

## **Research on the Relationship between China's Foreign Trade and Economic Growth Based on VAR**

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### **Abstract**

*Since reform and opening up, our national economy has been developing fast and foreign trade is presenting a state of rapid development. Foreign trade has been expanding steadily and its structure has been optimized continuously. This paper analyzes the relationship between China's GDP, the import volume and the export volume using the VAR model according to the statistical data for the period 1978 to 2008 and finds that there is a long-term dynamic and balanced relationship between them. The export trade has a considerable pushing effect on our economic development for a long period of time while the import trade has a far less influence on GDP than the export trade does.*

**Keywords:** Crimes of violence, property crime, crime prevention programs, fear of crime in the home, and walking.

### **1. Introduction**

Economic growth is one of the main issues that economics studies. As the trend of economy integration and globalization is strengthening increasingly, economy between countries is combined with each other more deeply. The economic development of any country in the world must depend on foreign trade. Consequently, it is vitally important to study the issues such as the relationship between foreign trade and economic growth and whether foreign trade can promote economic growth of the country <sup>[1]</sup>.

Since reform and opening up, our national economy has kept developing fast. In 1978 China's GDP only reached 364.52 billion RMB while in 2008 it reached 30.067 trillion RMB, which is 82 times as much as in 1978 at the current price. According to GDP rankings published by the IMF in Apr. 2009, our economic aggregate has overtaken Germany and moved to the third in the world. According to the latest data, in the 30 years from 1978 to 2008 China's average speed of GDP growth is 9.8 percent <sup>[1]</sup>. While our GDP is growing rapidly, both the volume of foreign trade and its pace of growth are presenting a state of rapid development, and they are growing at a higher speed than GDP. The total volume of import and export keeps a growth rate of 24.17 percent a year. In 2008 our import and export volume ranked third in the world and the amount of foreign capital China utilized ranked second in the world while foreign exchange reserves ranked first in the world. Foreign trade has been playing an important role in boosting the economy <sup>[1]</sup>. Our economy has been combined with other countries' economy more deeply and its foreign trade has been developing with astonishing speed especially since China joined WTO.

Therefore foreign trade has been an important support to our economic development. Under the background that the global economic crisis is deepening, this paper attempts to use the statistical model to make a quantitative analysis of the principle that foreign trade affects economic growth using the latest macroeconomic data according to our real conditions.

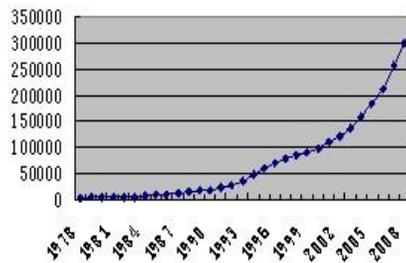


Figure 1 China's GDP, 1978-2008

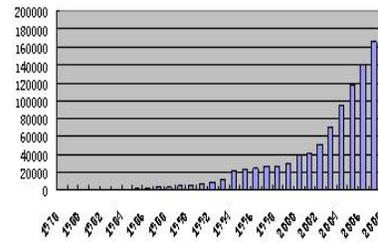


Figure 2 China's total volume of import and export, 1978-2008

## 2. Review of the relevant literatures

It causes close attention to economists and scholars both at home and abroad that the foreign trade has effort on economic growth. Ghatak(1998)used VARL model to analyze the relationship between Korea's real GDP per capita and export and found that export trade couldn't promote GDP growth.<sup>[1]</sup>Lawrence(1999)believed that import competition can cause an increase in total factor productivity by analyzing the influence that foreign competition had on its total factor productivity in more than one hundred manufacturing enterprises of the U.S. during the 1980s<sup>[1]</sup>. Cao Wei(2005)proved that economic growth is the key factor influencing foreign trade and he made a special effort to investigate the floating of exchange rates factor by using time series analysis method to investigate the relationship between China's economic growth, the floating of exchange rates and foreign trade in the period from 1978 to 2004<sup>[2]</sup>. Wan Jinjin and Xie Jinxiao(2006)drew the conclusion that foreign trade helps in promoting China's economic growth whether in the long term or in the short term using co-integration theory and error correction model to make empirical analysis using the statistical data of China's GDP, import volume and export volume for the period 1978 to 2004<sup>[3]</sup>. Lin Hong and Cai Hongbo (2007) used VAR model to analyze the relativity between the three indicators and economic growth from 1984 to 2006, that is, the extent of our goods trade's opening up, service trade's opening up and foreign direct investments opening up, and proved that there existed strong positive interactive response function between them<sup>[4]</sup>.

Research done at home and abroad shows that most results of studies suggest that foreign trade is a significant factor influencing economic growth, and at the beginning most scholars paid attention to the effects of export on economic growth although they gradually paid more attention to import later still they didn't take our macroeconomic situation change into consideration but that change will surely affect the extent of influencing between foreign trade and economic growth<sup>[1]</sup>.This paper uses basically regression model to make analysis in terms of quantitative analysis. Based on the previous studies by others, it makes empirical analysis on how import and export trade promotes our economic growth using VAR model which is widely used with complete theoretical principle by use of the latest macroeconomic data according to changes in the real macroeconomic situation since China's reform and opening .

## 3. Empirical research on the relationship between our foreign trade and economic growth based on VAR

### 3.1. The choice of variables and the sources of the data

The variables and data used in this paper including China's GDP, the total volume of import and the total volume of export are from China's annual data for the period 1978 to 2008 according to the Statistical Database from China Economic Information Network. This paper uses GDP Deflator (1978=100) deflate the data used<sup>[5]</sup> to make all data comparable. In order to eliminate the heteroscedasticity which may exist in data, we use the natural logarithm of the series above and the variables after being transformed are correspondingly called LGDP、LEX、LIM<sup>[6]</sup>.The software used in this paper to analyze and process data is Eviews6.0<sup>[12]</sup>.

### 3.2. The construction of the model and tests

#### (1) Unit Root Test

Considering that spurious regression problem may arise, when the dynamic regression model is fitted, the stability test of the series should be done in advance to avoid it<sup>[7]</sup>. This paper uses ADF test to check the stability of every series.

**Table 1: Results of Unit Root Test**

Variable	Test type (c,T,d)	ADF statistic	Critical value (5 %)	Prob.	conclusion
LGDP	(c,T,1)	-2.740050	-3.574244	0.2292	unstable
D(LGDP)	(c,0,1)	-2.909887	-2.971853	0.0569	stable*
LEX	(c,0,0)	-1.310170	-2.963972	0.6114	unstable
D(LEX)	(c,0,0)	-5.134567	-2.967767	0.0002	stable
LIM	(c,0,0)	-1.420427	-2.963972	0.5590	unstable
D(LIM)	(c,0,0)	-4.102228	-2.967767	0.0035	stable

Note(c,T,d)stands for intercept, trend and lag order in the test equation respectively. Lag order is selected by the least SC-value criterion. D(X) means first difference of X. \* denotes rejection of the null hypothesis at the 10% significance level.

The results in Table 1 indicate that the absolute values of the ADF statistics of LGDP, LEX and LIM are smaller than the ADF test critical values at the 5% level, which means three series are very stable at the 95% confidence level. Further test reveals that DLGDP is stable at least at the 90% confidence level while DLEX and DLIM are both stable at the 95% confidence level.

#### (2) Johansen co-integration test

LGDP, LEX and LIM are all integrated series so they satisfy the conditions for the co-integration test<sup>[8]</sup>. Use Johansen co-integration test to do further vector co-integration test for the multivariable system. Results are shown in Table 2 and Table 3.

**Table 2: Results of Rank Test**

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.667917	48.51252	42.91525	0.0125
At most 1	0.315065	17.64612	25.87211	0.3682
At most 2	0.222589	7.050027	12.51798	0.3394

**Table 3: Results of Maximum-Eigenvalue Test**

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05Critical Value	Prob.**
None *	0.667917	30.86641	25.82321	0.0099
At most 1	0.315065	10.59609	19.38704	0.5554
At most 2	0.222589	7.050027	12.51798	0.3394

Note : \*denotes rejection of the null hypothesis at the 5% significance level. \*\* Mackinnon-Haug-Michelin (1999) p-values

According to the results of Rank Test and Maximum-Eigen value Test, rejection of the null hypothesis without co-integration relationship at the 95% confidence level indicates that there is co-integration relationship between variables and at most one co-integration relationship corresponding to the null hypothesis is acceptable at the 95% confidence level. Consequently, there exists only one co-integration relationship at the 5% significance level.

#### (3) The construction of the VAR model

Based on the chosen variables LGDP, LEX and LIM and so on, the three-dimension VAR model is constructed. In order to determine the lag order for the VAR model, the lag structure of the model criterion is used. The results are shown in Table 4.

**Table 4: VAR Lag Order Selection Criteria**

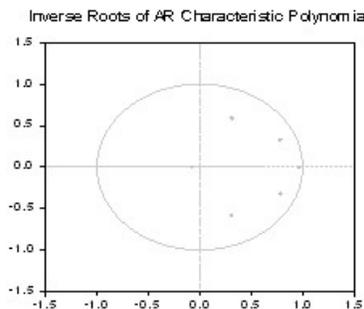
Lag	LogL	LR	FPE	AIC	SC	HQ
0	8.655201	NA	0.000132	-0.418904	-0.274922	-0.376090
1	96.90470	150.3510	3.75e-07	-6.289237	-5.713309	-6.117983
2	116.2923	28.72244*	1.79e-07*	-7.058692*	-6.050819*	-6.758999*
3	123.3269	8.858349	2.23e-07	-6.913105	-5.473286	-6.484971
4	131.8088	8.796027	2.69e-07	-6.874726	-5.002961	-6.318152

Note : \*indicates lag order selected by the criterion

According to Table 4 and Table 5, the evaluating indicators all point to lag order 2, which means VAR(2) should be selected. The model equation is as follows:

$$\begin{pmatrix} LGDP_t \\ LEX_t \\ LIM_t \end{pmatrix} = \begin{pmatrix} 1.27 \\ -0.74 \\ 2.30 \end{pmatrix} + \begin{pmatrix} 1.44 & 0.02 & 0.02 \\ 0.22 & 0.30 & 0.60 \\ -0.51 & -0.18 & 1.35 \end{pmatrix} \begin{pmatrix} LGDP_{t-1} \\ LEX_{t-1} \\ LIM_{t-1} \end{pmatrix} + \begin{pmatrix} -0.67 & 0.11 & -0.05 \\ -0.09 & 0.15 & -0.09 \\ 0.18 & 0.57 & -0.62 \end{pmatrix} \begin{pmatrix} LGDP_{t-2} \\ LGDP_{t-2} \\ LGDP_{t-2} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{pmatrix}$$

The empirical results show that goodness of fit 0.989165 for the model is generally good and it is 0.986221 after adjustments. Besides, no root lies outside the unit circle (as shown in Figure(3))and the model structure is stable so the fitting effect of model is pretty good.



**Figure 3: Inverse Roots of AR Characteristic Polynomial**

(4) Granger Causality Test

In order to determine the interrelationship between the variables, Granger Causality Test should be done for the variables of VAR model. The results are shown in Table 5.

**Table 5: Results of Granger Causality Test**

null hypothesis H <sub>0</sub>	Periods	F-statistic	Probability
LEX does not Granger Cause LGDP	28	4.69159	0.0117
LGDP does not Granger Cause LEX		1.25934	0.3138
LIM does not Granger Cause LGDP	28	2.47274	0.0898
LGDP does not Granger Cause LIM		0.83877	0.4878
LIM does not Granger Cause LEX	28	3.63580	0.0295
LEX does not Granger Cause LIM		0.94373	0.4373

It can be concluded from Table 5 that firstly, at the 5% significance level China’s total volume of export (LEX) Granger Causes China’s GDP(LGDP), which indicates export is definitely capable of influencing our economic development and facts have proved that it is true. Financial crisis has led to a considerable decrease in export trade and it has further influenced our economic growth.GDP does not Granger Cause the total volume of export.

Maybe it is because export benefits from China’s cheap labor and goods but not because it benefits from the overall level of GDP. Secondly, there isn’t a causal relationship between total volume of import (LIM) and GDP (LGDP). Thirdly, the total volume of import (LIM) Granger Causes the total volume of export (LEX), while the total volume of export does not Granger Causes the total volume of import, which indicates there is a unidirectional causal relationship between export and import. According to common sense, export should Granger Cause import as well.

(5) Impulse-response analysis

Because the VAR model is not theoretical, it is hard to explain the coefficients. When a detailed analysis is made, the influence of one single variable’s change upon another does not tend to be analyzed but impulse-response function is used to analyze the influence of the impact of a standard difference innovation, a random disturbance term, on the endogenous variables<sup>[9]</sup>. When an analysis is made, GDP (LGDP), the total volume of export (LEX) and the total volume of import (LIM) are given one positive-unit-size shock respectively, the impulse-response function graphs about GDP are obtained (as shown in Figure 4 to Figure 6), where the horizontal axis shows lag periods of the impact (unit: year); the vertical axis shows GDP; the full line represents impulse-response function, and the dashed line represent  $\pm 2$  standard errors.

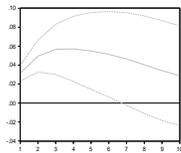


Figure 4 Response of GDP to GDP

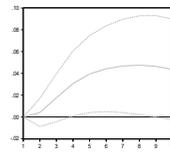


Figure 5 Response of GDP to the total volume of export

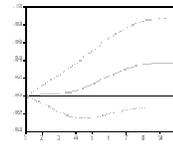


Figure 6 Response of GDP to the total volume of import

According to Figure 4, response of GDP to its own change is in the same way with its highest point at period 4 and it becomes converge gradually at the following periods. Figure 5 shows one positive shock given to the total volume of export at the current period causes the shock of GDP, which is rather small at the current period and it begins to increase steadily after the second period, which indicates that one shock of export leads to that of GDP in the same way and it provides the motivation and lasting influence. Figure 6 shows when one positive shock is given to the total volume of import at the current period, the effect on GDP is rather small at the first four periods but it increases steadily at the following periods and it is generally a long-term one but the export trade has a significantly stronger influence on our economy than the import trade does.

(6) Variance decomposition analysis

Variance decomposition analysis denotes the degree of contribution one structural shock makes to the endogenous variables (often measured by variance) to further evaluate the importance of different structural shock<sup>[10-11]</sup>. The VAR model established is used to make variance decomposition analysis. The results are shown in Table 6.

Table 6: Variance decomposition

Lag	S.E.	LGDP	LEX	LIM
1	0.031441	100.0000	0.000000	0.000000
2	0.058772	99.41646	0.472304	0.111255
3	0.083544	95.15272	4.697966	0.149318
4	0.105905	88.26173	11.33397	0.404271
5	0.126361	80.88812	17.69652	1.415335
6	0.145238	73.76183	22.69736	3.540791
7	0.162464	67.13600	26.44091	6.423070
8	0.177642	61.32592	29.28063	9.393412
9	0.190466	56.56662	31.41781	12.01551
10	0.200932	52.90065	32.94607	14.15325

Table 6 shows the degree of contribution which the change of the factor makes to itself is decreasing year by year with 80.89 percent at the fifth period and 52.90 percent at the tenth period, and it plays a major role but it makes the biggest degree of contribution to the change of GDP.

Although the degree of contribution which the change of export makes to the change of GDP is very slow at the first two periods but it is increasing year by year with 32.95 percent at the tenth period. The degree of contribution which import makes to the change of GDP is all very small at the first five periods with 14.15 percent at the tenth period, which is a long-term effect. The export trade makes far bigger contributions to GDP than the import trade does. The conclusion is the same as that drawn by making the impulse-response analysis.

#### **4. Conclusions and Suggests**

##### **4.1. Main conclusions**

This paper analyzes the relationship between China's GDP, the import volume and the export volume using the VAR model according to the statistical data for the period 1978 to 2008 and draws the following conclusions:

(1) Although the results of unit root test show that GDP, the total volume of export and the total volume of import are all unstable time series, co-integration test indicates that there is a long-term dynamic and balanced relationship between them.

(2) The results of Granger causality test show that export Granger Causes GDP while GDP does not Granger Cause the total volume of export, which indicates there is a unidirectional causal relationship between export and GDP and export is indispensable to our economic development today.

(3) The results of impulse response and variance decomposition shows further that the export trade has a considerable pushing effect on our economic development for a long period of time and the export trade has a far bigger influence on GDP than the import trade does. Concerning the influence of import on GDP, the empirical result negates Keynes' multiplier theory. In China, import has an influence on export and it has an indirect influence on GDP, which might be connected with our import and export structure.

##### **3.2. Suggestions about policies**

The results of analysis indicate that foreign trade helps in promoting our economic growth whether in the long term or in the short term, which is crucially important to make our macroeconomic policies. The variance decomposition analysis shows the degree of contribution which export makes to GDP reaches 32.95 percent and which import makes reaches 14.15 percent, which shows clearly that foreign trade is of importance to our economic growth. American subprime mortgage crisis which started at the beginning of the year 2007 has caused the global financial crisis and it has kept deepening. Influenced by multiple factors such as global economic fluctuations and exchange rate, China suffered a sharp decline in export trade in 2009 and it has led to a disruption in our economy. On the one hand, it disclosed a weakness in our economic development. Excessive dependence on import and export trade leads to high foreign trade dependence. Once undesirable big changes take place in the international economic environment, our economy will be affected greatly. On the other hand, it warns us to pay attention to the balance between foreign trade and internal trade in the course of our economic development. Although China is already a big trading nation, still it is not a powerful one. The overall level of development of trade is still not high enough and especially at present there are two marked contradictions and problems. One is that trade surplus is too large and the other is that the pattern of trade growth is too extensive. Therefore, it is urgent to change the pattern of trade growth and mitigate the trade imbalance.

First, major efforts should be devoted to developing import trade and mitigating the trade imbalance. In the recent years our trade surplus has grown too fast, which results from the combination of multiple factors and these factors are long-term ones or short-term ones and internal ones or external ones. We must note that long-term large trade surplus will affect the balance of payments and then increase the pressure of the appreciation of the Renminbi. It will prevent our economic balanced development and meanwhile it will easily cause trade frictions. The solution to this problem is directly related to overall economic development. The result of empirical analysis shows that China's import helps in promoting positively the national economic growth, which is different from Keynes' traditional theory that import is a leakage in the course of economic development. Consequently, we should develop import trade actively and prudently so that import can play a driving role in economic growth, and we should take a variety of comprehensive measures and promote the harmonious growth of import and export trade by expanding import instead of discouraging export.

Second, we should try to optimize the mix of imports and exports and improve the international competitiveness and support export of the products with independent intellectual property right, with independent brands and with high additional value and expand export of high-tech products, service products and agricultural products.

Meanwhile, we should hasten to thrash out the policies on import credit and import financing guarantee and create favorable conditions for improving advanced technology, key equipment and import of raw materials. We should also perfect the policies and measures on promoting export of products with independent brands and speed up the optimization and upgrade of the industrial structure in our country so that our country can develop from low end to high end in the division of international industrial chain and value chain and further promote the industrials with competitive advantage and comparative advantage internationally.

Third, we should promote domestic consumption and investment actively. Consumption, investment and import and export must develop co-ordinately as three ways of spurring economic growth. Our economic growth depends on investment, import and export excessively because of long-term insufficient domestic demand, which will bring adverse effect. In the current economic climate our country should convert the crisis into the opportunity, adjust the domestic industrial structure, expand the domestic demand effectively and change radically the current situation that the degree of dependence on foreign countries of our economic development is too high. Besides, during the course of economic development we should attach great importance to employment and maintain social stability and then promote the rapid, healthy and stable development of our economy.

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