

# Revealed Comparative Advantage Analysis Based on VEC models in Chinese Capital-technology-intensive Industry

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**Abstract.** We investigate the relationships among revealed comparative advantages of Capital-technology-intensive industry, GDP per capita and households deposits in China. With the non-stationary sequences of global Capital-technology-intensive products' exports, we constructed the vector error correction model with serial correlation, and found that revealed comparative advantage, GDP per capita and annual increase of RMB savings deposits of Chinese residents are not stable series, while after second difference to three series, they were stable series. The revealed comparative advantage index are from 0.37 to 0.78, and revealed comparative advantage index, GDP per capita and annual RMB increase are with cointegrated. The result has showed that it will make non-equilibrium state back to equilibrium by coefficient of 0.24 in long-term.

## Introduction

The relationship among revealed comparative advantage (RCA), GDP per capita (PRGDP) and household deposit (SBRAI) in Capital-technology-intensive industry is increasingly discussed globally. Some scholars in China argue the RCA of capital intensive industry has a competitive edge in the world, while other researchers did not agree with it. They argued that the RCA presently have an advantage in the labor intensive industry other than in capital intensive industry.

David Ricardo(1870) created the comparative advantage theory as against Adam Smith's absolute advantage theory. It has become one of the main methods in analyzing the trade profit by export trade in and out of a country. A century later, Sweden economist Heckscher and Ohlin provided the dominant theory of factor endowment theory. Later, Haberler(1933), Wassily W. Leontief(1933), Lerner(1932) have improved it. Posoner (1961) use Technology gap theory to explore the merit. Vernon(1966) discuss it by Product life cycle theory.

Paul Krugman(1972) created scale economy and trade theory. Micheal Port raised the competitive strategies, national strategy and advantages of competition. However Krugman reject that Port's view does not be applied in the angle of nations, only can be applied in firms.

Hong(1977) argued the trap of comparative advantages. He insisted that the comparison of cost should be discussed within a country other than out of the country.

Leontief 's method of input-output model is a good way. However the basic data of materials is hard to get. So the Balassa (1965,1989) revealed comparative advantage index can be the reflection of trade advantages.

Analysis of these views is a comprehensive analysis of RCA, PRGDP and SBRAI of in-depth theoretical equation models. This paper summarizes the scholars research among RCA, PRGDP and SBRAI, and use vector error correction model, VEC, to explore the relationships.

The innovation of this paper is to use a longer time-series data quantitative analysis to improve the reliability and validity of the study, revise and improve some of the conclusions of previous studies.

The paper is organized as follows, the second part is a theoretical overview of the relationship between the RCA, PRGDP and SBRAI, the third part is the empirical analysis on Chinese RCA, PRGDP and SBRAI, the fourth part draw conclusions.

## Theoretical Overview on the RCA, PRGDP and SBRAI

According to literatures, the RCA (Balassa,1965,1989) is

$$RCA_{ij} = \frac{X_{ij} / \sum_i^N X_{ij}}{\sum_j^N X_{ij} / \sum_i^M \sum_j^N X_{ij}}$$

$X_{ij}$  is the export of Capital-technology-intensive Products within a country;  $\sum_i^N X_{ij}$  is the total export of the country.  $\sum_j^N X_{ij}$  is the export of Capital-technology-intensive Products in the world.  $\sum_i^M \sum_j^N X_{ij}$  is the export of the whole world trade.

The purpose is to explore how PRGDP and SBRAI affect the RCA in China. Whereas PRGDP and SBRAI will also have effects on RCA. Any one of the three variables can be the dependent variables and independent variables. Then VEC or VAR models can do it.

If the three variables, RCA, PRGDP and SBRAI, dataset are all stationary series. Many models can be used. If three variables are non-stationary series. We can use difference equations to do integration. To discuss the cointegration of three variables, VEC models are necessary. So This paper using VEC model is to analyze and to determine the correlation among RAC, PRGDP and SBRAI.

## Empirical Analysis of capital-intensive product's RCA, PRGDP and SBRAI in China

### Models Construction

First of all, we have established the basic RCA, PRGDP and SRBAI impact model

$$\ln(RCA_t) = \alpha + \beta_t \ln(PRGDP_t) + \gamma_t \ln(SBRAI_t) + u_t \quad t = 1995, 1996, \dots, 2014 \quad (3.1)$$

RCA is the reveal competitive advantage index, PRGDP is the index of economic growth. SBRAI represent the source of capital using the annual increase of RMB savings deposits of urban and rural residents (100 million yuan) in China.

### Data Collection and Selection

The dataset come from the UN trade sources and Chinese Statistics Bureau. The category of products mainly include goods and services. Here we choose the goods data for RCA closely connecting with goods other than services. The standards of goods are HS, SITC and BEC. We use SITC rev.3. For the rev.4. has a short period. Capital-technology-intensive Products are 5th category and 7th category of the goods. The dataset of PRGDP and SBRAI in China are from database of Chinese Statistics Bureau.

### Model Analysis and testing

#### ADF Unit Root Test on RCA, PRGDP and SBRAI

In order to obtain intuitive understanding, we first draw charts of three variables (1995-2014) in Fig2, Fig3 and Fig4.

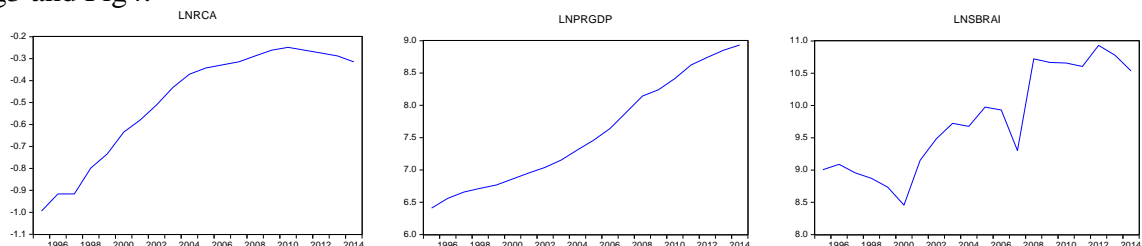


Fig2. Trend of RCA in China Fig3. Trend of China's PRGDP Fig4. Trend of SBRAI in China

It is clear that the graphs showed some trends. We judges that RCA has no clear trend. So, with unit root test, we have selected the intercept, no trend item unit root test. Analysis of results are in Table 2.

Table 2. ADF test of ln(RCA)  
Lag Length: 2 (Automatic - based on SIC, maxlag=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.732883	0.0152
Test critical values:		
1% level	-3.959148	
5% level	-3.081002	
10% level	-2.681330	

As can be seen,  $P = 0.0152$ , the test results showed, RCA sequence would accept the null hypothesis which is a non-stationary sequence. Further, we do the ADF test by first difference and second difference. We got  $\ln(RCA) \sim I(2)$ .

Second, we will determine the condition of sequence of PRGDP. It is clear that the graphs showed some trends. We judges that PRDGP has some trends. So, with unit root test, we have selected the intercept, no trend item unit root test. Analysis of results are in Table 3:

Table 3. ADF test of ln(RCA)  
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.649136	0.0025
Test critical values:		
1% level	-3.920350	
5% level	-3.065585	
10% level	-2.673459	

We can see SBRAI sequence would accept the null hypothesis which is a non-stationary sequence. When model adopt second difference equation,  $P = 0.0025$ , as Table 3 showed, the second difference series are stationary. Further, we do the ADF test by first difference and second difference. We got  $\ln(SBRAI) \sim I(2)$ .

Third, we will determine the condition of sequence of SBRAI.

It is clear that the graphs showed some trends. We judges that SBRAI has some trends. So, with unit root test, we have selected the intercept, no trend item unit root test. Analysis of results are in Table 4.

Table 4. ADF test of ln(PRGDP)  
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.252463	0.0008
Test critical values:		
1% level	-3.920350	
5% level	-3.065585	
10% level	-2.673459	

As can be seen,  $P = 0.4646$ , the test results showed, SBRAI sequence would accept the null hypothesis which is a non-stationary sequence. Further, we do the ADF test by first difference and second difference. We got  $\ln(SBRAI) \sim I(2)$ .

Cointegration by Engle-Granger two steps

There are two methods on cointegration. One method is two steps of Engle-Granger (E-G) by ADF tests. Another is Johansen cointegration test based on regressed coefficients.

In order to discuss the cointegration among RCA, PRGDP and SBRAI. We use methods of two steps of Engle-Granger (E-G).

step 1. Estimate the long equilibrium of model (3.1) by OLS. As we have known the CRA, PRGDP and SBRAI all are  $I(2)$ . Then it is possible the coinegration exists. We use the equation (3.2)

$$Y = \beta_0 + \beta_1 X + \mu_t \tag{3.2}$$

If the three variables are cointegration, we can get the coefficient of  $\beta_0$  and  $\beta_1$  by OLS.

step 2. Stationary test on estimated error series by ADF test.  $\{\hat{e}_t\}$  is the estimator of deviation in long equilibrium. If the estimated errors of  $\{\hat{e}_t\}$  is stationary, then three variables are cointegration, series  $\{Y_t\}$  and  $\{X_t\}$  is (1,1) cointegration. So, according to principle of ADF, we have to estimate the autocorrelation model (3.3)

$$\Delta \hat{e}_t = \rho \hat{e}_{t-1} + \varepsilon_t \quad (3.3)$$

After regression of model (3.1), we obtained the results of unit root tests e1 in Table 5:

Table 5. Unit root test of error

Lag Length: 1 (Automatic - based on SIC, maxlag=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.643943	0.0025
Test critical values:		
1% level	-3.920350	
5% level	-3.065585	
10% level	-2.673459	

From the results, we can see statistic of ADF is -4.64, less than critical value -3.07 at significant 5%. It shows the error series is stable, then can proved the RCA, PRGDP and SBRAI are cointegration.

Cointegration by Johansen and Juselius test

Now, we used the second method of Johansen(1988) and Juselius (1990) test (JJ) to explore the cointegration of three series, RCA, PRGDP and SBRAI.

After JJ test, we got the result in Table 6.

Table 6. Result of JJ test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.917188	65.73140	35.19275	0.0000
At most 1 *	0.571310	23.38135	20.26184	0.0180
At most 2	0.410425	8.981999	9.164546	0.0541

We can get two standard cointegration equations

$$\ln(RCA) = 1.53219 - 0.106082 \ln(SBRAI)$$

$$\ln(PRGDP) = 4.458212 - 1.306875 \ln(SBRAI)$$

RCA, PRGDP and SBRAI's VEC Models

Because RCA, PRGDP and SBRAI all are I(2) sequence. The three variable series do have the same integer order, we can establish error correction model (ECM) of RCA, PRGDP and SBRAI.

Firstly establish long-term equilibrium equation using the data of the year 1995 to 2014

$$\ln(RCA) = k_0 + k_1 \ln(PRGDP) + k_2 \ln(SBRAI) + u_t \quad t = 1, 2, \dots, T \quad (3.4)$$

So let residual series  $ecm_t = \hat{u}_t$ , as the error correction term, the establishment of the following error correction model is

$$\Delta \ln(RCA) = \beta_0 + \alpha ecm_{t-1} + \Delta \beta_1 \ln(PRGDP) + \Delta \beta_2 \ln(SBRAI) + \varepsilon_t \quad (3.5)$$

After the estimation, the result of equation (3.5) is

$$\Delta \ln(RCA) = -2.146677 + 0.203796 \ln(PRGDP) + 0.012282 \ln(SBRAI) - 0.2441e1_t \quad (3.6)$$

By measurement result ECM regression equation, we find that RCA affected their development in the extent of 24.41%. ECM reflects the size of the coefficient of deviation from the long-run equilibrium of readjustment. From 0.24 coefficient estimates we can see, when short-term fluctuations deviate from the long-term equilibrium, it will adjust the intensity of 0.24, and make non-equilibrium state back to equilibrium.

## Conclusions

Inspecting on Chinese revealed comparative advantage, PRGDP and SBRAI, the results are: Chinese revealed comparative advantage, PRGDP and SBRAI all are not stability sequences. Whereas by second difference, all are stationary sequences. When the short-term fluctuations deviate from the long-run equilibrium, adjustment of the PRGDP and SBRAI back to long term equilibrium will be -0.24.

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