

CAN THE VALUE-ADDED-RATE REFLECT THE QUALITY OF ECONOMIC GROWTH?^①

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ABSTRACT: It has been listed as one of the key indicators of the quality of the industrial sector and manufacturing sector in “Industrial transformation and upgrading plan (2011-2015)” and “Made in China 2025 Plan” respectively, for the industrial and manufacturing value added rate (Hereinafter referred to as the VAR). However, some facts are otherwise. For example, in the province of China, the increase in the industrial VAR level is almost the opposite of the economic development. The main conclusions have been drawn as follows: Firstly, there exists a threshold level of VAR. When the real VAR is below it, the larger the real VAR, the higher the quality of economic growth is. However, once the real VAR is above the threshold level, the trend shows the opposite trend. Therefore, we should be caution in practice, otherwise may backfire. Secondly, there exists a long-term co-integration relationship between the real VAR and the threshold level value, and there also exists an inverted U relationship between the real VAR and Total Factor Productivity. Finally, the threshold level of VAR varies considerably in different countries, and it is associated with the capital depreciation rate, population growth rate, saving rate and other macroeconomic indicators. Therefore, we need to fully implement “The Recommendations of the Thirteenth-Five-Year Plan of the Communist Party of China Central Committee on National Economic and Social Development” spirit, to enhance China’s VAR threshold level as to achieve consistency between the real VAR and quality of economic growth.

KEY WORDS: Quality of economic growth, value added rate, threshold level

I. Introduction

President Xi Jinping, the General Secretary of the Central Committee of the Communist Party of China (CPC), he made the remarks at the Asia-Pacific Cooperation (APEC) CEO Summit 2013, which are the signs of a change of direction in china’s economic policy. “We are no longer simply regard the GDP growth rate as the key performance indicator, but pay more attention to improve the quality and efficiency of economic growth. Facts proved that our new policy was right, and this policy is not only responsible for the china, but also responsible for the world”, Xi said. In March 2015 government work report, the Premier Li Keqiang also pointed out: “Adapting and leading the ‘new normal’ economy, making progress while maintain stability of the economy, keeping the economy index within a reasonable range, improving the quality and efficiency of economic development. Adjusting economic structures and changing ways of economy increase will play important role in the future work.” In October 2015, Central Committee of the Communist Party of China published the book:” recommendations for the 13th five-plan for economic and social development”. This recommendation provided an overview of the situation and our guiding thought, “development is the primary task, governments should take the economic quality and increase economic benefits as the center, which can speed the reform of economic system that will make the

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governments adapting and the mechanism of ‘new normal’ economy.” Obviously, For the governments, a scientific monitoring index system and an effective quality appraisal system, which can assess the quality of the economy growth, is very important practical significance.

VAR is a comprehensive indicator that measures input-output efficiency and quality of economic growth at the macro level^①. Compared with the most widely used total factor productivity, VAR is more in line with accounting, statistics and management logic. Therefore, VAR has become a new promising approach for the measurement of the quality of economic growth (Shen, Wang, 2006; Liu, 2011). In recent years, China Taiwan, Japan, Korea and other countries and reigns also proposed that the indicators of industrial development policy would prefer to adopt VAR rather than adopt GDP growth rate. In January 2012, for the facts and situation that Chinese industry is large scale but low capability of independent innovation and low capability of market competitive-force, Chia’s Council officially published: industrial transformation and upgrading plan (2011-2015)”. This plan first regarded “industrial VAR” as the indicator for the assessment of the quality of industrial economy, at the same time, this plan proposed a goal that Chinese industry should raise the industrial VAR by 2 percentage points during the period of “12th Five-Year Plan”. In May 2015, China’s council officially published” made in china 2025”. This plan again proposed a goal that Chinese industry should raise the industrial VAR by 2 percentage points during the year 2015-2020 and the year 2020-2025. However, when we use the VAR to assess the quality of economic growth of china, we found the following problems:

On the one hand, the VAR of China is far lower than other countries in the world. Just as figure 1 shows that the VAR of china is at the lowest levels in the typical countries and areas, and what was worse, the figure shows a steady decline of china’s VAR in recent years. Inexplicably, according to the figure 1, we find that the China’s economic growth quality is lower than Brazil if the VAR can reveal the quality of economy. At the same time, South Korea, with sophisticated and innovative companies such as Samsung and Hyundai, is lower than Brazil in the VAR.

On the other hand, the regional industrial development degree of economy is almost inversely proportional to the regional industrial added rate in Chinese provinces. Just as figure 2 shows, the VAR of Yangtze River delta region and the VAR of Pearl River Delta region are lower than the national average level. But, in fact, Yangtze River Delta region and Pearl River Delta region are the economic and cultural developed area of our country. Obviously, the information that figure 2 revealed is not fit into the facts.

^① According to the U. S. Department of Commerce, the official definition of economic research, intermediate input is the production process of goods and services (including the purchase of energy, raw materials, semi-finished products and services from all sources). These goods and services are mainly used for the production of other goods and services in the production process, rather than the final consumer goods. It is equal to the total output (including operating income, commodity tax, inventory changes) minus the added value (including wages, production and import taxes less subsidies, operating surplus).

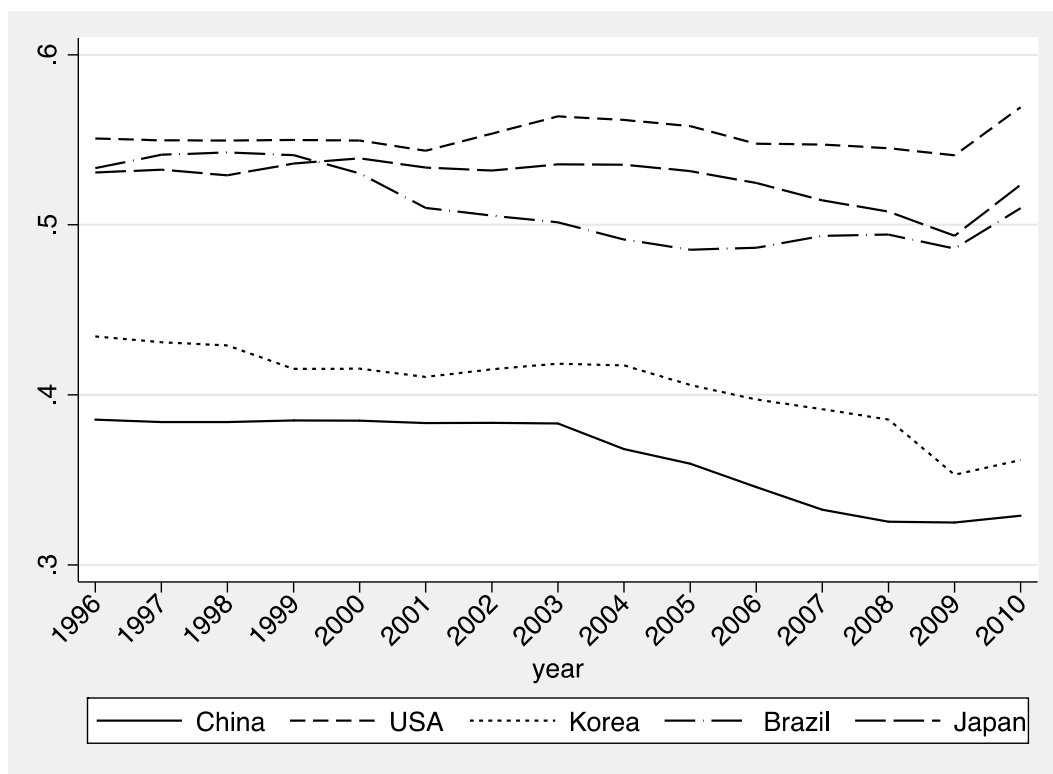


Fig.1 The VAR of Some Elected Countries

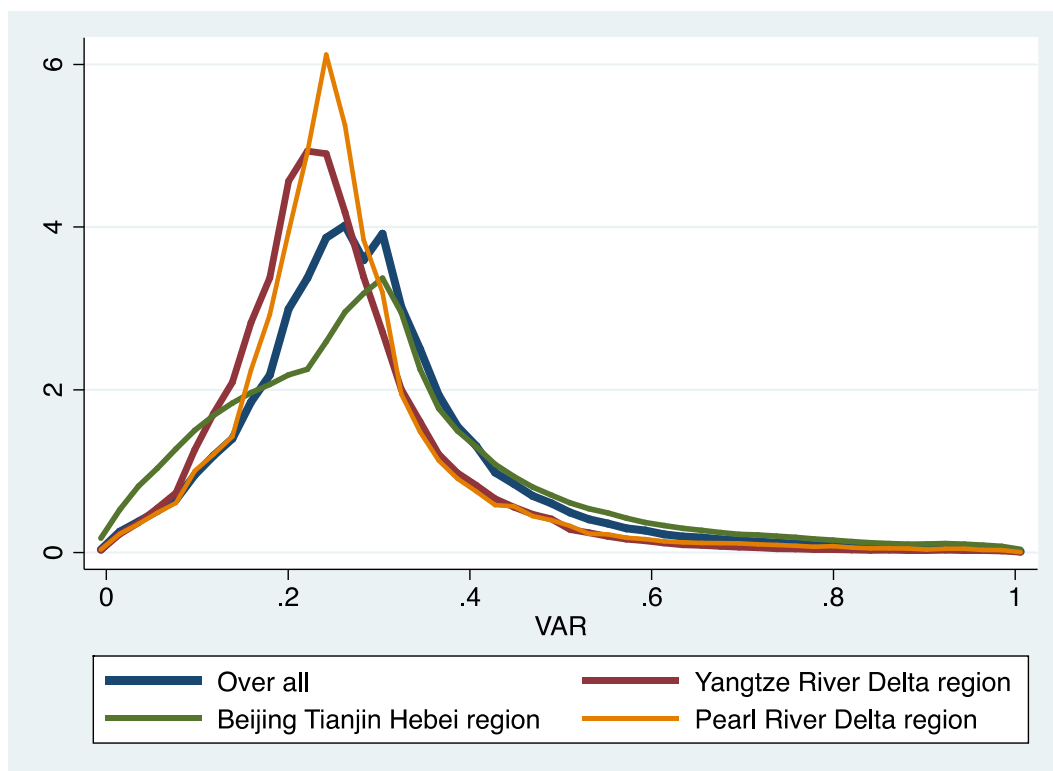


Fig. 2 Kernel Density of China's Industrial VAR

And according to the Table 1, we found that the highest industrial VAR is concentrated in undeveloped provinces, such as Heilongjiang, Inner Mongolia, Qinghai, Shanxi, Yunnan, etc. While

the lowest industrial VAR is concentrated in the well-developed provinces, such as Beijing, Jiangsu, Shanghai, Shandong, etc. (Ren 2012). If we sort by the quality of economy then the top 10 provinces are Beijing, Shanghai, Guangdong, Tianjin, Zhejiang, Jiangsu, Hainan, Shandong, Fujian, Liaoning, these are developed eastern provinces. And the undeveloped central and western provinces, such as Xinjiang, Henan, Guangxi, Gansu, Shanxi, Inner Mongolia, Ningxia, Guizhou, Qinghai, Yunnan, these provinces in the bottom ten. Obviously, the quality of economic growth in the eastern provinces is significantly better than the central and western provinces. But if we according to the industrial VAR, we found that the result is the opposite of the facts, therefore, the VAR exist some problems.

Table 1 Changes of Industrial VAR in China's Provincial Level

Province	2000	2003	2005	2007	2010	2011
Beijing	0.3290	0.3214	0.2458	0.2159	0.2018	0.2101
Tianjin	0.3016	0.3007	0.2890	0.2642	0.2633	0.2603
Hebei	0.6426	0.5272	0.4273	0.3820	0.3068	0.2965
Shanxi	0.6152	0.5296	0.4366	0.4032	0.3735	0.3722
Inner Mongolia	0.6465	0.5706	0.4934	0.4785	0.4191	0.3995
Liaoning	0.4977	0.4183	0.3146	0.2681	0.2427	0.2560
Jilin	0.3903	0.3496	0.3597	0.3347	0.3000	0.2907
Heilongjiang	0.6365	0.6443	0.5719	0.5416	0.4645	0.4546
Shanghai	0.3222	0.2844	0.2560	0.2316	0.2170	0.2222
Jiangsu	0.3682	0.3330	0.2886	0.2458	0.2094	0.2069
Zhejiang	0.4461	0.3469	0.2746	0.2520	0.2463	0.2603
Anhui	0.5327	0.4811	0.4023	0.3537	0.2887	0.2729
Fujian	0.5437	0.4161	0.3444	0.3113	0.2921	0.2797
Jiangxi	0.5834	0.5864	0.4886	0.3894	0.3088	0.3015
Shandong	0.4410	0.3711	0.3086	0.2664	0.2249	0.2138
Henan	0.5723	0.5362	0.4668	0.3673	0.3415	0.2977
Hubei	0.4057	0.4174	0.4086	0.3737	0.3111	0.3041
Hunan	0.6725	0.5686	0.4617	0.4014	0.3317	0.3078
Guangdong	0.3576	0.3201	0.2918	0.2704	0.2501	0.2599
Guangxi	0.6104	0.5665	0.4965	0.4556	0.4003	0.3779
Hainan	0.3473	0.3966	0.3740	0.2776	0.2789	0.2969
Chongqing	0.6588	0.5876	0.5122	0.4594	0.4044	0.3959
Sichuan	0.5558	0.4737	0.4090	0.3550	0.3210	0.3113
Guizhou	0.5204	0.4842	0.4185	0.3884	0.3606	0.3314
Yunnan	0.6621	0.5665	0.4501	0.3946	0.4028	0.3848
Tibet	0.6190	0.6461	0.6405	0.6678	0.6385	0.6437
Shaanxi	0.5317	0.5358	0.4858	0.4470	0.4071	0.4101
Gansu	0.3897	0.3906	0.3449	0.3292	0.3283	0.3116
Qinghai	0.4019	0.4727	0.4189	0.4188	0.4141	0.4287
Ningxia	0.4044	0.4286	0.3401	0.3518	0.3342	0.3278
Xinjiang	0.4913	0.5063	0.4574	0.4262	0.4046	0.4018

In short, through the comparison between the domestic areas and the comparison between the abroad countries, we found that some errors occurred in VAR. According to the basic conception of VAR, VAR should reflect the quality of economic growth, but why statistical comparisons between the domestic areas come to the opposite conclusion? There must be something wrong with the logic of VAR. So, do the VAR can reflect the quality of economic growth? Yes, it needs detailed analysis and discussion.

The paper is organized as follows: Section 2 is the literature review of the VAR. Section 3 is the basic model: the calculating formal of the upper limit of VAR. Section 4: explaining and solving two questions raised by section 3. Section 5: developing an economic model to analyze the pattern of Chinese real VAR. Section6: conclusion and recommendation.

II. Literatures Review

In the research of economic growth theory, people have become more and more aware of the situation of judging a country's economic growth, not only depends on the growth rate, but also depends on the quality of growth. How to judge the quality of economic growth is always an important area of economic research.

The existing research at home and abroad mainly include the basic concept, influencing factors, evaluation methods, and related measures. Representative view:

First, the quality of economic growth is the number of economic growth to a certain stage, improve the efficiency of economic growth, structural optimization, improve stability and welfare improvement, and improve the innovation ability. (Xi, 2012; Ren, Wang, 2013; Wang, Fang, Liu, 2009; Guo, 1996; Jeff, 1983).

Second, factors affecting the quality of economic growth are related to economic, natural, social, cultural, legal and other aspects (Ren, 2012; Jian, 2012; Niu, 2011; Zheng, 2007; Guo, 1996; Liu, 2002).

Third, the evaluation criteria of economic growth quality mainly include multi index method and single index method, multi index method is in fact a comprehensive analysis of various factors. Several indicators of economic growth quality from the 3 dimensions to the 7 dimensions are proposed in recent years (Xiang, Zheng, 2012; Ren, 2012; Niu, 2011) including the gradual and relatively mature indicators of well-off society (National Bureau of statistics, 2003; Jiangsu Provincial Bureau of statistics, 2004), modernization (basic modernization) index (Chinese Academy of Sciences, China's modernization research center, 2002; Jiangsu Provincial Bureau of statistics, 2011), sustainable development indicators (Institute of sustainable development, Chinese Academy of Sciences, 2002), happiness index (Chinese Academy of Social Sciences, 2004; Jiangyin Jiangsu Municipal People's government, 2008)etc. popular evaluation indicators converges. The evaluation method is almost exhausted all quantitative analysis tools, for example, multivariate statistical analysis, panel data model, CGE model, VAR model, system dynamics, etc. (Wang, Ren, 2015; Niu, 2011; Hu, 2010; Liu, Zhang, 2006; Liang, 2002) Meanwhile because of the comprehensive characteristics, the single index method has been paid more attention by researchers.

Single index method mainly includes total factor productivity method and added value rate method. At present, the total factor productivity method has become the most popular index to evaluate the quality of China's economic growth (according to our search for "total factor productivity"(TFP) in Chinese academic journals, as of October 18, 2015, a total of 4043 inquiries to all kinds of articles.) At the same time, some influential international institutions in the study of the economy, often tread the total factor productivity changes as an important part of the quality of economic growth, such as The World Bank, Organization for Economic Co-operation and Development, OECD research reports on China's development have estimated the trend of total factor productivity (TFP) in China. But Zheng (2007), Lin and Ren(2007) have pointed out that the measure of China's economic growth quality on total factor productivity is limited: "at present the calculation method of the total factor productivity method cannot reflect the factors of production cannot fully reflect the economic effect, the allocation of resources, the importance of capital accumulation is undervalued." The research on the quality of economic growth has been evaluated by the added value rate, which is mainly related to the three aspects of statistical research, economic growth, and policy operation.

First, value added rate level is directly related to the quality of economic growth (Shishido, et al., 2000; Xu et al., 2010). The added value rate is the ratio of the added value (macro GDP) to the total investment (including initial and intermediate inputs), using this index to evaluate the quality of economic growth is in the logic of accounting, statistics and management. Support the view that the root cause of the continued decline in value added rate in China in recent years is the low efficiency of economic quality (Shen, Wang, 2006; Shen, 2009; Wang, Szirmai, 2008; Liu, 2011).

Second, value added rate is associated with the type of industry (Johnson, Noguera, 2012; Shishido, Al et, 2000; Niu, Dou, 2000; Liu, Zhang, 2004), The lower value added rate of manufacturing industry, and the higher value added rate of the service industry is mainly related with the input-output structure.

Third, the value added rate is directly related to the length of the industry chain (Niu, Dou, 2000; Liu, An, 2011), social division of labor is more detailed, the higher the degree of specialization, the closer the collaboration relationship, the more the number of product transfer value to repeat the calculation, the increase in the value added rate will be reduced accordingly.

Fourth, the value added rate is related to the degree of economic system reform (Li, 2009). The high degree of state-owned monopoly, high capital-intensive industries with high value added rate, and the high degree of privatization, high labor-intensive industries with low value added rate.

In the research of economic growth related to the increase of value added rate, the existing research mainly concerns the structural economic growth theory and the intra product specialization theory.

First, structural economic growth theory mainly from the perspective of supply and demand analyses the impact of value added rate. In recent years, it has attracted the attention of researchers to analyze the economic structure growth model in the unified model (Foerster, et al. 2011; Duarte, Restuccia, 2010; Acemoglu, 2009; Ngai, Pissarides, 2007; Chen. 2007; Chen, Gong, 2005; Lin, 2012). Structural economic growth theory is mainly in accordance with the supply (including

productivity and capital deepening degree), demand direction(Acemoglu,2009).

Second, the theory of intra product specialization is mainly from the perspective of supply theory impact value added rate analysis. Globalization makes the level of international division of labor appeared a new trend: a lot of production process contains different processes and sections, be split up into different countries and regions distribution, forming process, section, and part of the division of labor system as the object. This trend is known as intra product division (Lu, 2004; Koopman, Al et, 2014). Among them, the non-competitive input output table is used to calculate the contribution of countries and regions in the global value chain, and to become the mainstream research direction of the research (Hummels, et, Al, 2001; Liu, 2007; Burstein, 2015; Cravino, Los, et al, Timmer et, 2015; Al, 2014).

In the evaluation of the quality of economic growth indicators in the actual operation of the most used is a well-off index, modernization (basic modernization) indicators, happiness index and other indicators of the representative, for example, “The main indicators of building a well-off society in an all-round way in Jiangsu province”.

2003, Jiangsu province to adapt to the central, the first to achieve a well-off, the first to realize the basic modernization of the requirements and put forward, and in the province, the city, county, township implementation and assessment. The index is divided into economic development, people's life, social development, democracy and the rule of law, the ecological environment, another 1 evaluation indicators, namely the masses on the completion of a comprehensive well-off social outcomes of satisfaction, as comprehensive evaluation reach index. Achieved remarkable results in the actual operation.

For example, Kunshan, Jiangyin, South of Jiangsu, the Soviet Union, the North Jiangsu and so on has achieved the well-off society in an all-round way, and has a certain exemplary role to the whole country. But the problems existing in the implementation of the multi index cannot be ignored: indicators have too much, not only part of the index between time series are highly correlated, and does not take into account resource endowment heterogeneity between different regions; second is no similar index system, because of the lack of international comparison, which makes it difficult to accurately determine the science and rationality of setting the goal of development. Other modernization (basic modernization) indicators carried out on other place, such as the well-being index, have similar scenarios. Therefore, it is very important to propose a single index method, which is comprehensive and operational.

In the single index to evaluate the quality of economic growth mainly includes science and technology progress in economic growth and the contribution rate of value added rate. At present, born out of the contribution of technological progress to the economic growth of total factor productivity (TFP) rate has become at all levels local governments in national economy and social development of the annual statistical bulletin, five-year plan, core indicators and report on the work of the government. In addition to the aforementioned TFP calculating theoretical problems, local governments at all levels in the actual operation of most of the "black box" operation of the index, and it has attracted no small questioned and criticized. In January 2012, the value added rate,

Chinese is industry big but not strong allow all doubt the fact that. Industrial transformation and upgrading of planning under the State Council issued a formal "(2011-2015)" for the first time, the industrial added value rate index of actual monitoring. The State Council also proposed the development goal of China's manufacturing industry to increase the value rate again in the formal issue of "made in China" in May 2015. Therefore, the discussion based on increased value rate method to study Chinese Research on the quality of economic growth, to implement the spirit of the Fifth Plenary Session of the eighth, to achieve " the 13th Five-year " period of China economic development the new normal background to achieve the completion of a comprehensive well-off society goals, put forward feasible countermeasures and suggestions, with important practical significance.

In summary, in order to increase the ratio of value represents the evaluation of economic growth quality of the single index method is more and more and more attention by the theoretical and policy level, but because of the value added rate of existing theoretical level only based on the input output table of statistical phenomenon arrangement, is still a lack of modern mainstream economics system theory and empirical research. Therefore, there is a lot of space to research.

III . The Threshold Limit of the VAR: Theoretical Derivation

The theoretical model of structural economic growth associated with the rate of increase is related to the form of production function. The present of the Theory of Separability can make the intermediate input and the middle output equal and eliminated for the total study. This provide the probability to study the production function only by value added function but not total output production function (Leontief, 1947; Morishima, 1961). Therefore, the mainstream of modern macroeconomics textbooks generally do not discuss the issue of value added rate (Romer, 2014; Sargent, 2014). But Jones (2011, 2013) studies suggest that: Since the middle input accounts for more than half of the total investment, the effect of the intermediate input multiplier effect on the total output can not be ignored. Therefore, the production function should be discussed including the total output function. Obviously, the separation theorem does not apply to the production function especially when study about the industry (Duan, 2010; Duffy, Papageorgiou, 2000; Yuhn, 1991). Therefore, it makes possible to study the VAR only consider the intermediate inputs and the total output production function could.

3.1 Basic assumptions

For the convenience of research, this paper referring to Jones (2011, 2013) to set the basic assumptions:

- (1) Assumption that aggregate output is produced by the primary input and intermediate input. And the initial input is composed of capital and labor. Taking the Cobb-Douglas technology into the output function. labor is exogenous and constant.
- (2) Assumption that the intermediate inputs are as part of total outputs during the previous period. Jones(2011) supposed that the intermediate inputs are also a kind of capital, and will

be completely consumed in the production process, which is "fully depreciated". So the total output is divided either into consumption, or investment, and will be transferred to the next stage as intermediate goods. In another words Gross domestic product (GDP) in this economy is consumption plus investment, or output net of intermediate goods, assuming a constant fraction x of gross output is used as an intermediate good.

(3) Assumption that there is no technological progress, and a constant depreciation rate, saving rate.

3.2 Theoretical derivation

In the scenario above, the production process of economic activity can be simplified and be expressed as:

$$q_{t+1} = k_{t+1}^\alpha [(1-v)q_t]^{1-\alpha} \quad (1)$$

where, q_t is gross output, k_t is stock of capital, v is defined as the approximate of value added rate, The subscript t represent for the t^{th} period. In the case of discrete production, the product of the last period of the total output and the intermediate input coefficient is the intermediate input of this period, where the intermediate input coefficient is $(1-v)$, this structured the middle part of the input in formula (1).

The form of capital movement is:

$$k_{t+1} - k_t = svq_t - (n + d)k_t \quad (2)$$

where s is saving rate, n is the growth rate of population, d is the depreciation rate. The product of value added rate and the gross output is the value added in current period.

Combined (1) and formula (2), the total output of the movement can be obtained:

$$q_{t+1} - q_t = k_{t+1}^\alpha [(1-v)q_t]^{1-\alpha} - q_t \quad (3)$$

Insert formula (2) into formula (3), get:

$$q_{t+1} - q_t = [svq_t - (n + \delta)k_t + k_t]^\alpha [(1-v)q_t]^{1-\alpha} - q_t \quad (4)$$

The system of difference equations:

$$\begin{cases} \Delta k_t = svq_t - (n + \delta)k_t \\ \Delta q_t = [svq_t + (1 - n - \delta)k_t]^\alpha [(1-v)q_t]^{1-\alpha} - q_t \end{cases} \quad (5)$$

When $\Delta k_t = \Delta q_t = 0$, we get:

$$\begin{cases} q_t = \frac{n + \delta - 1}{sv - (1-v)^{\frac{\alpha}{1-\alpha}}} k_t \\ q_t = \frac{n + \delta}{sv} k_t \end{cases} \quad (6)$$

When $\frac{n + \delta - 1}{sv - (1 - v)^{\frac{\alpha}{1-\alpha}}} > \frac{n + \delta}{sv}$, the movement of q_t and k_t will be like 3(a).

When $\frac{n + \delta - 1}{sv - (1 - v)^{\frac{\alpha}{1-\alpha}}} < \frac{n + \delta}{sv}$, the movement of q_t and k_t will be like 3(b).

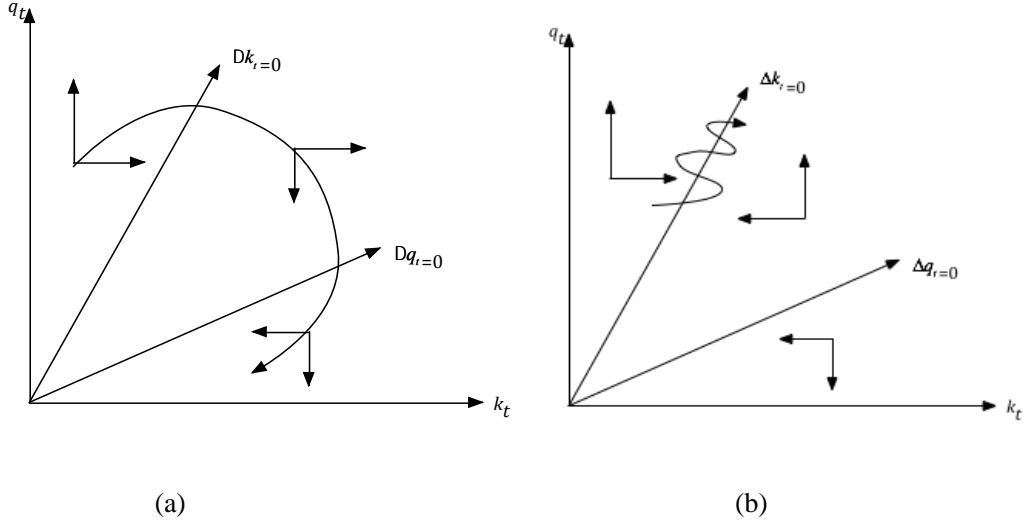


Fig. 3. The Movement of q_t and k_t

Compare the movement of q_t and k_t in 3(a) and 3(b), The difference of parameters such as population growth rate, depreciation rate, saving rate and so on could lead to the slope of the two lines $\Delta k_t = 0$ and $\Delta q_t = 0$ of the equation system is different. So there are also two kinds of development trends. In figure 3(a), the slope of $\Delta q_t = 0$ is bigger than $\Delta k_t = 0$, In this case, regardless of the starting point of the economic level, the ultimate economic trend is most likely to embark on a road of recession. In the figure 3(b), the slope of $\Delta k_t = 0$ is bigger than $\Delta q_t = 0$, In most of the starting position of the economy will eventually be in the vicinity $\Delta k_t = 0$ and rise in volatility.

According to the analysis above, the economic system to determine the parameters of the two line slope. And the real economy is best to meet certain conditions to achieve the movement in Figure 3 (b).

Further research on the conditions of the above two kinds of conditions^①:

① With similar conditions in the capital contribution level and intermediate input variable, in order to meet the sustainable economic growth rate, condition of added value: $\frac{(n + \delta)(1 - v)^{\frac{\alpha}{1-\alpha}} - sv}{sv - (1 - v)^{\frac{\alpha}{1-\alpha}}} < 0$, That is to

say: $sv - (n + \delta)(1 - v)^{\frac{\alpha}{1-\alpha}}$ and $sv - (1 - v)^{\frac{\alpha}{1-\alpha}}$ must be the same sign, so there exists to conditions:

For the sake of simplicity, it is assumed that capital and intermediate inputs have a similar level in contribution. Where, $\alpha = 0.5$.^①

$\frac{n + d - 1}{sv - (1 - v)^{\frac{a}{1-a}}} < \frac{n + d}{sv}$ could be simplified to:

$$\frac{n + d - 1}{sv + v - 1} < \frac{n + d}{sv} \quad (7)$$

To meet the requirement of figure 4 (b) above, the value of the added value rate should meet the the inequality(8):

$$v < \frac{n + d}{s + n + d} = 1 - \frac{s}{s + n + d} \quad (8)$$

The inequality (8) means that only when added value rate is less than the quotient between the population growth rate plus the depreciation rate and the savings rate plus the growth rate plus the depreciation rate can make sure economy embark on a road as the derivation of Figure 4 (b).

We define the level which consist of population growth rate depreciation rate and savings rate as the threshold of value added rate w

$$w = \frac{n + \delta}{s + n + \delta} \quad (9)$$

To further study the savings rate, population growth rate and the depreciation rate of value added rate threshold limit, we get

$$\frac{\partial w}{\partial s} = - \frac{n + \delta}{(n + s + \delta)^2} \quad (10)$$

$$\frac{\partial w}{\partial n} = \frac{\partial w}{\partial \delta} = \frac{1}{n + s + \delta} - \frac{n + \delta}{(n + s + \delta)^2} \quad (11)$$

Formula (10) - (11) show that the savings rate of the added value of impact rate threshold limit is negative, and the rate of depreciation and the population growth rate showed a positive correlation.

$$sv - (n + d)(1 - v)^{\frac{a}{1-a}} > 0 \quad \text{and} \quad sv - (1 - v)^{\frac{a}{1-a}} > 0, \quad \text{or} \quad sv - (1 - v)^{\frac{a}{1-a}} < 0 \quad \text{and} \quad sv - (n + d)(1 - v)^{\frac{a}{1-a}} < 0 \quad (n + d)$$

is less than 1, so the condition can be simplified to: $sv - (1 - v)^{\frac{a}{1-a}} > 0$ or $sv - (n + d)(1 - v)^{\frac{a}{1-a}} < 0$. $\frac{(1 - v)^{\frac{a}{1-a}}}{v}$ Is a reduction function of v , So the reasonable numerical value added rate is below a certain threshold at or above a certain threshold. Considering the law of economic development, and China's value added rate is relatively low in fact, we assume that the capital and intermediate inputs have a similar level of contribution, that is, with second inequalities.

^① We (Jiang, Fan, Yuan, 2014) calculated the contribution rate of the capital contribution of the calculation of the intermediate input and the initial coefficient of elasticity in the other part, the value is 0.467, so here it is assumed that the capital contribution rate is 0.5.

This means In order to increase threshold level of value added rate (TL-VAR) to achieve higher quality of economic growth, we need to expand domestic demands for the purpose of reducing the saving rate, to adjust family plan policy for the purpose of ensuring the rate of population growth, to improve the industrial level and to expedite the elimination of over-production capacity for the purpose of accelerating depreciation.

III. Explanation of the Aforementioned Problems

The following is based on the conclusion of the third part and explain the questions forward in the introduction.

This paper argues that the VAR threshold limit is an important logic to measure the quality of economic growth when using VAR. And we should take full account of its effects while comparing economic growth quality by using the VAR index.

4.1 An explanation of the problem of VAR among the provinces of China

According to the derived formula (8) above, we try to calculate China's value added rate (see table 2). In recent years, the overall trend of TL-VAR of China is declining. This situation is directly related to the continuous rise in savings rates and the continuous decline in population growth rates.

Table 2 Calculation Results of TL-VAR in China

Year	n (‰)	d (%)	s (%)	TL-VAR
1996	10.42	5.7783	30.8556	0.1810
1997	10.06	5.9405	33.0477	0.1737
1998	9.14	6.2882	33.0718	0.1788
1999	8.18	6.3346	31.5307	0.1849
2000	7.58	6.1491	30.8416	0.1830
2001	6.95	6.1723	31.5460	0.1788
2002	6.45	5.9869	32.9106	0.1677
2003	6.01	5.7783	35.1311	0.1537
2004	5.87	5.7551	36.7762	0.1471
2005	5.89	5.4769	38.6180	0.1358
2006	5.28	5.1524	40.1735	0.1239
2007	5.17	4.8047	41.8021	0.1129
2008	5.08	5.871	42.3590	0.1309
2009	4.87	5.9637	42.7658	0.1311
2010	4.79	5.6855	43.9203	0.1231
2011	4.79	5.9405	43.7661	0.1279

Data sources: savings rate from the world bank, the rate of population growth from 2015 "China Statistical Yearbook", the depreciation rate from reference of Chen's(2014) estimates.

Using the data in Table 2, and analysis the problem in table 1, will inset the TL-VAR into the

industrial VAR of Chinese province in 2010, see Fig. 4.

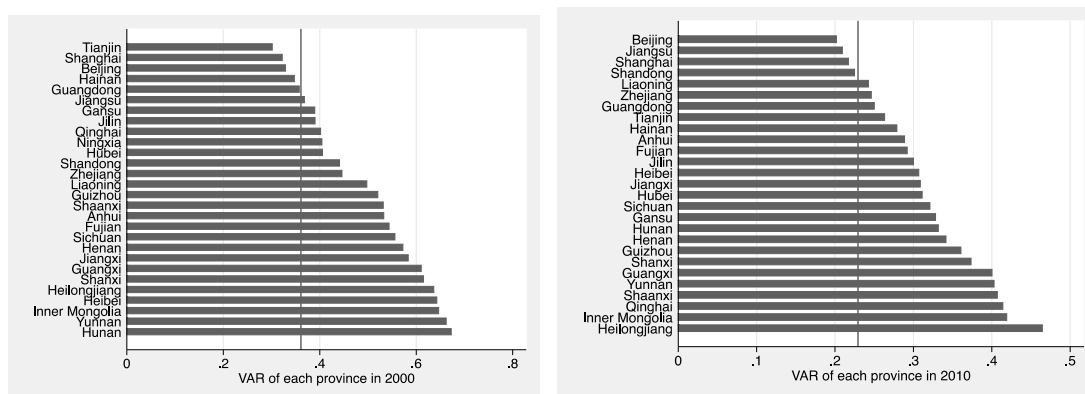
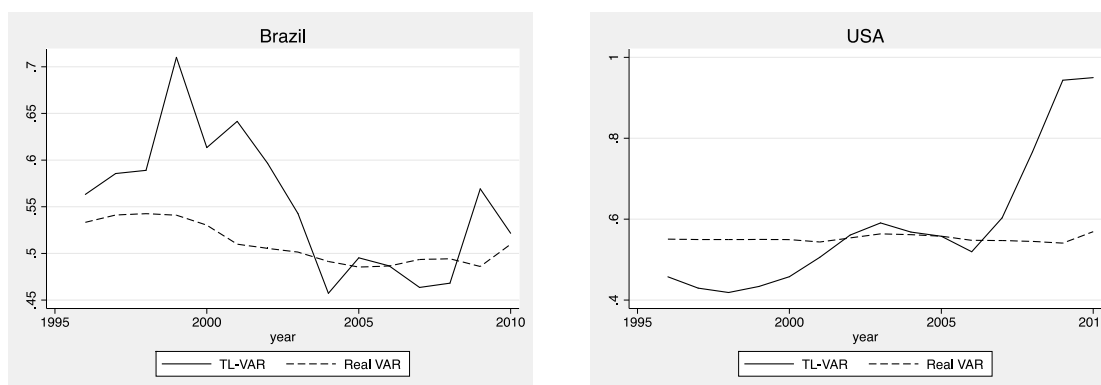


Fig. 4 shows that, although the VAR change in the provinces, China's TL-VAR is also changing, however, the province vicinity of the TL-VAR remains unchanged. If set the TL-VAR as the upper limit of VAR, when the real VAR is below the TL-VAR, the larger the better. However, once the real VAR is above the TL-VAR, it means that the larger VAR does not represent the higher quality of economic growth. The conclusion we get from this rule is close to the Chinese province economic growth quality ranking which made by Ren (2012).

So when the real VAR is under the TL-VAR, our intuitive judgment about VAR is establish, namely, the higher VAR directly reflect the benefits of reducing the intermediate consumption and the higher value added, so the output effect is better, this further reflect the higher quality of economic growth. But when the real VAR exceeds the TL-VAR, this understanding is not correct, due to some more complex questions, the higher VAR is not the better, such as from the technical level, every industry must have an lowest intermediate inputs in order to ensure the normal production.

4.2 Explanation of the problem of VAR among countries

The VAR and TL-VAR in the international comparison, the results are shown in Figure 5



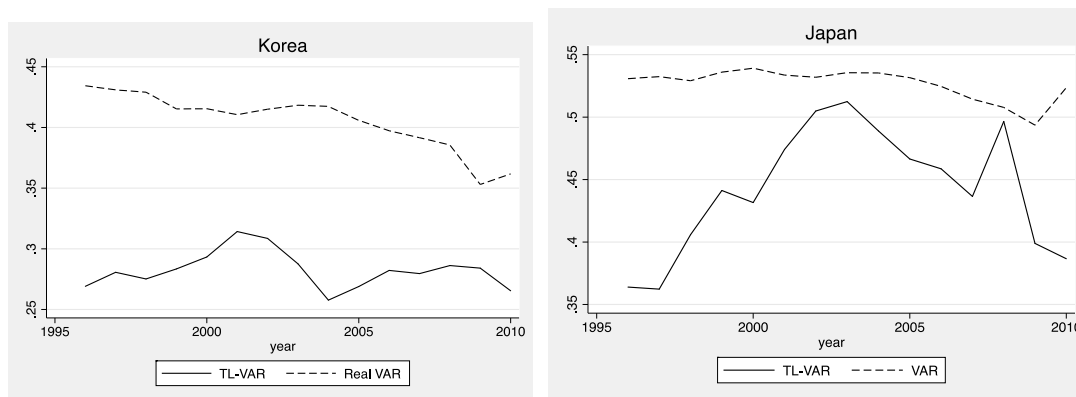


Fig. 5 Change Trend between the Actual VAR and the TL-VAR of the Selected Countries

Compare the four countries in figure 5, the VAR of the United State did not change much, However, for the benefit of the continues increase of TL-VAR, the quality of the real VAR is rise. although South Korea's actual VAR is beyond the threshold value, but in recent years there has been a shrinking trend, Japan has once narrowed the actual VAR of the threshold value gap, but in recent years, the trend is increasing.

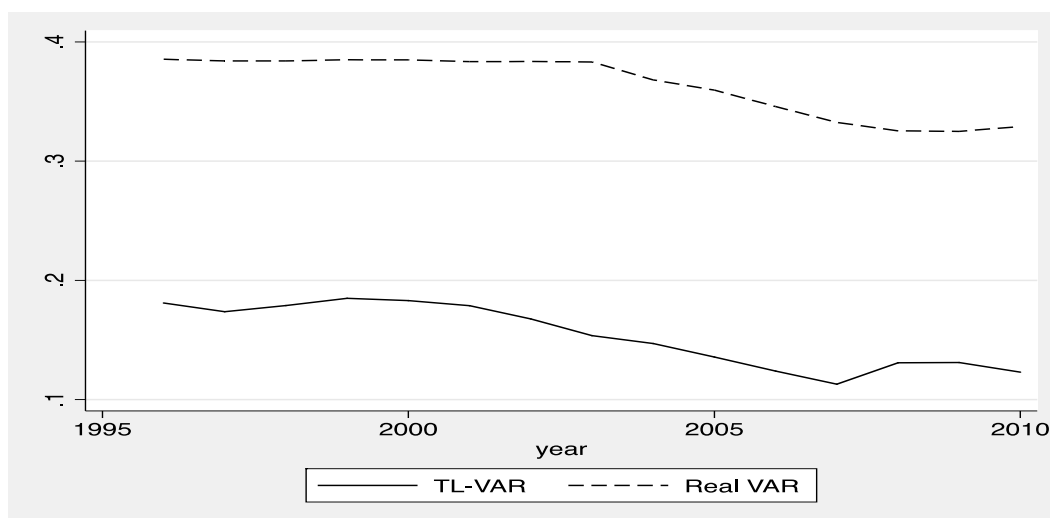


Fig. 6 The Real VAR and TL-VAR of China

The situation of China is shown in Fig.6. It is not the same as the other four countries, The real VAR is above the TL-VAR in China all along, and the gap between real VAR and the TL-VAR has not changed much in many years. This explains the question that compare the quality of economic growth of China and other countries using value added rate as a measure index, it is not the quality of China's economic growth is low, but the actual VAR of China exceeded the threshold limit, resulting in the evaluation of the quality of economic growth will produce biased. Based on formula (9) - (11), China's real value added rate showed a significant downward trend, this may be result from China's increasing saving rate in recent years, and directly related with the slowing down of population growth rate. Figure 6 shows that the change of TL-VAR and the change of real VAR is consistent, then, is the adjustments of real VAR is based on the change of TL-VAR? This need further analysis.

V. Econometric Analysis

5.1 The relationship between the real VAR and the TL-VAR by using VEC model.

(1) Data resource

China's actual value added rate (v) data from the world input-output table database (WIOD), the current data released is 1995-2011, 17 years of annual data in total. The threshold of value added rate(w) data is calculated using the derive in chapter 4, is function related with savings rate, population growth rate and depreciation rate.

(2) Estimate long-run equilibrium response function

Unit root test. If the time series of a set of variables is not stable, then each variable is subordinate to the first order unit root process is the premise that they exist cointegration relationship, through the ADF unit root test method, the results shown in table 3. Test results show that the variable V and W respectively have a unit root process.

Table 3 Unit Root Test of the Real VAR and TL-VAR seires

Variable	ADF	critical value			Z
		1%	5%	10%	
v	-0.030	-3.750	-3.000	-2.630	0.9559
w	-0.694	-3.750	-3.000	-2.630	0.8484

select lagged rank of model, use the BIC and AIC Information Criterion to determine the lagged rank in table 4.

Table 4 The Lagged Rank of the VAR Model

Lag	LL	LR	df	p	FPE	IC		
						AIC	HQIC	SBIC
0	55.4089				2.1e-07	-9.71071	-9.75632	-9.63837
1	76.4868	42.156	4	0.000	9.6e-09*	-12.8158	-12.9526	-12.5988
2	79.8407	6.7077	4	0.152	1.2e-08	-12.6983	-12.9263	-12.3366
3	82.9992	6.3171	4	0.177	1.9e-08	-12.5453	-12.8645	-12.0389
4	93.1712	20.344*	4	0.000	1.5e-08	-13.6675*	-14.0779*	-13.0164*

Table 5 The Co-integration Regression Test of VAR and TL-VAR

Rank	parms	LL	Eigen value	Trace statistic	5% critical value
0	14	77.4632		31.4160	15.4100
1	17	91.2249	0.9181	3.8926	3.7600
2	18	93.1712	0.2980		

Impulse response function is used to analyze the dynamic effect on the system when an error changes or the model is affected by a certain impact. In figure 7, when the actual VAR or the upper limit of VAR threshold of this period was given a positive impact, they have a long-term impact to each other, when the current actual VAR was given a positive impact, VAR threshold limit has a

large growth in the first three periods, then tend to be stable. When the VAR threshold limit of this period was given a positive impact, the actual VAR has a large growth in the first four periods, and begins to drop slightly in the fifth period after maintaining for one period, and then tends to be stable. According to the conclusions, the upper limit of VAR threshold is related to macro indicators such as saving rates, population growth rate and depreciation rate, etc., therefore, policy changes related with banking, family planning, finance, taxation, industry, etc., will influence the actual VAR in three to four years, and it will be a lasting effect.

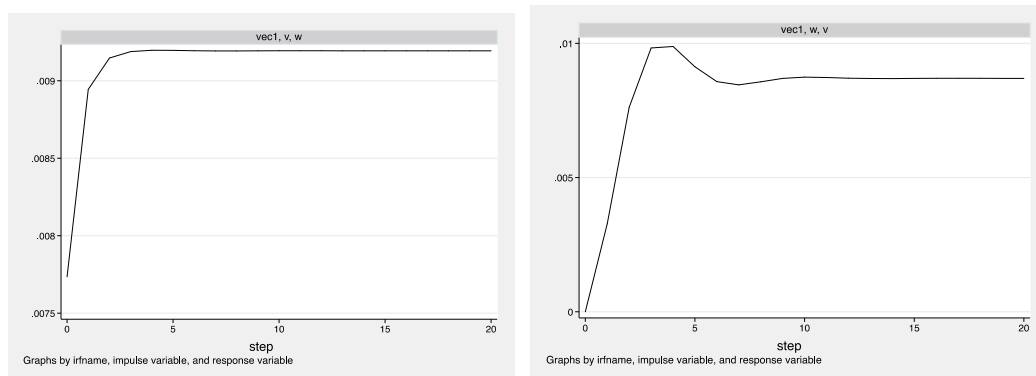


Fig.7 Response between the Actual VAR and the Upper Limit of VAR threshold

(4) Conclusions

From what has been discussed above, we get the following conclusions:

On the one hand, there exists a long-term co-integration relationship between the actual VAR and the upper limit of VAR threshold, and the real value rate is adjusted according to the upper limit of VAR threshold, it also explains the reason for the decline in VAR in recent years in our country.

On the other hand, the upper limit of VAR threshold is related to macro indicators such as saving rates, population growth rate and depreciation rate, therefore, policy changes relevant to the banking, family planning, finance, industry, etc. will influence the actual VAR in three to four years, and it will be a lasting effect.

5.2 Estimation of the relationship of the actual VAR and the total factor productivity (TFP)

5.3

The TFP is considered currently to be the most popular composite index of single index to evaluate the quality of economic growth, so it is necessary to further expound the relationship between the actual VAR and the TFP from the angle of time sequence.

(1) Comparison between the actual VAR and the existing representative evaluation index of the quality of economic growth

Considering comprehensively domestic representative results of researches concerning China's TFP measurement (Zhang, Shi, 2003; Wu etc., 2014; Yu, 2015), since China's reform and opening up, its TFP has shown positive growth in most years, and it has positive effect on the economy, despite the growth rate of TFP obviously lag behind the rapid economic growth, but TFP accumulation is

upward. In other words, the quality of China's economic growth tends to increase overall, when the TFP accumulation is used as the method of single index to evaluate the quality of the China's economic growth (see Fig. 8).

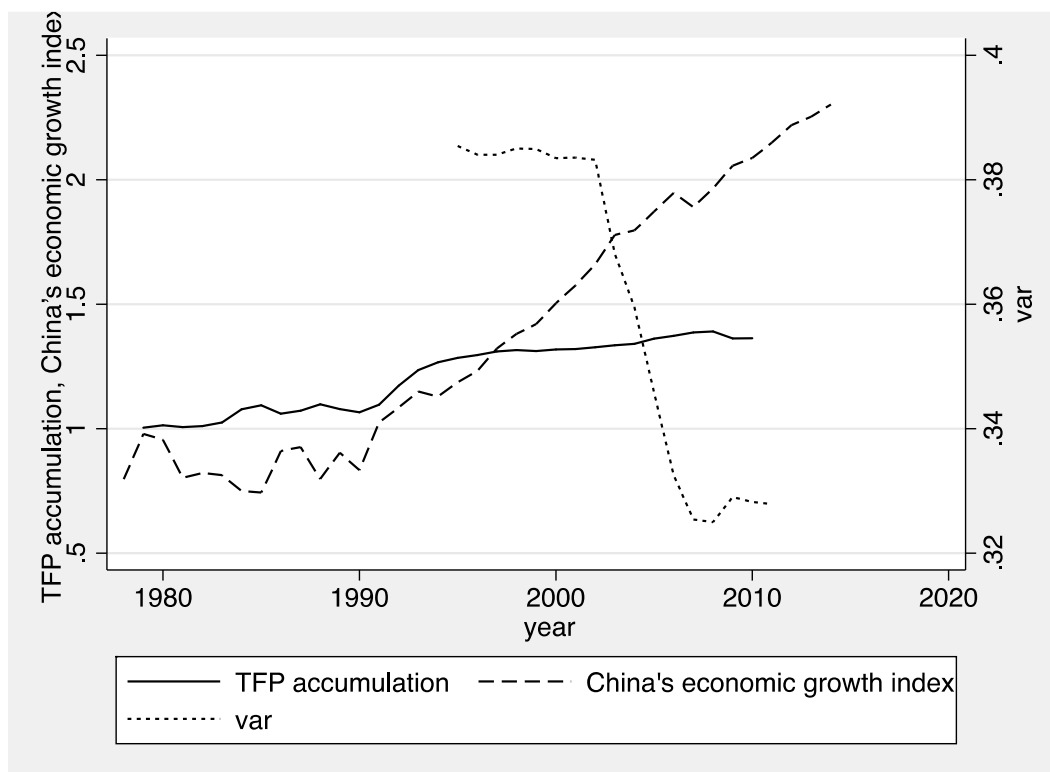


Fig.8 Comparison between the Actual VAR and the Existing Representative Evaluation Index of the Quality of Economic Growth

Source: TFP index and TFP accumulation is from the measure by Wu etc. (2014), the quality index of economic growth comes from the Wang & Ren (2015), the VAR of 1995-2011 is from the calculation by authors according to WIOD data.

The evaluation given by Wang & Ren (2014) shows that the quality of China's economic growth tends to increase overall, while they use the index system of economic growth (that is, the proposed "economic growth quality index") composed of economic efficiency, economic structure, economic stability and economic sustainability, which is consistent with the result when using the single index TFP accumulation to evaluate the quality of China's economic growth that of (see Fig. 9).

1995-2011 China's VAR tends to fall (see Figure 9), contrary to the trend of TFP accumulation and the index of the quality of economic growth during the same period. Obviously, according to this situation we cannot believe that the quality of China's economic growth is declining, this should be related to the fact that China's actual VAR has been below the upper limit of VAR threshold with the above analysis. Apparently, without considering the fact that China's actual VAR has been below the upper limit of VAR threshold, devotion to increase the actual VAR, may results in just the opposite.

(2) Econometric analysis of the relationship between actual industrial VAR and the TFP

In order to further research from the prospect of region and industry the relation between the VAR and the TFP, we analyze from the prospect of provincial industrial economy. There are two reasons for choosing the prospect of provincial industrial economy: first, in China the industrial VAR is highly correlated to the overall VAR, the correlation coefficient is 0.9967. “The planning of industrial transformation and upgrading (2011-2015)”, “Made in China 2025” are in the form of the government documents, successively monitoring indicators including “industrial VAR” and “manufacturing VAR”, therefore, research of the industrial VAR has extremely strong political significance; second, the data is available, which is beneficial for more reliable econometric analysis. “Industrial economic statistical yearbook of China” and the national bureau of statistics has released respectively the gross value of industrial output and industrial added value of provinces of the nation, which is convenient for the provincial industrial VAR.

According to our measuring of the correlation coefficient of industrial VAR and overall VAR from 1995 to 2011 of 36 countries using the data from WIOD, China's top, 0.9967, followed by Bulgaria, South Korea and Turkey, 0.9857, 0.9846 and 0.9823, respectively. In 36 countries, the number of countries with the correlation coefficients of industrial VAR and overall VAR above 0.90 is a total of 13, and 0.80 a total of 11. Especially the countries with developed manufacturing industry, and larger proportion of the added value of the second industry in GDP, such as Germany, Japan, the Netherlands, South Korea basically have the correlation coefficients above 0.90.

Learning from the measurement of Zhang and Shi (2003) we obtained the data of TFP in various provinces in 1992-2012^①, and according to the gross value of industrial output and industrial added value of provinces of the nation released by the “Industrial economic statistical yearbook of China” and the national bureau of statistics released respectively over the same period. Then we conduct panel regression analysis of the industrial VAR and TFP. According to the above theory, there is truncation of industrial VAR in maximum limit. The upper limit is also to consider when analyzing the relationship between VAR and TFP. We choose the adjustment of the average value of time trend maximum VAR 0.35^② as the truncation. Respective regression of fixed effects and random effects are conducted for VAR around 35%, panel random effects regression results are shown in table 7.

Table 7 the regression result based on the panel data of industry VAR

	model(1)	model(2)	model(3)	Model(4)
	v<35% (fe)	v<35% (re)	v>35% (fe)	v>35% (re)
VAR	4.812***	4.625***	-1.255***	-1.228***
t	(3.37)	(3.27)	(-4.58)	(-4.48)
c	-0.351	-0.396	1.393***	1.394***

^① Limited to space, the country's TFP calculation results is not list here. The calculated results of China's TFP trend is completely consistent with the Peen World Table (PWT8.1, <http://www.rug.nl/research/ggdc/data/pwt/>) published in the same period.

^② According to estimates, China's overall increase rate value threshold limit range from 0.3610 in 2000 down to 2010 of 0.2293, considering the overall value added rate threshold limit and China's industrial added value rate and the overall value added rate gap, the industrial added value rate threshold limit will be set to 0.35 in our econometric model. (0.35 is the optimal value we have obtained from repeated experiments in the econometric analysis. In fact, the existence of the value is also just in turn to the actual data to verify the rationality of the threshold limit of the added value rate.

t	(-0.88)	(-0.79)	(10.64)	(4.68)
n	254	254	273	273

Table 7 shows that when the actual industrial VAR is less than the threshold limit, there exists a positive relationship between the actual industrial VAR and TFP. And when it is greater than the threshold value, the relationship with TFP presents reverse change. If TFP is able to reflect the quality of economic growth, the VAR index can be positive reflection of the quality of economic growth at the range of its maximum limit, and beyond the limit is negative to reflect the quality of economic growth.

Table 8 Regression of VAR and TFP Based on the Panel Data of China in Provincial Level

TFP	co	S.D.	z	P	[95% confidence interval]	
VAR ²	-5.6263	1.6991	-3.31	0.001	-8.9565	-2.2961
VAR	4.5336	1.4594	3.11	0.002	1.6733	7.3941
c	0.0548	0.3998	0.14	0.891	-0.7288	0.8384
sigma_u	1.4353					
sigma_e	0.6453					
Rho	0.8319	(fraction of variance due to u_i)				

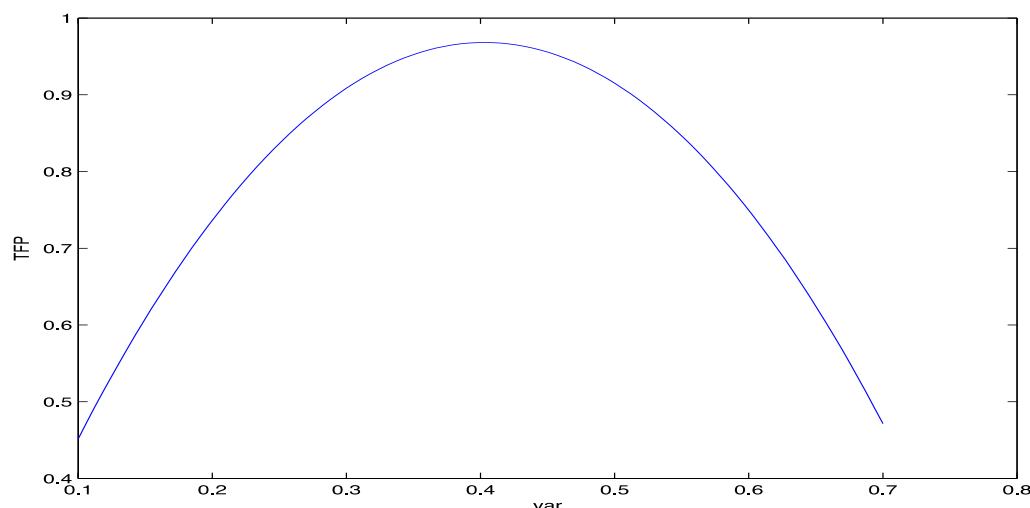


Fig. 9 Inversed U Relationship between TFP and VAR

VI. Conclusions and Prospects

Taking VAR as an important indicator to measure the quality of economic growth has a certain degree of recognition both in the theoretical research level and the policy practice. Generally speaking, the higher the rate of the added value of a country or region, the lower the production cost, and the higher the quality of economic growth. Chinese industry is big but not strong which is indubitable fact, In January 2012, the state council officially issued the 'industrial transformation and upgrading planning (2011-2015)', in which the industrial added value rate index was adopted as the index of industrial quality benefit for actual monitoring for the first time and put forward the industrial added value rate increased by 2% during the period of "12th Five-Year Plan" goal. Then

the state council issued “MadeinChina2025” in May 2015, in which put forward the development goals again that the manufacturing value added rate in 2020 and 2025 increased by 2 and 4% than in 2015, respectively. But many reality is very different: first, the added value of China's rate is relatively low in the world, and has been falling in recent years; second, the regional industrial added value rate index was totally opposed to regional economic development. The industrial added value rate in developed areas is low, and the backward area high instead.

Firstly, the VAR can reflect the quality of economic growth, but it is not in the simple way that the greater the better. Secondly, there exists a TL-VAR, and it varies considerably in different countries. In the same region it can also be varied at different times. As a result, we should take full account of its effects while comparing economic growth quality by using VAR index. Thirdly, when the real VAR is below the TL-VAR, the larger the better. However, once the real VAR is above the TL-VAR, it means that the larger VAR does not represent the higher quality of economic growth. Finally, the TL-VAR is associated with the depreciation rate, population growth rate, saving rate and other macroeconomic indicators. In order to increase China's TL-VAR to achieve higher quality of economic growth, we need to expand domestic demands for the purpose of reducing the saving rate, to adjust family plan policy for the purpose of ensuring the rate of population growth, to improve the industrial level and to expedite the elimination of over-production capacity for the purpose of accelerating depreciation.

Therefore, this paper put forward the following countermeasures

On the one hand, implement the "suggestion" spirit fully. Improve the threshold limit of China's value added rate from the aspects of population, financial, consumer, industrial under the combination of supply, demand and government. Then, the China's actual value rate can reflect the quality of China's economic growth truly. On October 18, 2015, The fifth Plenary Session of the 18th CPC Central Committee passed the "recommended", which laid a solid foundation to achieve the above conditions. "Build a well-off society in an all-round way" helps to form the agreement of promoting economic growth quality. "The universal two-child policy" improve China's population growth rate. "Shared development", "harmonious development" will help close the gap among regions and the difference between urban regions, rural regions and community, also expand domestic demand and reduce the savings rate. "Innovation and development" is helpful to improve the level of industry and accelerate the process of eliminating the excess capacity to accelerate depreciation, further improve the depreciation rate of capital.

On the other hand, integrate the current statistical system, measure, track and monitor the overall level of actual value rate and the threshold value rate upper limit of Chinese industry and regions, systematically and comprehensively, then master the China's economic growth quality scientifically. At the macro level, the national and provincial (except Tibet) input-output table only formally announced every five years, according to China's current national economic accounting system and there are 2 to 3 years of lag, which brings practical difficulties for the assessment of value rate of economic growth quality; But at the micro level, the enterprises, especially industrial enterprises, industrial added value and gross industrial output value are the commonly used statistical indicators by statistics department. Value added rate threshold limit proposed in this paper is related to

macroeconomic indicators such as depreciation rate, population growth rate and the interest rate on savings accounts. At the same time, it is also easy to obtain and measure. The current statistical system, therefore, makes this article research results easy to practice. Compared with factor productivity, and contribution rate of scientific and technological progress in economic growth, this method is more easy to operate and track, especially the comparison of cross section and time series for international, national and regional.

research prospect

Firstly, on the theoretical research, relax the basic assumptions of the model, and obtains the conclusion with more rich connotation. the output of model used in the existing researches is Cobb - Douglas model based on the ideas of Jones (2011, 2013), which can be further used CES and beyond the logarithmic to do expanded and theoretical analysis.

Secondly, on empirical research, enrich the new connotation of ‘the industrial transformation and upgrading planning (2011-2015)’ and “MadeinChina2025”.It has been more than three years since the state council officially issued the industrial transformation and upgrading planning (2011-2015),and" MadeinChina2025 "has been about to begin. Through the sorting of policy implemented and data, comparing among countries and regions will help to comprehensive evaluation, monitoring and forecasting for the effect of policy implementation. It will be helpful to put forward scientific, systematic and operable suggestions.

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