The impact of real effective exchange rate of RMB on China’s export and value-added export

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**Abstract:** As China’s international trade surplus growth continuously, China is now under great international pressure to let its currency appreciate. How does China’s export change if RMB appreciate? Based on the time series data from 1990 to 2015, the impact of real effective exchange rate of RMB on China’s export was analyzed, using econometric analysis methods like regression model. And its influence on value-added export was further analyzed utilizing Chinese DPN table of the year 2010, detailed export structure in 2013 and export data in 2015. The result showed that every 1% appreciation of RMB would decrease China’s value-added export by 0.52% and 0.72%, before and after 2005 respectively; REER becomes even more important to China’s export after the establishment of new floating exchange rate system; China’s export will decrease 16.45 billion dollars and finally the 1% increase of REER will decrease domestic value added by 11.28 billion dollars, based on export data in 2015.

**Keywords:** the RMB exchange rate；export；value added；DPN table

**1.Introduction**

With the expanding of China's trade surplus, trade frictions between China and US (Japan and other developed countries) become increasingly frequent since the turn of the century. Facing mounting international pressure to let its currency, the renminbi(RMB), rise in value, China has adopted the market supply and demand-based, managed floating exchange rate system, from July 21st, 2005 to present. The rate of RMB to USD increase from 8.28 in 2005 to 6.05 at the beginning of 2014, and then RMB [depreciate](http://m.youdao.com/dict?q=depreciate) by 7% at the end of 2015.

 The fluctuation of exchange rate of RMB will influence China’s economy. The increase of exchange rate may rise the price of export commodities and decrease the price of commodities imported, according to the Exchange rate flexibility theory. And finally it will cause the decline of exports. But this theory was based on the Marshall-Lerner condition, the demand elasticity of export commodities plus demand elasticity of import commodities was greater than 1. A flood of literature were published researching the influence of changing of exchange rate on trade benefit (Lau ,2004&Berman N,2012& Tatliyer,2016). There were three main points on this issue: the changing of exchange rate had positive influence on trade benefit (Bohara, 2001&Eleanor Doyle, 2001), the changing of exchange rate had negative influence on trade benefit (Cushman, 1983&Hooper, 1978 &Li H., 2008), the influence was non-significant (Bailey, 1987).

 The relation between exchange rate and trading is a domestic and international issue, an accordant conclusion still has no formation because of the difference of research methods, data sample and variables. Using econometric approaches, such as co-integration analysis and ARMA regression model, the change of influence of RMB exchange rate on China’s export before the year of 2005 and after, was analyzed. And its subsequent effect on China’s domestic value added was calculated, based on China’s DPN table in 2010 and its export data in 2015.

**2.The impact of REER on China’s export**

The real effective exchange rate of RMB ( ‘REER’ as its abbreviation ) was chosen to represent China’s exchange rate for the following two reasons. Firstly, REER not only reflects all the relative changes in bilateral nominal exchange rate, but also removed the influence of inflation on itself. It can also reflect RMB’s value and the relative purchasing power comprehensively. The rise of REER index means appreciation of RMB, while the decline of REER index means depreciation of RMB. The data of dependent variable (REER, see Fig. 1) and independent variable (China’s export, EXP) were gathered from IFS.

Figure 1 Real Effective Exchange Rate of China

Data source: International Finance Statistics (IFS).

We evaluated the logarithm of REER and EXP in order to get the elasticity coefficient, the change rate of China’s export when REER rise by 1%. The logarithm of REER and EXP were denoted by LNREER and LNEXP respectively. The stationary test of LNREER and LNEXP were made as the first step, and the result of ADF test see Table1.

Table1 The result of unit root test

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | (C,T,K) | ADF-statistic | Prob. |
| LNREER | (C,T,1) | -0.03 | 0.9462 |
| △LNREER | (C,N,0) | -5.08 | 0.0004 |
| LNEXP | (C,T,1) | -1.01 | 0.7331 |
| △LNEXP | (C,N,0) | -4.19 | 0.0035 |
| Et | (C,T,1) | -1.97 | 0.2942 |
| △Et | (C,N,0) | -2.64 | 0.0012 |

\*△LNREER means first order difference of LNREER,

The result of the unit root test shows that LNREER and LNEXP were integrated of order 1. As LNREER and LNEXP were integrated of the same order, co-integration test was made to assure whether long-run equilibrium relationship exists between them. The E-G two-stage method, Engle-Granger, was adopted. We established a least-squares regression model between LNREER and LNEXP, the regression equation see Eq(1).

LNEXP= -20.32+5.82\*LNREER (1)

And then we can get the residual time series of this model, denoted by et. The ADF test result of et can be seen in Table 1, and it was integrated of order 1. There is a co-integration relationship in (2,1) order between LNREER and LNEXP.

Considering that China adopted the new floating exchange rate system on July 21st, 2005, the whole time series data was divided into two periods: 1990-2005 and 2005-2015. So we can calculate the impact of LNREER on LNEXP in the two periods and compare their difference before and after 2005. The models we finally chose were listed following.

The regression model of 1990-2005:

LNEXP = 4.77 – 0.52\*LNREER + 1.06\*AR(1) (2)

 (2.20) (-2.11) (29.49)

R2 = 0.98 , DW = 2.4

The regression model of 2005-2015:

LNEXP = 11.64 – 0.72\*LNREER + 0.87\*AR(1) (3)

 (1.46) (-0.50) (7.21)

R2 = 0.92 , DW = 2.5

The figures in brackets were t-statistics correspondingly. The result of the two regression models shows that China’s export would decrease 0.52% if the real effective exchange rate of RMB appreciated by 1% before 2005, and the extent of variation in China’s export turned into 0.72% after 2005 if REER appreciates by the same level. The change of coefficient from 0.52% to 0.72% means that REER becomes even more important to China’s export after the establishment of new exchange rate system. Exchange rate were more susceptible to market than before, and the rising trend were obvious and stable after 2005. The stable trend of REER and expanding of foreign trade may be the main reasons that caused the change in regression coefficient. From another perspective, Exchange rate is not completely determined by the market, so the absolute value of coefficient is small.

**3.The impact of REER on China’s value added export**

We calculated the impact of REER on China’s export before and after 2005, and compared the difference between two regression coefficients in the previous section. And we know that China’s export will decrease 0.72% if the real effective exchange rate of RMB appreciated by 1% after 2005. It means that China’s export will decrease 16.45 billion dollars in 2015 if REER appreciated by 1%. As Scientific research becomes more rigorous, researchers prefer domestic value added as the most suitable index to measure the real implication of foreign trade than gross volume of export. So to what extent will China’s domestic value added change in this situation?

The calculation was made using China’s DPN table in 2010, detailed export structure in 2013 and export data in 2015 ordered by HS2(data source: General Administration of Customs). And then calculated the impact of REER on value added export combining the result of previous section and the domestic value added. Because of the limitation of data, we made several [hypothesis](http://m.youdao.com/dict?q=hypothesis)es to simplify the calculation, includes: the production structure in 2015 was the same with 2010, the export structure was the same with 2013.

Data used to measure China’s value added export in 2015 includes:

1)detailed export structure of total export and processing trade in 2013, a mapping matrix from 98 chapters to 139 industries.

2) mapping table from 139 industries to 65 industries.

3)export of 98 chapters in 2015.

4)China’s DPN table in 2010 with 65 industries.

5)the circulation fee rate of 139 industries in 2012.

The detailed calculation steps:

1)obtain export structure in 2015 by multiplying the export of 98 chapters in 2015 with export structure matrix in 2013(98\*139), and the same operation within processing trade data.

2)non-processing trade structure = total - processing trade structure

3)transformation from FOB price to producer price, using matrix of circulation fee rate in 2012

4)the export structure of 139 industries merged into 65 industries

5)calculating domestic value added in 2015, more detailed process see (Chen X.K., 2001&2010, Duan Y.W., 2012).

The domestic value added of exports in 2015, see Table2. The top five industries with the highest value added were also listed.

Table2 Domestic value added of China’s export in 2015(unit: billion USD)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Export | Value added of export | PVA(%) |
| China | 2284.5 | 1567.5 | 100.00 |
| Wholesale and Retail Trade | 405.3 | 385.2 | 24.58 |
| Textile and Garment manufacturing | 133.6 | 112.4 | 7.17 |
| Communications Equipment and Radar manufacturing | 176.4 | 95.4 | 6.09 |
| Electronic Component Manufacturing Industry | 163.9 | 87.0 | 5.55 |
| General and Special Equipment manufacturing | 86.5 | 55.0 | 3.51 |

The total volume of China’s export in 2015 was 2284.5 billion dollars, and the value added it created was about 1567.5 billion dollars. The value-added rate was0.686, while the Wholesale and Retail Trade made the biggest contribution having the highest proportion, 24.58%.

Combined with the results in section 2, China’s export will decrease 0.72% while the real effective exchange rate of RMB appreciated by 1%, and it means that China’s export will decrease 16.45 billion dollars. And finally the 1% increase of REER will decrease domestic value added by 11.28 billion dollars.

**4.Conclusion**

Econometric approaches, such as co-integration analysis and ARMA regression model, were used to calculate influence of RMB exchange rate on China’s export. Considering that China adopted the new floating exchange rate system on July 21st, 2005, two regression models were established of the two periods: 1990-2005 and 2005-2015, and the difference in coefficients between these two models was analyzed. And then its subsequent effect on China’s domestic value added was calculated, based on China’s DPN table in 2010 and its export data in 2015. The result shows that: if the real effective exchange rate of RMB appreciated by 1%, China’s export will decrease 0.52% before 2005, while it will decrease 0.72% after 2005; REER becomes even more important to China’s export after the establishment of new exchange rate system; China’s export will decrease 16.45 billion dollars and finally the 1% increase of REER will decrease domestic value added by 11.28 billion dollars.

Only the impact of REER on China’s total export was considered in this research because of limitation of data, there are many meaningful topics can be analyzed further, includes: analyzing the impact of REER on processing and non-processing trade separately(Koopman,2012); calculating the impact of REER on export in each sectors if the data is sufficient; considering the change of consumption coefficient in DPN table.

**Reference**

Bailey M. J.,Tavlas G.S. and Ulan M“. The impact of exchange rate volatility on export growth: some theoretical considerations and empirical results.” Journal of Policy Modeling1987(9):225-243.

Berman N, Martin P, Mayer T. How do different exporters react to exchange rate changes?[J]. The Quarterly Journal of Economics, 2012, 127(1): 437-492.

Chen X. K. , Cheng, L.- K. , K.C. Fung, L.J. Lau. (2001), The estimation of domestic value-added and employment induced by exports: an application to Chinese exports to the United States. Stanford University, Presentation available at: /http://www.stanford.edu/\_ljlau/Presentations/Presentations/010618.pdfS.

Chen X. K. , Cheng, L.- K. , K.-C., Fung, Lau, L. J. , Y.-W. , Sung, Yang C. H. , Zhu K. F. ,Pei J. S. , Duan Y. W. , 2012, “Domestic Value Added and Employment Generated by Chinese Exports: A Quantitative Estimation”, China Economic Review, 23, 850-864.

Cushman D., “The effects of real exchange rate risk on international trade.” Journal of International Economics,1983: 45-63.

Duan Y.W., Yang C.H., Zhu K.F., et al. Does the domestic value added induced by China's exports really belong to China?[J]. China & World Economy, 2012, 20(5): 83-102.

Tatliyer M, Yigit F. Does Exchange Rate Volatility Really Influence Foreign Trade? Evidence from Turkey[J]. International Journal of Economics and Finance, 2016, 8(2): 33.

Eleanor Doyle. “Exchange rate volatility and Irish-UK trade,1979 1992.”Applied Economics,2001(2):249.

Hooper P. & S. W. Kohlhagen. “The effect of exchange rate uncertainty on the prices and volume of international trade.” Journal of International Economies,1978(8):483-511.

Koopman R. , Wang Z. , Wei S. J. , 2012, “Estimating Domestic Content in Exports When Processing Trade is Pervasive”, *Journal of International Economics*, 99(1), 178-189.

Lau, Francis, Yik-ko Mo, and Kim-hung Li, “The Impact of a Renminbi Appreciation on Global Imbalances and Intra-regional Trade,” Hong Kong Monetary Authority Quarterly Bulletin March (2004):16–26.

Li H., “The influence of RMB effective exchange rate on China's foreign trade- empirical analysis based on different trade mode”, Finance Teaching and Research, 2008(6):29-35.