

# The effects of the RMB's appreciation on trade balance in US

Chi Gong\*, Zi-Yang Liu\*\*

## Abstract

This paper applied a VAR model to analyze the effects of RMB exchange rate brought to processing trade, non-processing trade and FDI. Then we can get the results that the appreciation of RMB could not solve the problem of US trade deficit. It is more likely that the appreciation just can transfer the trade imbalance to other country with US, which could not radically solve the economic problems of US. Also this paper find that the data of service trade is surplus while the main goods deficit was occur in advanced technology product, especially in the information & communications trade And US has real advantage in these industries, so the situation will be changed if US decreased the barrier in these industries. In that way, the imbalance situation should be greatly reduced.

▶ Keyword : RMB's appreciation; trade balance; processing trade; FDI; advanced technology product trade; information & communications trade

## I. Introduction

As the main two economic countries, China and US play the vital role in pushing the world trade forward, and their trade relationship is a hotspot in the economic research.

Since established the diplomatic ties with China in 1979, the US's trade deficit not only exists every year, but also continues to grow. Many researchers deeply analyzed and explain the reasons of the trade imbalance, such as 1. The undervalued RMB is the main reason of the US-China trade deficit; 2. Kinds of incentive policy about export in China result that abundant China's goods enter in US; on the contrary, US's goods encountered much resistance from the many limitations of the China or US's policies. Therefore, the trade imbalance do existed; 3. Under the background of globalization, the international mobility of produce factors and the fact that China is in the low level of the whole industrial chain in the international

specialization induced many the international commercial activities, which enlarged the US-China trade imbalance.

However, they are always can be divided into two sides: the one is that the undervalued RMB is the main reason of the US-China trade deficit, and the other one is the appreciation of RMB could not be the clever way to improve trade balance of US.

Actually our paper is supporting the later one. For the logic of the arrangement of the content, our paper is organized as follows: Section 2 briefly explains the trade structures of and trade relations between China and US. In the section 3 will analyze the effects of RMB exchange rate brought to processing trade, non-processing trade and FDI. Section 4 concludes this paper.

## II. Trade Relations between China and US

From now on, this paper will examine trade relations

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• First Author : Chi Gong, Corresponding Author : Ziyang Liu

\*Chi Gong (gongchi81@hotmail.com), School of Economics, Sichuan University, China

\*\*Ziyang Liu (morninglzy@naver.com), College of Business and Economics, Kyonggi University, Korea (College of Business and Economics, Kyonggi University)

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between China and US. Such discussion will shed light on why many politicians and researchers concerning the trade conflict of China-US. Table 1 shows some important information about the economies of the three countries, which also reflect the importance of China and US's relation.

Table 1. The economic index of China and US, 2014

	China	US
Area (thousand sq.km)	9,596	9,826
Population (million)	1,356	319
GDP (trillion US\$,PPP)	17.630	17.460
GDP rank	1th	3nd
GDP per capital (US\$,PPP)	12,900	54,800
Growth rate of GDP (%)	7.4%	2.4%
Total Trade Volume (trillion US\$)	4.201	3.944
Export (trillion US\$)	2.252	1.610
Import (trillion US\$)	1.949	2.334

Source: World Factbook 2015

The data shows us that along with the China's opening, the China-US economic and trade relations have shown the overall trend of continuous development. And the development of trade relationship can be divided into three periods.

1979~1991: according the statistics of U.S. Census Bureau, the bilateral total trade volume is increased from 1985's 7,717.4 million USD to 1991's 25,247.4 million USD, and the average increase rate is over 12%.

1992~2001: By further reforming and opening up in China, the structural changes appeared in their trade relationship, which enlarged the total trade volume form 1992's 33,146 million USD to 2001's 121,460.7 million USD and the average increase rate is over 10%.

2002~now: Along with the China becomes to be the main part of worldwide division system, their relationship was fully developed. The total bilateral trade volume is increased from 2001's 121,460.7 million USD to 2014's 590,430.2 million USD, and the average increase rate is over 34.7%.

US is not only the main economic partner of China but also the biggest export market and the 4th largest import partner of China. As well as China is the second largest trade partner, the biggest import partner and the 3rd largest export market of US in 2010. Figure1 describes the trade conditions between US and China.

Resource: U.S. Census Bureau

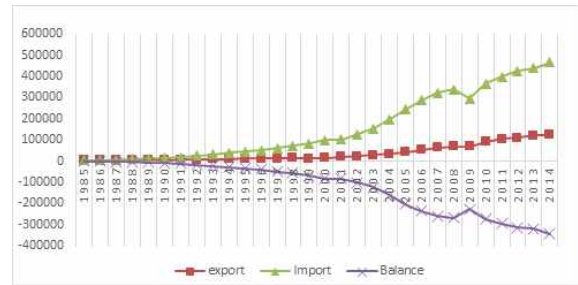


Fig. 1. the US Trade with China (1985~2014)

It can't be denied that although the trade relationship was the quickly developed, there still exist many problems between US and China, such as the trade imbalance. (Figure 2)

Now, we will deeply examine the trade imbalance of US-China.

According to the statistics from US census bureau, the main goods that US exported to China is "machinery and transport equipment", "Crude materials, inedible, except fuels" and "Chemicals and related products" (by 1-digit SITC), whose export volume is 33.9 billion USD, 27.4 billion USD and 12.7 billion USD, and they sharing 36.8%, 29.8%, and 13.8% of total export in 2010 respectively.

As well as the mainly goods US import to China is "machinery and transport equipment", "Miscellaneous manufactured articles" and "Manufactured goods classified chiefly by material", whose export volume is 180.4 billion USD, 125.2 billion USD and 37.7 billion USD respectively, and they sharing 49%, 34.3%, and 10.3% of total export in 2010. Actually, the goods China export to US is mainly concentrate in labor intensive products if we see more digits SITC.

And according the statistics of China's Ministry of Commerce, the 69.7% of trade volume and 73% of export volume was accomplished by foreign invest enterprises. Especially, the 83% of advanced technology products' export and 75% of IT products' export was accomplished by multinational corporations. Thereinto, 90% of advanced technology products' export to US was accomplished by multinational corporations. This means that multinational activities should hold the responsible for the US trade deficit. China just get the name of "world factory" with little benefit.

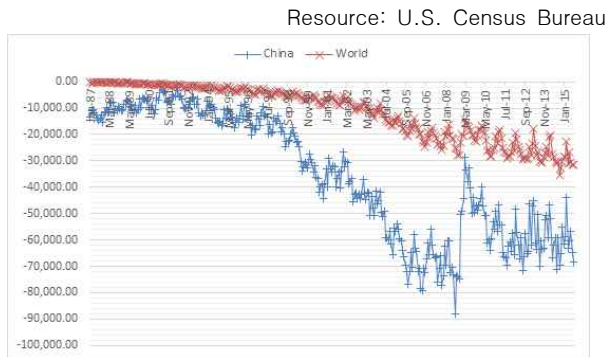


Fig. 2. US's trade balance with China and the World

For example, Yuqing Xing and Neal Detert (2010) and they summarizes the CHINA's iPhone exports to the US and corresponding bilateral trade deficits associated with iPhone trade. Using total unit manufacturing costs as the unit price of iPhones exported to the US, they estimate that in 2007 US\$687 million worth of exports from CHINA to the US was attributed to iPhones. In 2009, that amount exceeded US\$2 billion. Since iPhones were not sold in the CHINA until late 2009 and the sales of the iPhone were very limited, iPhones shipped to the US from the CHINA became a part of the US trade deficit with the CHINA. And they find that most of the bilateral deficit associated with iPhone trade did not originate in the CHINA as CHINA workers contributed a very small portion of the value-added to an iPhone sold in markets. The decomposition on the production costs of the iPhone shows that, it costs only US\$6.50 per unit to assemble all parts and components into a ready to use iPhone. The assembly cost accounts for merely 3.6% of the total manufacturing cost (e.g., the shipping price),

For other words, High-tech products such as iPhones in this context do not help increase US exports, but instead contribute to the US trade deficit. In addition, conventional trade statistics greatly inflate bilateral trade deficits between a country used as export-platform by multinational corporations and its destination countries. In the case of iPhone trade, the CHINA actually contributed only 3.8% of the US US\$1.9 billion trade deficit; the rest was simply a transfer from Japan, Korea, and Chinese Taipei.

This is a representative case which can reflect the truth of RMB's appreciation and trade balance in US.

As we know, US always maintain the leading position in the world economy after World War II. For adapting the ever-changing environment, US keep adjusting its production department, production process, and production factors, according their costs and efficiency. By long term optimization of industrial structure, the producing of many primary products, such as daily articles, the products by raw material process, and the intermediate products, was transferred to the developing countries. These products are the necessity of producing and daily consumption, which determines that US needs to import these primary products. And for another hand, because the industries and product structures are still backward in China, most of the enterprises which export these primary products produced the goods for multinational corporations. So the optimization of industrial structure of US itself could cause the trade imbalance.

Table 2. the status of the advanced technology product trade in China, 2013

Unit: 0.1 Billion USD

	total trade		export		import	
	amount	Sharing %	amount	Sharing %	amount	Sharing %
Total	12185.2	100	6603.3	100	5581.9	100
1、bytrademodes						
processing trade	6742.2	55.3	4314.2	65.3	2428	43.5
General trade	2458.7	20.2	1107.3	16.8	1351.5	24.2
others	2984.3	24.5	1181.9	17.9	1802.5	32.3
2、byregisteredtype						
Foreign funded companies	8493.1	69.7	4817.6	73	3675.5	65.9
Others	2783.7	22.8	1413.3	21.4	1370.4	24.6
State owned companies	908.5	7.59	372.4	5.6	536.1	9.6
3、byproductstypes						
IT	5665.1	46.5	4390.9	66.5	1274.2	22.8
electronic products	4167.47	34.2	1367.91	20.7	2799.56	50.2
photoelectric technology	974.61	8.09	393.29	6	581.32	10.4
Computer-Integrated Manufacturing	444.17	3.7	109.61	1.7	334.55	6
life science and technology	444.8	3.7	225.77	3.4	219.03	3.9

aerospace engineering	353.01	2.9	51.12	0.8	301.9	5.4
Materials Technology	105.09	0.9	51.55	0.8	53.54	1
Others	17.14	0.1	7.07	0.1	10.07	0.2
biotechnology	13.83	0.1	6.08	0.1	7.75	0.1

Resource: Ministry of commerce industry Secretary, China

The other main reason of expanded trade imbalance is the international industries transfer, especially the manufacturing industries from other regions. Due to the ruler of origin (For a product which has been produced in more than one country the product shall be determined to have origin in the country where the last substantial transformation took place.), the origin of processing products is transferred from other regions to China, which induced their export indirectly transfer to China. According to the statistics of IMF in 2005, 21.8% export of Korea, 11.5% export of Malaysia and 8.3% export of Thailand are transferred to China, which

shares China's 21.4% export to US and 18.9% export to EU. Compare with year 2001, the sharing of China's import from ASEAN, Korea and other countries is increased in 2005, as well as these countries' export to US is decreased 1%, 1.1%, and 0.7% respectively. And in the same period, China's export to US increased 5.8%. So it is clear that some Asia countries' trade surplus with the US transfer to China's trade surplus with the US by the international industries transfer.

Further, according to the China statistics yearbook, the processing trade's proportion in the export and import increases every year. And the proportions have already exceeded 40%, especially the proportion in total trade volume is over 50%. There are 75% processing products in the export of the mechanical and electrical products, which sharing 51.9% total export volume in 2003. As well as that there are 90% processing products in the export of the advanced technology products in 2003 and its proportion decreased to 78.8% in 2010. (Table

2) In 2010, the main exported advanced technology products were IT products and the main imported advanced technology products were electronic products (integrated circuit products). And the foreign companies share 80.2% total trade, 83.1% export, and 76.8% import of advanced technology products.

Therefore, as the main trading mode, the processing trade determined that the trade imbalance is the inevitable existing between China and US.

And by table 3, we can easily to find out that foreign funded companies are the main promoting body of China's export. These companies not only promote the increase

of processing trade but also promote the increase of the total trade volume. So we could not hesitate to take the FDI into consideration in our research in that the FDI can represent the foreign funded companies in some sense.

Table 3. China's the export by the registered type of company

Unit: 0.1 Billion USD

	2001	2005	2010	2013	2014
total	2661	7620	15784	22107	23432
	1132	1688.1	2344	2490.6	2565.8
State owned companies	42.5%	22.2%	14.9%	11.3%	10.9%
foreign funded companies	1332.2	4442.1	8626.7	10446	10748
	50.1%	58.3%	54.7%	47.3%	45.9%
	196.8	1489.8	4813.7	9169.7	10119
Others	7.4%	19.6%	30.5%	41.5%	43.2%

Resource: Ministry of commerce industry Secretary, China

Therefore if we find that the RMB's appreciation affects the processing trade and FDI more than non-processing trade, then we could get the conclusion that the appreciation of RMB could not solve the problem of US trade deficit. It just can transfer the trade imbalance to other country with US, which could not radically solve the trade imbalance of US.

### III. The empirical studies

Now we focus on RMB's appreciation affects to processing trade, non-processing trade, and FDI in China. Here we use the month date of 1995.1~2015.8 to analyze the effects. And we use the date of China to World instead it of China to US by the reason that the trade of China to US shares most part of the whole trade of China, but also it have the almost the same trend with the whole world. Of course, the difficulty of the data collection is another reason for doing so.

In this paper, we will apply the VAR or VECM method. Particularly, we use the impulse response and variance decomposition methods to represent relationships among the variables. We are dealing with time series data;

hence, we need to conduct unit-root tests to examine whether the data set is stationary or not. If the data sets are non-stationary, the spurious regression will come out. To compress the scale of the variables (too big to calculate effectively), we take the logarithm of exchange rate(exe), processing trade(pt), non-processing trade(npt), and FDI. Then we check all variables through unit-root tests.

Table 4. Unit-root test result

	DLNEXC	DLNFDI	DLNPT	DLNPT
ADF test statistic	-4.104**	-7.161**	-4.240**	-2.785*

\*\*means p<0.05; \* means p<0.1

The results show that the all 4 variables pass the ADF-test only by first-order difference, So they are I(1) process.

Table 5. Johansen cointegration Rank test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. Of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.23	111.72	47.856	0.00
At most 1 *	0.14	46.95	29.80	0.00
At most 2	0.03	8.94	15.49	0.37
At most 3	0.003	0.97	3.84	0.32
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.23	64.76	27.58	0.00
At most 1 *	0.14	38.02	21.13	0.00
At most 2	0.03	7.96	14.26	0.38
At most 3	0.003	0.97	3.84	0.32

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

For avoid the Spurious regression, which would make us could not find some important information (such as the long run relations) by simple difference the variable if there exist the cointegrated processes, we need apply the Johansen cointegration rank test to make sure how many cointegrated processes exist in our model. Then select the regression model to use, VAR or VECM.

The Max-eigenvalue test and Trace test all indicate that our series have 2 cointegration equations at the 0.05 level (table 5).

So we will set VECM model as below

$$\Delta Y_t = c + a_1(\text{CoinEq}_1) + a_2(\text{CoinEq}_2) + \sum C_i \Delta Y_{t-i} + \mu_t$$

Where  $Y_t$  is a four-dimensional endogenous variable vector,  $Y_t = (\text{Lnexc}, \text{LnFDI}, \text{LnNPT}, \text{LnPT})$ , and where  $\Delta$  is the differencing operator, such that  $\Delta y_t = y_t - y_{t-1}$ , and  $\text{CoinEq}$  is the error correction term,  $t$  is time, and  $i=1,2$  is the lag order. Meanwhile,  $\mu_t$  is the error matrix, and  $a_1, a_2$  are coefficients.

The AR root graph test (Figure 3) also suggests that the model is stationary, guaranteeing the significance of the impulse response analysis and the variance decomposition analysis.

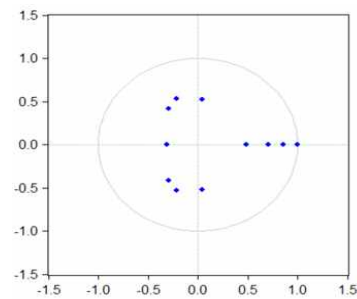


Fig. 3. Inverse roots of the AR characteristic polynomial

By giving Cholesky One SD shocks to each variable, we obtain the impulse response graphs as below (Figure 4).

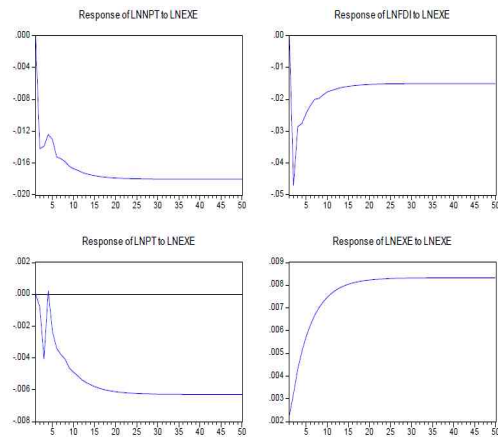


Fig. 4. Response to Cholesky One SD innovations

In the Figure, the horizontal axis indicates the lag periods of the impulse response (month), and the vertical axis indicates the value of the impulse response. The Figure suggests that the impulse responses of the relative factors enhance EXE.

Figure 4 shows that when a positive impulse is given to exchange rate (EXE), which means that there's a depreciation in RMB, only exchange rate and Processing trade will yield the positive response,

following by some fluctuations. Other variables have the negative responses. From the long term equilibrium to see, the increase of RMB's exchange rate (depreciation) will cause the increase of China's trade surplus with US while decrease the Processing trade amount. This is means that the RMB's appreciation could not narrow the huge export amount to US; on the contrary, it will enlarge the trade imbalance of China and US. This is inconformity with the traditional theory. We think this is mainly relative with trade structure of these two countries which we have discussed before. Therefore, according the Marshall-Lerner condition, we can think that the sum of price elasticity of exports and imports (in absolute value) of China is smaller than 1( The condition states that, for a currency devaluation to have a positive impact on trade balance, the sum of price elasticity of exports and imports (in absolute value) must be greater than 1). Actually some researcher calculates that China's price elasticity of exports just was 0.2.

By Figure 5, we also observed that the responses of NPT, PT and FDI to exchange rate reached the stead state after 20 periods (20 months) and finally stay in the negative quadrant. And from the response level to see, the fluctuation of RMB's exchange rate affects the NPT and FDI more than PT.

In another words, the appreciation of RMB will affect non-processing trade and FDI more than processing trade; which reflects that if the sum of price elasticity of exports and imports of China is larger than 1 as time goes on, the appreciation of RMB will make multinational corporations transfer their investment to other countries whose operating cost is much lower than US or China because the multinational corporations are the main power of non-processing trade and FDI. Therefore, the appreciation of RMB could not solve the problem of US trade deficit. It is more likely that the appreciation just can transfer the trade imbalance to other country with US, which could not radically solve the economic problems of US.

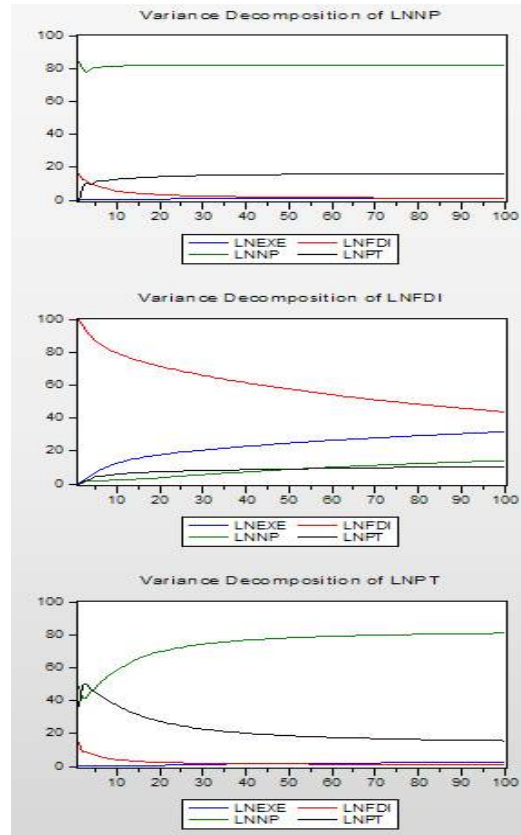


Fig. 5. Graph of variance decomposition (500 periods)

Table 6. Order of contribution to changes in certain variables

Order	LNNPT	LNPT	LNFDI
1	LNNPT (81.60%)	LNNPT (80.94%)	LNFDI (43.70%)
2	LNPT (16.16%)	LNPT (15.60%)	LNXE (31.56%)
3	LNFDI (1.15%)	LNXE (2.32%)	LNNPT (14.11%)
4	LNXE (1.08%)	LNFDI (1.14%)	LNPT (10.62%)

We apply variance decomposition to analyze the contribution of every variable to the affect non-processing trade, FDI, and processing trade. We forecast them for 100 periods. Table 6 show us the Order of contribution to changes in certain variables. We can find that the exchange rate is not very important to non-processing trade (less than 10%) and processing trade, especially processing trade (less than 1%).

Table 7. The trade balance in trade in advanced technology products

Unit: millions of US dollars

	1996	2004	2006	2014
Biotechnology	0	-4	5	1075
Life science	173	423	617	-9203
Opto-Electronics	-192	-7643	-12796	-12089
Information & communications	-1157	-32137	-50705	-78486
Electronics	772	5235	6514	4599
Flexible manufacturing	281	1070	794	276
Advanced materials	60	32	42	42
Aerospace	2315	2037	6326	47428
Weapons	7	-4	-98	1070
Nuclear technology	7	-61	-29	-1004
Total	2269	-31049	-49327	-46292

Resource: US Census Bureau

This also verifies that the appreciation of RMB is not the good solution for solving the US's trade deficit.

As we know before, there almost 90% Processing trade was advanced technology trade, So from table 7, we also find that Information & communications trade is the main part of advantage technology trade. This also reflect that Information & communications trade is the main determinant of the trade imbalance of US. In that way, once US decreased the barrier in these industries, the imbalance situation will be greatly reduced. This the right way to solve the imbalance of US.

#### IV. Conclusion and Policy Implications

Therefore, we can draw the following conclusions.

1. Multinational corporation's activities should hold the responsible for the US trade deficit.

When we consider the trade imbalance between US and China, It's necessarily to take multinational corporations into account. In the traditional statistics, the current account just reflects one country's trade and investment revenue, but do not regard the trade activities of multinational corporations. As we know, a big proportion of China's export to US is induced by the US's corporations which transfer their factories to China for chasing the cheap labor of China. In this sense, the trade imbalance was enlarged every year while US's corporations make the money and China becomes the Scapegoat of the trade imbalance.

2. The appreciation of RMB is not benefit decreasing

the US's trade deficit.

Since China's currency reform in 2005, the RMB has appreciated over 20%, but the US's trade deficit still increased 47% although the US's total trade deficit decreased 6.2% which mostly because the global financial crisis.(see Figure 2) So it is enough to prove that the appreciation of RMB is not benefit decreasing the US's trade deficit at all. There is a similar example, although the exchange rate of Japanese Yen appreciate from

225¥/ \$ in 1985 to 100¥/ \$ in 2002, the fact that the trade imbalance still exist in US-Japan's trade.

3. By building the VECM model and applying the impulse response method, we find that the appreciation of RMB affects non-processing trade and FDI more than processing trade, which reflects that if the sum of price elasticity of exports and imports of China is larger than 1, the appreciation of RMB would pushed the multinational corporations to transfer their investment to other countries whose operating cost is much lower than US or China in that the multinational corporations are the main power of non-processing trade and FDI. Therefore, It is more likely that the appreciation just can transfer the trade imbalance to other country with US, which could not radically solve the economic problems of US.

4. The trade balance needs the international cooperation, which could not be simply solved by the RMB's appreciation.

The right way to solve US's trade deficit is that every country of the world need adjust the economic structure of industries, savings and consumption. Etc. Especially US need find the point of breakthrough from itself. For more detail, US need adjust its economic structure, welfare policies and the financial regulations. Such as cutting the fiscal deficit, increasing the saving rate, cancelling the export limitation, and encouraging developing the low value-added industry. Etc.

5. The advanced technology trade barrier, especially the Information & communications trade barrier is one of the main determinants increase the deficit of US, So reduced tariffs of it, will impel the recovery of US economy, it also would support a possible 60,000 new U.S. jobs and boost global gross domestic product by an estimated \$190 billion annually.



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## Authors



Chi Gong Received the B.A. degree in Economics from Harbin Institute of Technology, China, in 2005, and M.A. degree in Economics from Incheon University, Korea, in 2008, and Ph.D. degree in Economics from Seoul National University, Korea, in 2012.

Dr. Gong joined the faculty of the School of Economics at Sichuan University, Chengdu, China in 2014. He is currently an Associate Professor in the School of Economics, Sichuan University. He is interested in international finance and econometrics.



Ziyang, Liu. Received the B.A. degree in Management from Army superintend institute of shijiazhuang China PLA, China, in 2006, M.A. degree and Ph.D. degree in Management from Kyonggi University, Korea, in 2010 and 2013, respectively.

Dr. Liu joined the faculty of the College of Business and Economics Kyonggi University, Korea in 2012. He is currently an Lecture Professor in the College of Business and Economics Kyonggi University. He is interested in Quality Management, Management Information Systems, International economics, E-business etc.