Cointegration Analysis of China's Exchange Rate Changes and Changes in Import and Export Trade

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Abstract. This paper selects the exchange rate and import and export trade to study the two factors, analysis of both influence each other. data selected from 2000 to 2012, using the ADF test and cointegration analysis and granger test methods to analyze dependence between exchange rate and import and export trade. The results show that the exchange rate and import and export trade have no direct link.

Introduction

From 2000 to 2005, China's exchange rate policy is fixed exchange rate and the exchange rate basic stay on a fixed value. In July 21, 2005, China reform the formation mechanism of the RMB exchange rate, its content is China's exchange rate will no longer be in the United States as the only goal, but according to the actual situation of China's national conditions and foreign economic relations and trade for the choice of multiple currencies, and gives different weights to the multinational currency, make them form a basket, in order to management and regulation of the RMB exchange rate, keep the RMB exchange rate on the basis of stable equilibrium. In implementing the new policy on the day of the RMB exchange rate increased by 2%, after that, the RMB exchange rate has been reference to a basket of currencies, implement a managed floating exchange rate system, the sharp rise in the RMB against the dollar.

Since 2000, China's total import and export trade of basic maintain sustained growth trend, especially in the exchange rate rise due to implement the New Deal in 2005, the total import and export trade is more substantial increase. So, China's import and export trade is affected by the exchange rate, as a result, the relationship between import and export trade and China's exchange rate changes were studied.[1]

It is mainly used for the analysis of the effect of devaluation on the trade balance situation. With trade relations in the exchange rate on the analysis of the main elastic analysis method are used to solve the problem, when Marshall – Lerner[2] condition was established, so the country's import and export commodity prices will be a certain change because of currency devaluation, which would lead to the change of import and export commodities in quantity to produce, so that the impact on the country's trade balance.

Ronald McKinnon[3], Obashi Ayako [4] analyzed the relationship about Japan and the United States since world war ii and between exchange rate and trade balance. They doubt the elastic analysis method .They think, after the devaluation or appreciation, if Marshall -Lerner condition was established, the relative price effects will lead to improved terms of trade, but for highly open economy, other effects may be partially or even completely offset the relative prices of favorable

effect. These factors include: the reverse absorption effect, transfer effect, inflation effect, incomplete J curve effect, for the case of yen appreciation, will produce hollowing out of the question.

In Keynes's[5] theory system, a country's currency devaluation does not necessarily lead to the improvement in net exports conditions. According to the Keynesian theory, in open economy, a country's equilibrium national income depends on domestic consumption, investment, the relationship between government spending and net exports.

Cointegration theory

Cointegration is the concept of the 1980s puted forward by Engle-Granger[6]. Cointegration theory is used to find equilibrium relationship between two or more non-equilibrium variables, and to establishing error correction model if there is a cointegration relationship of variables. In practice, most economic time series are balanced, but time series of some linear combination of some non equilibrium may be smooth. If two or more of the same order some linear combination of vector time series can be a smooth error sequence, then the non-stationary time series, there is a long-term equilibrium relationship, or the sequence with cointegration. Since there is only two variables with the same single whole order there possible is a cointegration relationship. Before the cointegration analysis, therefore, the first thing to test in the single order number of variables, we use extension Dickey - Fuller sequence of unit root test.

For each time series, we estimate the following equation:

$$\Delta Y_t = c + bt + \alpha Y_{t-1} + \Delta Y_{t-2} + \mu_t \tag{1}$$

Where, $\Delta Y_{t-i} = Y_{t-i} - Y_{t-i-1}$, u_t for the error term, c as intercept, t as time trends, when no significant statistical tests, the intercept and trend term from the equation of regression. Lag item choice makes residual autocorrelation. In order to further verify the time series I (2) process, we also in the form of a regression, ΔY_t was explained variable, ΔY_{t-1} and ΔY_{t-i} as explanatory variables. Test results show that the time series are first order sheet the whole process, we can use it to do long-term cointegration analysis. Engle and Granger put forward two-step estimation cointegration vector, namely first to cointegration vector by least square regression, and then put the cointegration regression residuals for unit root test. By EG two-step estimation cointegration parameters measuring tool has the ultra strong consistency and validity, but under the condition of limited samples, the estimator is biased, and the smaller the sample size, the greater the deviation.

Data description

This paper selects the RMB exchange rate against the dollar in 2000-2012, total import and export commodities, TC index variables such as analysis and research. Data sources: （http://www.stats.gov.cn/）

Each data in 2000-2012, of which the yuan against the us dollar (usd = 100) (yuan) (average), the data and the TC index calculated in table 1 as follows.

year	RMB exchange rate against the dollar	Total exports (millions of us dollars)	Total inports (millions of us dollars)	Total exports (millions of us dollars)	Total imports (millions of us dollars)	Total exports and imports(millions of us dollars)	Import and export the difference (millions of us dollars)	TC index
2000	827.84	249203	225094	249203	225094	474290	24110	0.05
2001	827.7	266098	243553	266098	243553	509650	22550	0.04
2002	827.7	325596	295170	325596	295170	620770	30430	0.05
2003	827.7	438228	412760	438228	412760	850998	25468	0.03
2004	827.68	593326	561229	593326	561229	1154550	32090	0.03
2005	819.17	761953	659953	761953	659953	1421910	102000	0.07
2006	797.18	968978	791460.87	968978	791460.87	1760440	117520	0.07
2007	760.4	1220456	956116	1220456	956116	2176570	264344	0.12
2008	694.51	1430693.1	1132567	1430693.1	1132567	2563255.2	298123	0.12
2009	683.1	1201611.8	1005923.2	1201611.8	1005923.2	2207535	195678	0.09
2010	676.95	1577754.3	1396244	1577754.3	1396244	2973998.3	181510.31	0.06
2011	645.88	1898381.5	1743483.6	1898381.5	1743483.6	3641860	154897.87	0.04
2012	631.25	2048714.4	1818405	2048714.4	1818405	3867119	230309	0.06

From the above table 1 we can see that before 2005, China's total import and export in a steady growth trend, after the reform in 2005, due to the RMB exchange rate against the dollar, a big drop in total import and export of our country have been soaring state, although the global financial crisis of 2008 led to the total import and export of the year before, but after the financial crisis in 2008, 2009 national economy began to recovery, China's import and export trade also gradually pick up, total import and export again presents a fast growth momentum. Thus, we concluded that China's exchange rate changes will affect our country's import and export trade.

According to the above TC data and RMB exchange rate against the dollar ($= 100) (yuan) (average) rendering index changes in the overall trend and the trend of exchange rate movements. From table 2 we can see changes in the exchange rate between the TC index and trend compared with the traditional elasticity theory is not the same, in terms of the general theory of economics, under the floating exchange rate system, if a country's currency appreciation, leads to export commodity prices denominated in foreign currencies, there by weakening the country's exports in the international market competitiveness, to inhibit the action of the export. In local currency, on the other hand, said before the import prices will be a devaluation is cheap, the number of imports will increase, the country's foreign trade competitiveness will be weakened. The situation in China, however, is different with theory, can be seen in the figure 2: after our country began to implement the floating exchange rate mechanism in 2005, 2005-2008 and 2008-2012 China's exchange rate has been in a state of appreciation, but during this period our country foreign trade competitiveness has been enhanced, and the theory of state is just the opposite.

The empirical process

For more conveniently analysis the data, we have handled by TC index, TC value, if the TC = (TC + 1) * 100, again to the value of logarithmic, expressed in the TC. What said the yuan

exchange RATE against the dollar on value.

(1) ADF stationarity test

ADF test, choose contain relating to intercept and trend, on the right side of the largest lag period is set to 2. The unit root test for variables of TC and RATE are as follow table 2.

Tab. 2 Unit root test for TC and RATE

Variable	Inspection form （C,T,K）	ADF Test value	5% critical value	Prob.	Result unit root	Stationary
TC	（C,T,2）	-2.571547	-4.008157	0.2979	accept	Non stationary
ΔTC	（C,0,2）	-2.503648	-3.175352	0.1402	accept	Non stationary
$\Delta^2 TC$	(C,0,2)	-4.072274	-3.212696	0.0139	reject	stationary
$RATE$	（C,0,2）	-1.850495	-3.875302	0.6178	accept	Non stationary
$\Delta RATE$	（C,0,2）	-2.260002	-3.175352	0.1988	accept	Non stationary
$\Delta^2 RATE$	（C,0,2）	-3.653252	-3.212696	0.0259	reject	stationary

On the above table 3 of model TC, the t test value is greater than 0.05 significance level value. Therefore, in this case cannot reject the null hypothesis, namely in the TC series has a unit root, TC series is stationary series.

On the above table 3 of model ΔTC, which is TC series of first order difference, choose contain among them intercept, on the right side of the largest lag period is set to 2. Similarly, the t test value is greater than 0.05 significance level value. Therefore, D (TC) sequence is a stationary series.

On the above table 3 of model $\Delta^2 TC$, which is TC series of second order differential, choose contain among them intercept, on the right side of the largest lag period is set to 2.From the point of the test result of the second order difference, t value is less than 0.05 significance level of value. Therefore, reject the null hypothesis that the second order differences sequence of TC no unit root, or the sequence of the stationary series

RATE of ADF test, choose contain relating to intercept and trend, on the right side of the largest lag period is set to 2. It can be seen from table 3 of model RATE, the model t test value is greater than 0.05 significance level value. So, accept the null hypothesis, namely RATE sequence has a unit root, RATE sequence is a stationary series.

Then $\Delta RATE$, RATE sequence of first order difference, choose contain among them intercept, on the right side of the largest lag period is set to 2.The $\Delta RATE$ model, the t test value is greater than 0.05 significance level value. Therefore, $\Delta RATE$ sequence is not a stationary series.

Then $\Delta^2 RATE$, second order differential RATE sequence, choose contain among them intercept, on the right side of the largest lag period is set to 2. From the point of the test result of the second order difference, t value is less than 0.05 significance level of value. Therefore, reject the null hypothesis, namely the RATE of second order differential sequence no unit root, or the sequence of the stationary series.

From table 3, TC, ΔTC and RATE, $\Delta RATE$ are non-stationary time series, $\Delta^2 TC$ and $\Delta^2 RATE$ are stationary time series, so the TC and RATE are second order single whole sequences, thus can do cointegration analysis.

(2) Cointegeation test

For $\Delta^2 RATE$ and $\Delta^2 TC$ do cointegration regression equation, inspection, such as table 3.

Tab. 3 Cointegration regression of $\Delta^2 RATE$ and $\Delta^2 TC$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\Delta^2 RATE$	-0.104000	0.321452	-0.323532	0.7537
C	0.000720	0.010348	0.069576	0.9461
R-squared	0.011497	Mean dependent var		0.000909
Adjusted R-squared	-0.098337	S.D. dependent var		0.032697
S.E. of regression	0.034267	Akaike info criterion		-3.746307
Sum squared resid	0.010568	Schwarz criterion		-3.673962
Log likelihood	22.60469	Hannan-Quinn criter.		-3.791910
F-statistic	0.104673	Durbin-Watson stat		2.770266
Prob(F-statistic)	0.753684			

By the content of the table 4 can get the regression equation is as follows.

$$\Delta^2 TC = 0.000720 - 0.1040\, \Delta^2 RATE + u \qquad (2)$$

$$R^2 = 0.0115 \qquad \bar{R}^2 = -0.0983 \qquad DW = 2.7703 \qquad F = 0.1047$$

Use Eviews to unit root test of u, the results such as table 4.

Tab. 4 ADF test for residual

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.050437	0.0477
Test critical values	1% level	-5.295384	
	5% level	-4.008157	
	10%level	-3.460791	

Can be seen from table 4, u is smooth, therefore, accept $\Delta^2 RATE$ is co-integration with $\Delta^2 TC$ hypothesis. That is to say the RMB exchange rate against the dollar and there is a long-term equilibrium relationship China's trade competitiveness.

(3) Granger causality test

Through the above analysis shows that there may be relationship between TC and RATE , so using Granger causality tests on the further analysis of the test. After logarithmic correction of Granger inspection of the RMB exchange rate and trade competitiveness index, the following result table 5 shows the test result of the lag length is 2.

Tab. 5 Granger causality test

Null Hypothesis:	Obs	F-Statistic	Prob.
TC does not Granger Cause RATE	11	2.36229	0.1751
RATE does not Granger Cause TC		0.30939	0.7449

According to the above the output results of the Granger test , when the lag order number is 2, F statistic value is small, and P values > 0.05, accept the null hypothesis, namely, there is no direct causal relationship between.

Conclusion

From 2000 to 2012, from the data of China's exchange rate and foreign trade import and export of the total amount, we can find that the RMB's exchange rate against the dollar in our country has been in decline range type, but the total amount of China's foreign import and export trade has kept increasing growth. Although due to the financial crisis of 2008, the 2009 China's total foreign trade import and export of present a downward trend, but it's not hard to find in 09 years after 2010, China's total foreign trade import and export of rendering again increased year by year. From the point of view, we can speculate that China's exchange rate changes will affect our country's import and export trade.

As a result of the selected data is based on time, so in the process of cointegration analysis, first has carried on the ADF test to this group of data, to analysis whether the group data for stationary time series. In order to analyze the data more clearly, the TC index and the RMB exchange RATE against the dollar value to the processing, TC and RATE are obtained. After the ADF test, we get the first order difference of TC, TC and RATE, RATE of first-order difference are non-stationary time series. Leveled off after the second order difference, time series, thus infer the TC index and the RMB against the dollar exchange rate between the long-term stable equilibrium relationships.

In order to more in-depth analysis of the relationship between the TC and RATE, again to the TC and RATE of Granger causality test, the test results show that the trade competitiveness index and there is no direct causal relationship between RMB exchange RATE against the dollar, the RMB against the us dollar is not directly influence factors influencing China's trade competitiveness. In other words, it is the change of RMB exchange rate against the dollar won't directly affect the import and export trade of our country.

Acknowledgments

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