Scientific Research

The Impacts of Sino-US Trade on China's Economic Growth

Hao Xie

Shanghai-Hongkong Development Institute, Fudan University, Shanghai, China
Email: xiehao1978@hotmail.com

Abstract

China has witnessed many exciting changes after the Chinese government adopted reform and opening-up policy in 1978. In this process, the United States has a positive influence on China's economic growth. Traditional view thinks that the influence of exports on China's GDP growth is greater than imports, but the result of regression analysis shows that imports have a greater impact on China's GDP growth rather than the exports. Based on the statistics from 1998-2007, China's GDP will increase by 0.455% if the volume of China's exports to US increases by 1% while China's GDP will increase by 0.825% if the volume of China's imports from US increases by 1%.

Keywords

China, The United States, Economic Growth

1. Introduction

Since the Chinese government adopted reform and opening-up policy in 1978, bilateral trade has become an important way for China and the United States to communicate with each other. Therefore, the economic influence of the United States cannot be ignored in the process of China's economic growth.

Andrea believes that the international trade could guarantee the process of capital accumulation and promote economic growth [1]. Lewer and Berg also believe that free trade obviously has a positive influence on economic growth [2]. Dong compares the development track of China's foreign trade and China's economic growth and concludes that there is a two-way causal relationship between China's foreign trade and China's economic growth [3]. While Yao thinks that there is no generally accepted method which can be used to measure the impact of foreign trade on China's GDP growth [4]. Shen and Gu hold the point of view that China should not simply rely on the exports of labor-intensive products and on the processing trade to promote its trade and GDP. Instead, China should move toward producing technology-intensive and capital-intensive products [5].

This paper will analyze the relations between China's economic growth and Sino-US trade. The paper uses the economic statistics from 1997-2008 for the following reasons. Firstly, the Asian Financial Crisis occurred in 1997 and it seriously affected China's normal trade with other countries in the next year. In order to safeguard regional security and stability, the Chinese government made a painful decision not to devalue the RMB, which imposed China tremendous pressure. At the same time, the Chinese government changed its economic policy to expand domestic demand and stimulate economic growth in order to ensure the stability of RMB exchange rate. Secondly, Chinese economy slowed down after the Asian Financial Crisis for the Chinese government adopted the deflation economic policy, which can be seen as a turning point in the history of Chinese economy. Thirdly, the year of 2008 witnessed the global financial crisis resulted from the subprime mortgage crisis in the United States. The real economy around the whole world has immense downward momentum under the influence of that. Hence a new round of trade relations between China and the United States began after the year of 2008. Thus, this paper chooses a time series model from 1998 to 2007. The statistics can reflect economic relations between China and the United States as well as the impact of the Sino-US trade on China's economic growth during this period.

2. The Relations between China's Economic Growth and Sino-US Trade Volume

In order to make an in-depth analysis of the relations between China's economic growth and Sino-US trade vo-lume, this paper adopts the annual data of Chinese GDP, Sino-US total trade and China's exports and imports to the United States (see **Table 1**).

Firstly, three line graphs (see **Figures 1**-**3**) are made on the basis of the above statistics. It is not difficult to find that all of the four variables (China's GDP, total trade with US, China's exports to US and China's imports from US) have shown an upward trend. What is more, their fluctuations and trends are quite similar. Thus, a hypothesis can be put forward that there is some inner relation between the above four variables. Secondly, in order to test if China's GDP has a linear relationship with the volume of total trade with US or China's exports to US or the volume of China's imports from US, three scatter plots can be made (see **Figures 4**-**6**) and the re-sult shows that China's GDP has a linear relationship with the volume of total trade with US, the volume of China's export to US and the volume of China's imports from US. After analyzing the line graphs and scatter plots, it can be concluded that China's GDP does have a linear relationship with the volume of total trade with US, the volume of China's export to US and the volume of China's imports from US, Moreover, the figure shapes of the graphs and plots can also be described. However, the problem lies in the degree of closeness be-tween each other. In that case, the correlation coefficient between China's GDP and the volume of total trade with US or the volume of China's exports to US or the volume of China's imports from US should be figured out in order to verify the hypothesis.

Table 1. China's GDP and China's trade with the United States from 1998 to 2007 ($ billion).

	China's GDP	Total Trade with US	China's Exports to US	China's Imports from US
1998	1019.5	85.5	71.2	14.3
1999	1083.3	94.9	81.8	13.1
2000	1198.5	116.3	100.0	16.3
2001	1324.8	121.5	102.3	19.2
2002	1453.8	147.3	125.2	22.1
2003	1641.0	180.8	152.4	28.4
2004	1931.6	231.4	196.7	34.7
2005	2243.7	285.3	243.5	41.8
2006	2644.6	343.0	287.8	55.2
2007	3250.8	386.7	321.5	65.2

Sources: International Monetary Fund & US International Trade Commission, US Department of Commerce, and US Census Bureau.
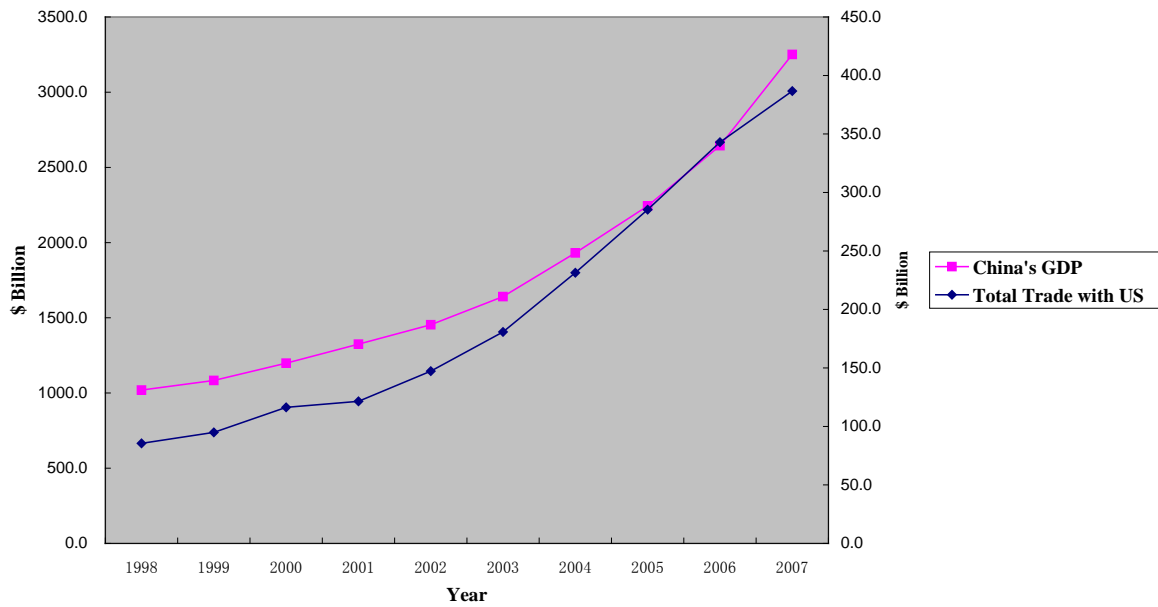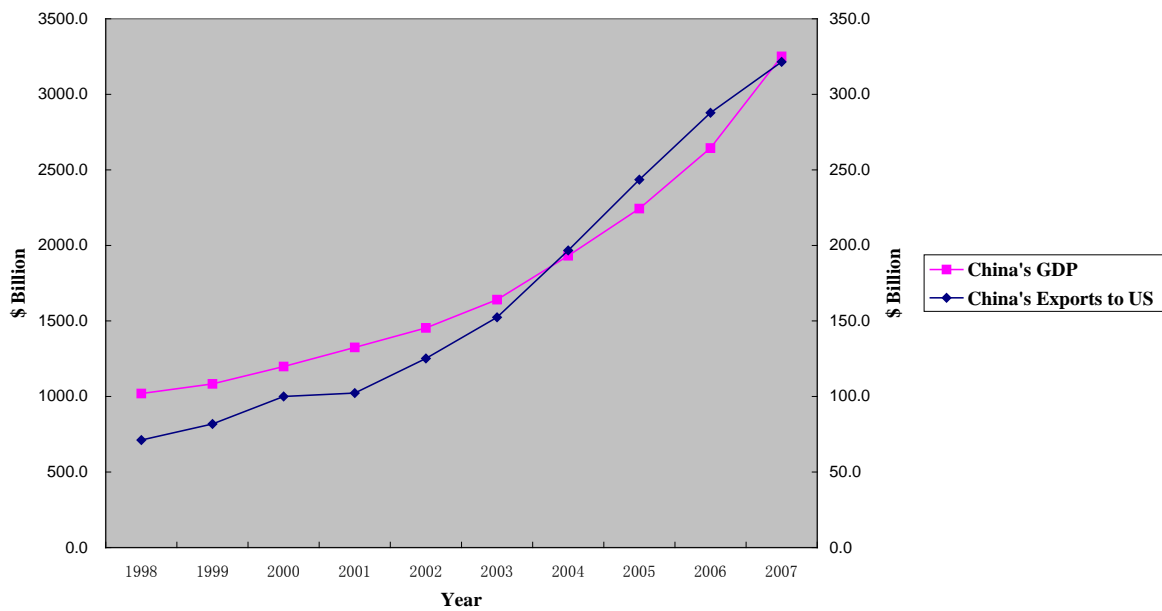
Figure 1. China's GDP & total trade with US.

Figure 2. China's GDP & China's exports to US.

3. How to Determine the Correlation Coefficient between China's GDP and Sino-US Trade Volume

The Correlation Coefficient can show the strength and direction of linear relations between two random variables. The formula of Correlation Coefficient Formula is:

$$r = \frac{\dfrac{\sum (x - \overline{x})(y - \overline{y})}{n}}{\sqrt{\dfrac{\sum (x - \overline{x})^2}{n}} \sqrt{\dfrac{\sum (y - \overline{y})^2}{n}}}$$

Note: *n represents the number of items*; *x is independent variable and y is dependent variable.*
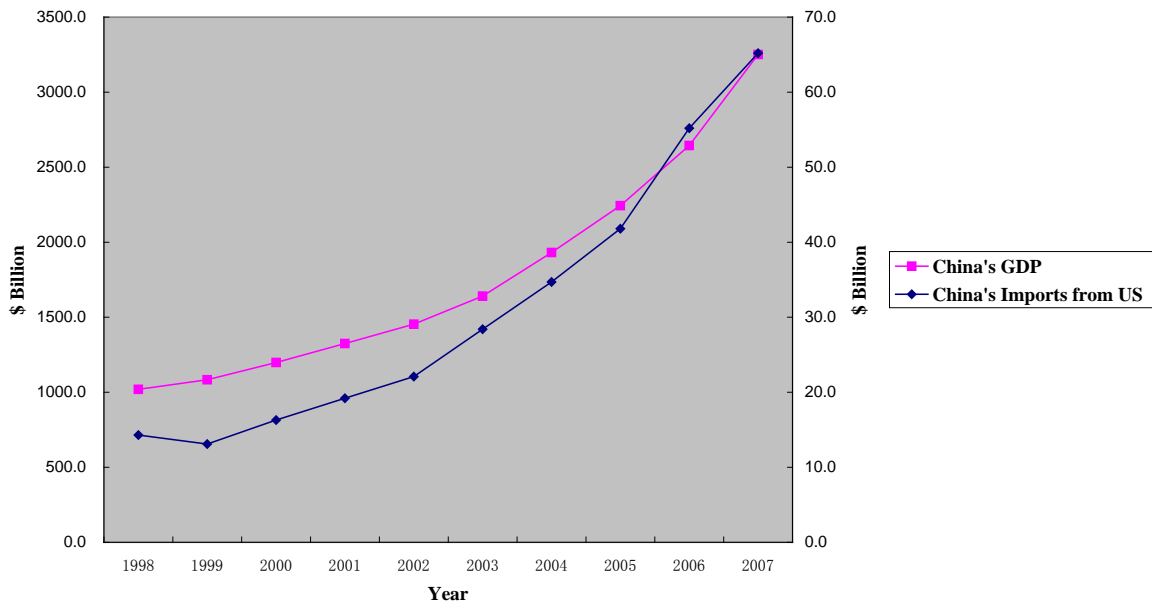
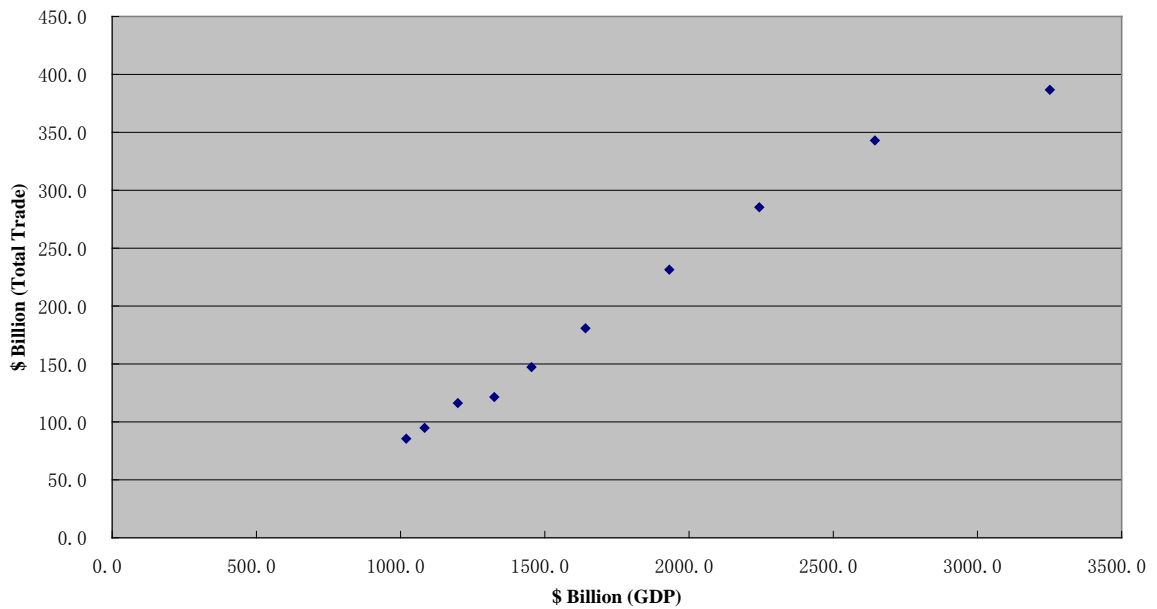**Figure 3.** China's GDP & China's imports from US.

Figure 4. China's GDP & total trade with US.

This paper calculates the Correlation Coefficient between China's GDP and the volume of total trade with US and the result shows that the Correlation Coefficient between them is 0.992. It is necessary to carry out the correlation test. The paper assumes that there is no linear relationship between China's GDP and the volume of total trade with US:

$$H_0 : \rho = 0, \ H_1 : \rho \neq 0$$

$$T = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

Note: *The paper use two-tailed tests and set a statistical significance level at* 0.05.

After calculating relative data, the result proves that the value of T is much bigger than the value of $t_{\alpha/2}$, and
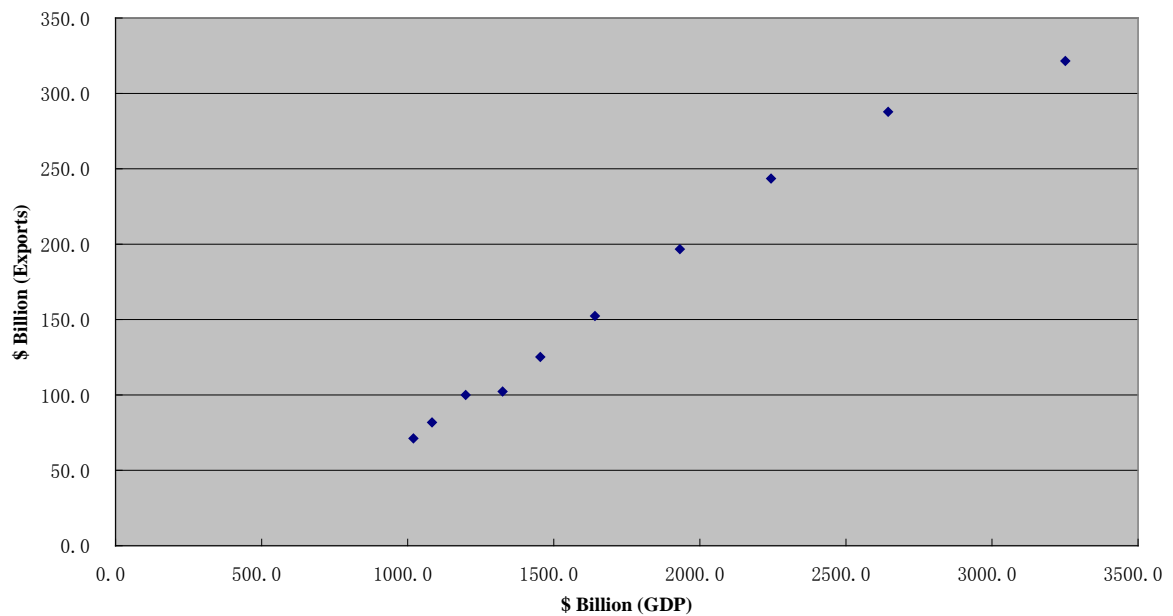
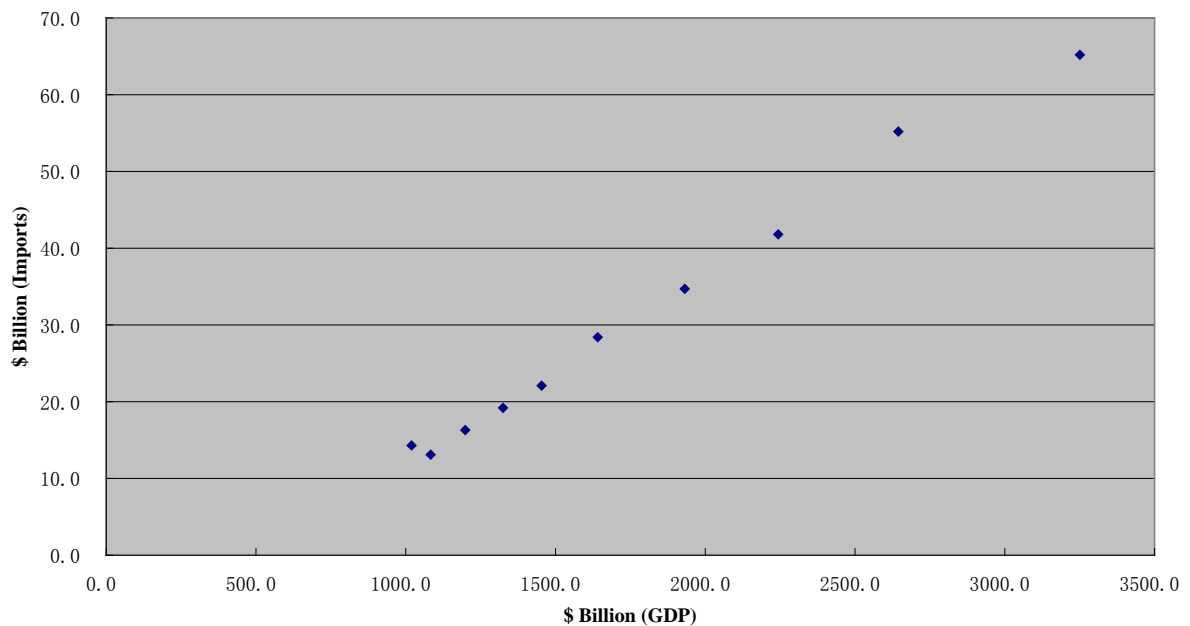**Figure 5.** China's GDP & China's exports to US.

Figure 6. China's GDP & China's imports from US.

P-value is 1.7366E−08, which is significantly less than 0.05. Both results do not meet the original assumption. Thus, a conclusion can be made that there is a high positive correlation between China's GDP and the volume of total trade with US. The paper also uses the same research method to calculate the Correlation Coefficient between China's GDP and China's exports to US and the Correlation Coefficient between China's GDP and China's imports from US. The Correlation Coefficient between China's GDP and China's exports to US is 0.990. After carrying out the correlation text, the value of T is much bigger than the value of $t_{\alpha/2}$ and the P-value, 4.68376E−08, which is also obviously less than 0.05.

The Correlation Coefficient between China's GDP and China's imports from US is 0.997. The results show that the value of T is still bigger than the value of $t_{\alpha/2}$ and this P-value is 5.11328E−10 which is also significantly less than 0.05. Therefore, this correlative analysis indicates that the high positive correlation can be ob-

served not only between China's GDP and China's exports to US but also between China's GDP and China's imports from US. Here, it is worth noting that the Correlation Coefficient of China's GDP and China's imports from US, 0.997, is the highest among those three different Correlation Coefficients.

4. A Regression Analysis between China's GDP and Sino-US Trade Volume

The analyses of Correlation Coefficient of China's GDP, China's exports to US and China's imports from US have proven that there are three different kinds of high positive correlations between them. Thus, it is possible to use the method of Ordinary Least Square (OLS) to make a regression analysis (see **Table 2**). Firstly, it is assumed that the influence of other factors on China's economic growth is stable. Secondly, China's GDP is regarded as a dependent variable and the total trade with US is also regarded as an independent variable. Then, a simple linear regression model is created:

$$y_c = a + bx$$

$$\begin{cases} b = \dfrac{n\sum xy - \sum x \sum y}{n\sum x^2 - \left(\sum x\right)^2} = \dfrac{\overline{xy} - \overline{x} \cdot \overline{y}}{\sigma^2} \\ a = \dfrac{\sum y}{n} - b\dfrac{\sum x}{n} = \overline{y} - b\overline{x} \end{cases}$$

$$\textit{Note}: \ \overline{xy} = \frac{\sum xy}{n}$$

According to the data of **Table 2**, the R Square is 0.984. The value of F is 496.746 which is big enough. The result of the test for linear relation indicates that the regression effect of the simple linear regression model is significant. Moreover, both results of t-test (22.288) and P-value (1.7366E−08) reveal that the influence of one independent variable on the other dependent variable is significant. In other words, China's total trade with US does have a significant influence on China's GDP. Therefore, a simple linear regression model is figured out which reflects predictable relations between China's GDP and its total trade with US:

$$y_c = 424.726 + 6.797x$$

or

China's GDP = 424.726 + 6.797 Total Tarde with US

Similarly, Ordinary Least Square (OLS) can be taken to make regression analysis and calculate other two kinds of simple linear regression models. It is still assumed that the influence of other factors on China's eco-

Table 2. Regression analysis of China's GDP and total trade with US (1998-2007).

SUMMARY OUTPUT							
Regression Statistics							
Multiple R			0.992043563				
R Square			0.984150431				
Adjusted R Square			0.982169235				
Standard Error			98.3635241				
Observations			10				
ANOVA							
	df	SS	MS	F	Significance F		
Regression	1	4806203.801	4806203.801	496.7455928	1.7366E−08		
Residual	8	77403.06299	9675.382874				
Total	9	4883606.864					
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	424.7255501	68.26830044	6.221416783	0.000253451	267.2985671	582.1525331	267.2985671	582.1525331
X Variable 1	6.796981231	0.30496434	22.28779022	1.7366E-08	6.093732203	7.500230259	6.093732203	7.500230259

nomic growth is stable. Next, China's GDP is seen as a dependent variable and the volume of China's exports to US is also seen as an independent variable, or China's GDP is regarded as a dependent variable and China's imports from US is regarded as an independent variable.

In this case, the following simple linear regression models can be made.

$$China's \text{ GDP} = 410.125 + 8.137 \text{ China's Exports to US}$$
$$China's \text{ GDP} = 515.680 + 40.718 \text{ China's Imports from US}$$

If these simple linear regression models are analyzed only from the perspective of mathematics, China's GDP will increase by an average of $6.797 billion if the volume of total trade with US increases by $1 billion; China's GDP will increase by an average of $8.137 billion if the volume of China's exports to US increases by $1 billion; China's GDP will increase by an average of $40.718 billion if the volume of China's imports from US increases by $1 billion. The information shows that the correlation between China's GDP and China's imports from US is stronger than the correlation between China's GDP and China's exports to US or between China's GDP and total trade with US Moreover, its regression coefficient is 40.718 which is 32.581 higher than the regression coefficient of China's GDP and China's exports to US.

5. A Re-Examination of the Regression Analysis between China's GDP and Sino-US Trade Volume

However, the period from 1998 to 2007 may not a good time series for it only has ten observations. So, it is necessary to choose a long time series to test whether the same result can be reached that the correlation between China's GDP and China's imports from US is stronger than the correlation between China's GDP and China's exports to US. In that case, a longer span from 1978 to 2007 is chosen for the test (see **Table 3**). Two line graphs are made in the same way (see **Figure 7**, **Figure 8**). It is obvious to notice that the upward trend of China's GDP is quite similar with the trend of China's exports to US and the trend of China's imports from US. So it is reasonable to assume there are some relations among those variables during that period.

Then, in order to test whether China's GDP has linear relations with the volume of China's exports to US and the volume of China's imports from US, this paper makes two scatter plots using the same data (see **Figure 9**, **Figure 10**). Compared with the data of Sino-US trade from 1998 to 2007, the data of Sino-US trade from 1978 to 2007 still shows us the similar result that the arrangements are tending to become straight lines except for a few points. Although time series has been extended to thirty years, it still can be concluded that the growth of China's GDP has linear relations with the volume of China's exports to US and the volume of China's imports to US in this period.

Since China's GDP also has a linear relationship with the volume of China's export to US and the volume of China's imports to US during that period. The correlation coefficient among them can be calculated (see **Table 4**, **Table 5**).

From 1978 to 2007, the Correlation Coefficient of China's GDP and China's exports to US is 0.993. After carrying out the correlation text, it shows the value of T is much bigger than the value of $t_{\alpha/2}$ and the P-value is 1.22612E−27, which is obviously less than 0.05. During the same period, the Correlation Coefficient of China's GDP and China's imports from US is 0.987. Its value of T is also bigger than the value of $t_{\alpha/2}$ and this P-value is 1.46922E−23 which is significantly less than 0.05. Thus, the result of correlative analysis indicates hat, from 1978 to 2007, the high positive correlation can be observed not only between China's GDP and China's exports to US but also between China's GDP and China's imports from US. It can be also noticed notice that, during this period, the Correlation Coefficient of China's GDP and China's exports to US, 0.993, is higher than the Correlation Coefficient of China's GDP and China's imports from US.

Next, Ordinary Least Square (OLS) is applied to make regression analysis and calculate simple linear regression models. First, it is assumed that the influence of other factors on China's economic growth is stable. Second, China's GDP is seen as a dependent variable and the volume of China's exports to US is seen as an independent variable, or China's GDP is regarded as a dependent variable and the volume of China's imports from US is regarded as an independent variable. Therefore, the following simple linear regression models can be made:

$$China's \text{ GDP} = 241.148 + 8.435 \text{ China's Exports to US}$$
$$China's \text{ GDP} = 146.776 + 49.639 \text{ China's Imports from US}$$

From the perspective of mathematics, these two models indicate that China's GDP will increase by an average of $8.435 billion if the volume of China's exports to US increases by $1 billion; China's GDP will increase by

Table 3. China's GDP and China's trade with the United States from 1978 to 2007 ($ billion).

	China's GDP	China's Imports from US	China's Exports to US
1978	147.3	0.8	0.4
1979	175.6	1.7	0.7
1980	188.2	3.8	1.2
1981	193.0	3.6	2.1
1982	202.1	2.9	2.5
1983	227.4	2.2	2.5
1984	256.1	3.0	3.4
1985	304.9	3.8	4.2
1986	295.7	3.1	5.2
1987	268.2	3.5	6.9
1988	307.2	5.0	9.2
1989	342.3	5.8	12.8
1990	354.6	4.8	16.3
1991	376.6	6.3	20.3
1992	418.2	7.5	27.5
1993	440.5	8.8	33.7
1994	559.2	9.3	41.3
1995	728.0	11.7	48.5
1996	856.1	12.0	54.4
1997	952.7	12.8	65.8
1998	1019.5	14.3	75.1
1999	1083.3	13.1	87.8
2000	1198.5	16.3	107.6
2001	1324.8	19.2	109.4
2002	1453.8	22.1	133.5
2003	1641.0	28.4	163.3
2004	1931.6	34.7	210.5
2005	2243.9	41.8	259.8
2006	2644.7	55.2	305.8
2007	3250.8	65.2	340.1

Source: The World Bank Group & United Nations Commodity Trade Statistics Database.

an average of $49.639 billion if the volume of China's imports from US increases by $1 billion. Comparing those simple linear regression models (1978-2007) with the former simple linear regression models (1998-2007), the results are quite similar. From 1978 to 2007, the correlation between China's GDP and China's imports from US is still much stronger than the correlation between China's GDP and China's exports to US. Its regression coefficient is 49.639, 41.203 higher than the regression coefficient of China's GDP and China's exports to US. And, in order to make a deep comparison between the impact of China's imports from US and China's exports to US on China's GDP respectively, we can get the following **Table 6**.

After that, Ln (China's GDP) is regarded as a dependent variable and Ln (China's exports to US) is regarded as an independent variable. In the same way, China's GDP is seen as a dependent variable and China's imports from US are seen as an independent variable. Then, the following models are made on the basis of the regression analyses:

$$Ln\ (China's\ GDP) = 4.947 + 0.455\ Ln\ (China's\ Exports\ to\ US)$$
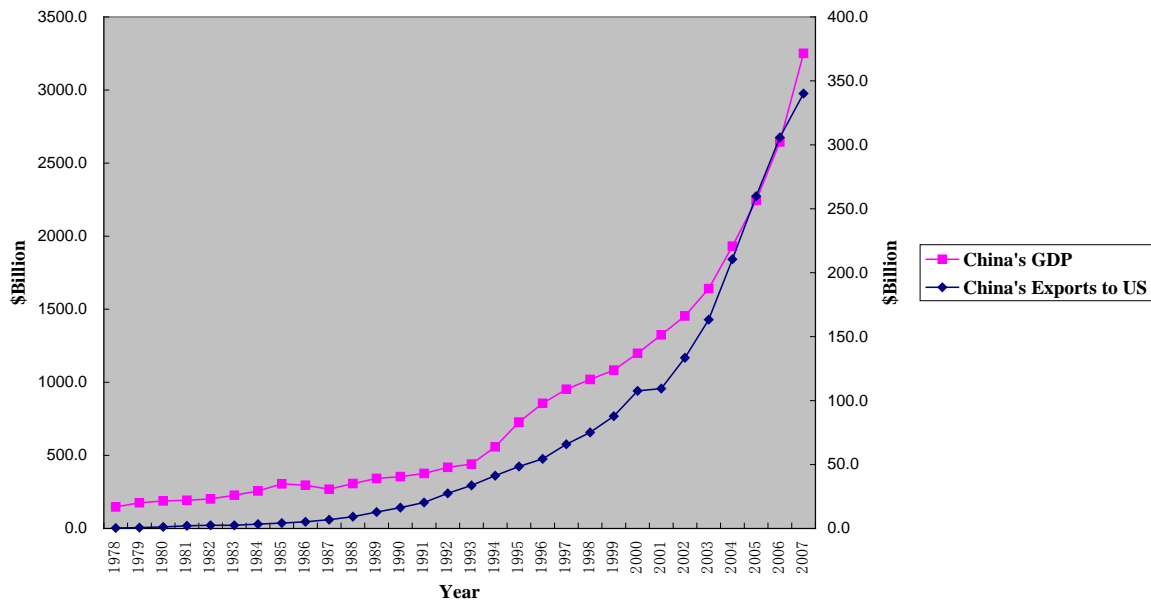$$Ln\ (China's\ GDP) = 4.599 + 0.825\ Ln\ (China's\ Imports\ from\ US)$$

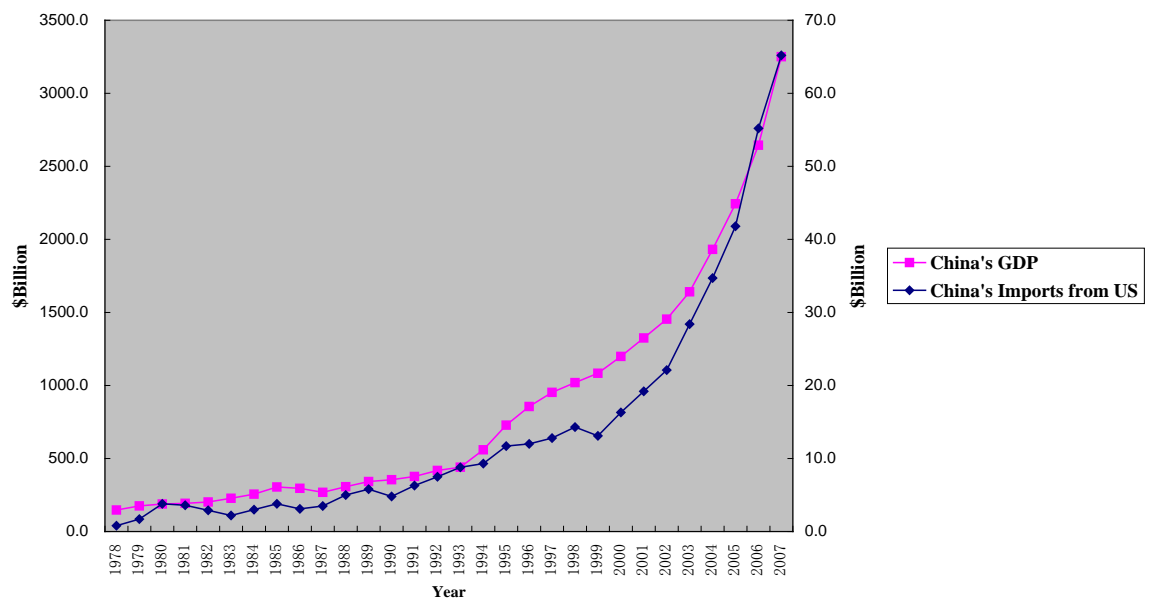**Figure 7.** China's GDP & China's exports to US.

Figure 8. China's GDP & China's imports from Us.

The two models indicate that China's GDP will increase by 0.455% if the volume of China's exports to US increases by 1%; China's GDP will increase by 0.825% if the volume of China's imports from US increases by 1%. Therefore, both two the researches of 10-year time series (1998-2007) and 30-year time series (1978-2007) yield the same result that, if these models are analyzed only from the perspective of mathematics and other factors are not considered, the influence of China's imports from US on China's GDP growth is much bigger than the influence of China's exports to US on it.

6. Conclusions

The Sino-US trade relations can be regarded as one of the most important trade relations in the world. Both China and the United States should attach great importance to the bilateral trade relations if they want to maintain stable economic growth in both countries. The main purpose of this paper is to analyze the relations be-
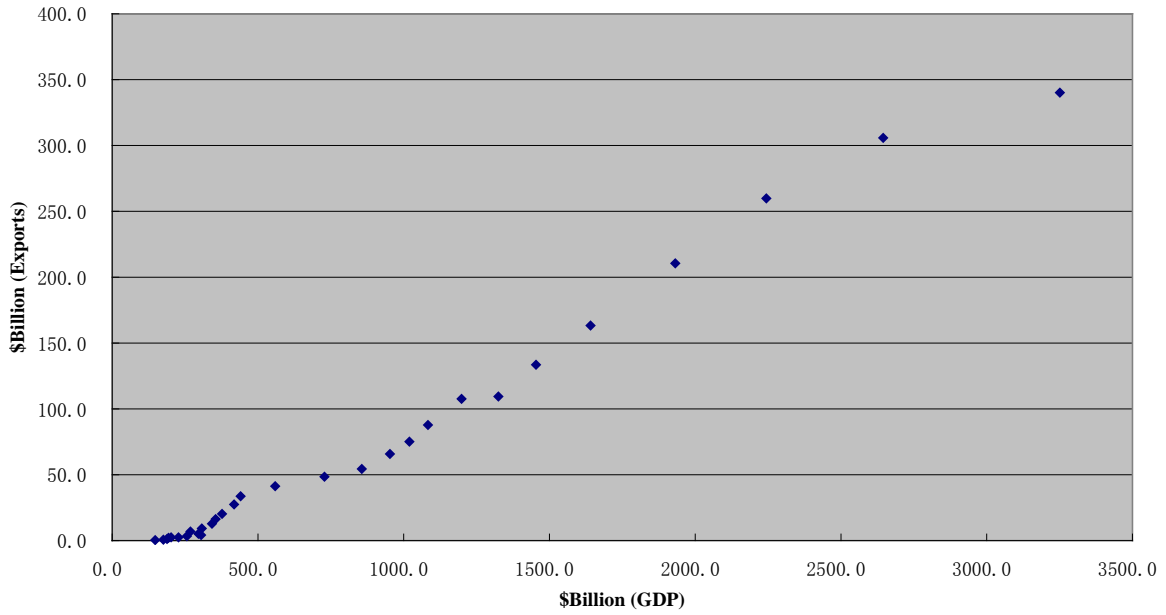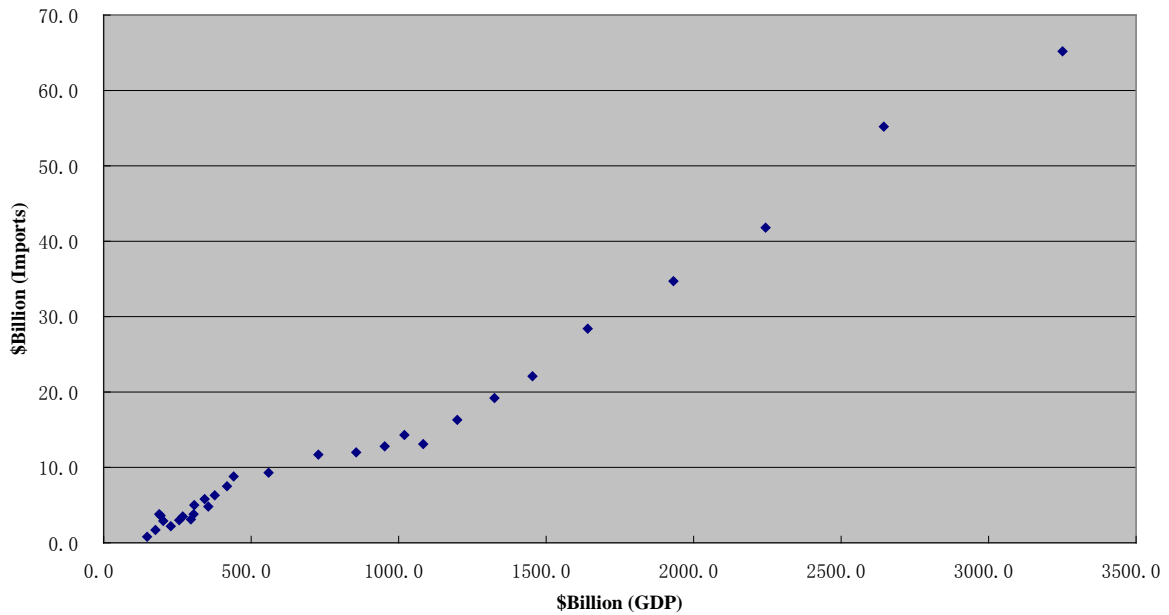
Figure 9. Chian's GDP & Chian's exports to US.

Figure 10. China's GDP & China's imports from US.

Table 4. Correlation coefficient of China's GDP and China's exports to US (1978-2007).

	China's GDP	China's Exports to US
China's GDP	1	
China's Exports to US	0.993129591	1

Table 5. Correlation coefficient of China's GDP and China's imports from US (1978-2007).

	China's GDP	China's Imports from US
China's GDP	1	
China's Imports from US	0.986524132	1

Table 6. Taking logarithm of each individual number in Table 3.

	Ln (China's GDP)	Ln (China's Exports from US)	Ln (China's Import from US)
1978	4.992471323	−0.916290732	−0.223143551
1979	5.168208681	−0.356674944	0.530628251
1980	5.237505227	0.182321557	1.335001067
1981	5.262690189	0.741937345	1.280933845
1982	5.308762624	0.916290732	1.064710737
1983	5.426710581	0.916290732	0.78845736
1984	5.545567993	1.223775432	1.098612289
1985	5.719983854	1.435084525	1.335001067
1986	5.689345427	1.648658626	1.131402111
1987	5.591732971	1.931521412	1.252762968
1988	5.727499001	2.219203484	1.609437912
1989	5.835687546	2.549445171	1.757857918
1990	5.870990394	2.791165108	1.568615918
1991	5.931183616	3.010620886	1.840549633
1992	6.035959787	3.314186005	2.014903021
1993	6.087910445	3.517497837	2.174751721
1994	6.326507191	3.7208625	2.2300144
1995	6.590301048	3.881563798	2.459588842
1996	6.752387192	3.996364154	2.48490665
1997	6.859300059	4.186619838	2.549445171
1998	6.92706759	4.318820559	2.660259537
1999	6.987767217	4.475061501	2.57261223
2000	7.088826054	4.678420648	2.791165108
2001	7.189016784	4.69501089	2.954910279
2002	7.281936097	4.894101478	3.095577609
2003	7.403061091	5.095589	3.346389145
2004	7.566103954	5.349485653	3.546739687
2005	7.715970702	5.559912104	3.73289634
2006	7.880312916	5.722931293	4.010962953
2007	8.086656399	5.829239692	4.177459469

tween China's economic growth and Sino-US trade.

In the analysis of the influence of Sino-US trade on China's GDP growth, after analyzing the line graphs and scatter plots, it is not difficult to notice that from 1998 to 2007, the growth of China's GDP has linear relations with the volume of total trade with US, or the volume of China's export to US, or the volume of China's imports to US. Moreover, the correlative analysis indicates that the high positive correlation can be observed among them. It is worth noting that the Correlation Coefficient of China's GDP and China's imports from US, 0.997 is the highest among these three different kinds of Correlation Coefficients. Those simple linear regression models show that China's GDP will increase by an average of $6.797 billion if the volume of total trade with US increases by $1 billion; China's GDP will increase by an average of $8.137 billion if the volume of China's exports to US increases by $1 billion; China's GDP will increase by an average $40.718 billion if the volume of China's imports from US increases by $1 billion. The information indicates that, during this period, the correlation between China's GDP and China's imports from US is stronger than the correlation between China's GDP and China's exports to US and its regression coefficient is 40.718, 32.581 higher than the regression coefficient of China's GDP and China's exports to US. However, the year from 1998 to 2007 may not be a good time series

for it only contains ten observations. So a longer time series is chosen from 1978 to 2007 to test the result again. Both the research of 10-year time series (1998-2007) and the research of 30-year time series (1978-2007) indicate that, if these simple linear regression models are analyzed only from the perspective of mathematics, China's imports from US have a much bigger positive influence on China's GDP growth compared with China's exports to US. Another two mathematical models indicate that China's GDP will increase by 0.455% if the volume of China's exports to US increases by 1%; China's GDP will increase by 0.825% if the volume of China's imports from US increases by 1%. Further research is suggested to explore the reasons accounting for the conclusion in this paper from the perspective of Sino-US trade commodity structure.

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