0499
β_K	0.9189	0.9212	0.9178

It can be known from the results in TABLE 5 that when formula (3) takes investment consumption ratio (IC) as threshold variables and when the investment consumption ratio is equal to 0.564, the occurrence effect of labor and capital element on output growth will change. In the first mechanism (IC≤0.564), with the increase of each unit labor, the output increased by 0.0599; and with the increase of each unit capital, the output increased by 0.9199. In the second mechanism (IC>0.564), with the increase of each unit labor, the output increased 0.0397; and with the increase of each unit capital, the output increased by 0.9189.

In formula (3), where the investment export ratio (IE) is threshold variable, when IE is 1.648, the labor and capital elements will have effect changes on the output growth. In the first mechanism (IE≤1.648), with the increase of each unit labor, the output increased by 0.0293; with the increase of each unit capital, the output increased by 0.9221. In the second mechanism (IE>1.648), with the increase of each unit labor, the output increased by 0.0229; with the increase of each unit capital, the output increased by 0.9212.

In formula (3), where investment (consumption+export) ratio (ICE) is threshold variable, when ICE is 0.469, the labor and capital elements will have effect changes on the output growth. In the first mechanism (ICE≤0.469), with the increase of each unit labor, the output increased by 0.0673; with the increase of each unit capital, the output increased by 0.9192. In the second mechanism (IE>0.469), with the increase of each unit labor, the output increased by 0.0499; with the increase of each unit capital, the output increased by 0.9178.

CONCLUSIONS AND SUGGESTIONS

Research conclusions

According to above analysis, we drew several important empirical results: (1) when investment consumption ratio is smaller than or equal to 0.564, the output effect brought about by unit labor and capital element should be relatively big, and economic growth is relatively in the intensive growth status. (2) when investment export ratio is smaller than or equal to 1.648, the output effect brought about by unit labor and capital element should be relatively big, and economic growth is relatively in an intensive economic growth status. (3) when investment (consumption+export) ratio is smaller or equal to 0.469, the output effect brought about by each unit labor and capital element input should be relatively big, and economic growth is in a relatively intensive growth status.

Suggestions about China's demand structure adjustment

According to above empirical analysis, when investment consumption structure namely investment consumption ratio is smaller than or equal to 0.564, production element can bring into play relatively high output efficiency, and the economy is in a relatively intensive growth state. However, in practice, only the investment consumption ratio during the two periods of 1981-1983 and 1989-1990 is in the reasonable range. Similarly, the investment and export structure is relatively reasonable only in the three periods of 1990-1991, 2000 and 2002-2008; and investment and (consumption+export) structure is relatively reasonable only in the two periods of 1981-1982 and 1989-1991. Accordingly, China's investment and consumption structure, investment and export structure and investment and (consumption+export) structure didn't promote production element to have maximum contributions to outputs in most of the time, so the economy was in a non-intensive growth state. Accordingly, China needs to adjust unbalanced investment and consumption structure, investment and export structure and investment and (consumption+ export) structure by refraining investment, expanding consumption and increasing or stabilizing exports, and respectively adjust current investment and consumption structure, investment and export structure and investment and (consumption+export) structure to the state that the investment consumption is ≤0.564, the investment export ratio is ≤1.648, and the investment (consumption+export) ratio is ≤0.469.

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