Chapter 36
Study on China's Import and Export Growth Rate Based on VAR Model

Kai Fan and Guanghai Nie

Abstract This paper takes the total amount of imports and exports in the period of 1979–2007 as sample, and the annual import and export volume increment as growth rate, and conducts an empirical study of the linkage relations between China's import and export growth rate by using the VAR model and the dynamic variance decomposition method. The results show that: the import growth rate is the cause of export growth rate of the Granger Causality. In the short term, the main reason of the fluctuations of the total import and export growth rates are from their own changes. In the long-term, the impact of imports on the export growth rate improved and kept in a later period. The related relationships of growth rate have obvious increasing trend in the recent 30 years, and the two growth rates have a certain convergence.

Keywords Import and export increment · Import and export growth rate · VAR model · Granger causality test

36.1 Introduction

Since the reform and opening up policy in China from 1979, the import trade (IM) and exports (EX) have developed rapidly. The imports increased from 24.29 billion yuan in 1979 to 7.32846 trillion yuan in 2007; the exports increased to 9.34556 trillion yuan in 2007 from 21.17 billion yuan in 1979. Since the U.S. subprime mortgage crisis broke out in 2007, as the foreign import demand the reduction of China's total imports and exports began to decline, to avoid the

K. Fan (✉) · G. Nie
Wuhan University, Hubei 430000, Wuhan, China
e-mail: wujhhi@163.com

Y. Yang and M. Ma (eds.), *Proceedings of the 2nd International Conference on Green Communications and Networks 2012 (GCN 2012): Volume 2*,
Lecture Notes in Electrical Engineering 224, DOI: 10.1007/978-3-642-35567-7_36,

fluctuations of the financial crisis to import and export, this paper only collects the data of 1979–2007 for research [1].

The increment of the total imports and exports is the accumulation of imported per year increment (DIM) and the total export volume increment (DEX) [2]. At the same time, DIM and DEX stands for the growth rate of total imports and total exports growth rate, respectively. The rapid growth of them two prompted the paper to conduct the research from the following two aspects: the linkage relationship between DIM and DEX; preliminary judgment DIM and DEX may exist the following four types of relationships: (1) DIM cause the growth of DEX, (2) DEX led to the growth of DIM, (3) mutual promotion between the two, and (4) there is no obvious correlation between the two [3].

36.2 Literature Review

The literature review found that the scholars have studied the relationship between the domestic and international import and export volume, the results show that:

By the research framework of VAR model, it analyzed the causal relationship between exports and imports empirically, the findings show that: First of all, there is a cointegration relationship between total imports and total exports; it means that there is a long-running steady state between them. Second, they proved the existence of a two-way causal relationship between the import and promotion of growth. Finally, Japan's economy obeys the exports and promotes the growth of GDP, while it has a negative impact on export growth in Korea.

Many scholars in our country also have studied the relationship between import and export trade, most of them have researched the other economic variables related to the import and export:

The impulse response function analysis showed that FDI has long-term role in promoting China's exports and imports, and the impact of FDI on China's export trade has long-term stable positive effect on China's export trade; on the other hand, the impact of the export trade has a positive effect on FDI, the imports have a negative effect on FDI. The variance decomposition results showed that FDI have some contribution to the forecast variance of the import and export trade, showing that China's trade and investment integration has been gradually formed.

To sum up, Chinese scholars did the research largely based on the correlation between imports, exports, and other economic variables, but for the long-term relationship between the growth rate of imports and exports growth rate, as well as Granger causality, there has no one studied. Since 2012, the impact

of the subprime crisis has faded, the basic situation of China's foreign trade has begun to improve, so it is necessary to do the quantitative study about the relationship between the imports and exports growth rate. The paper will focus on this point.

36.3 Analysis Methods and Data Processing

In this paper, it is studied about the relationship between Chinese imports annually total incremental (i.e., the growth rate of imports) and total annual export increment (i.e., export growth) in the period of 1979–2010, by the time series analysis method which is based on the VAR model.

1. handling smoothly about the total import and export data, its visual map shows that IM and EX changes in the same direction, and there is a strong trend between them (Fig. 36.1).
2. import and export growth rate and its unit root examination

To process the annual total imports IM and total exports EX to get the results of DIM and DEX, and to use ADF test the stationarity of DIM and DEX. As the line chart of them shows that they have the constant term, so a constant term and trend unit root test is necessary, the test results are as follows: (Fig. 36.2), (Table 36.1).

The ADF value of DIM is −3.789162, which is less than the critical value −3.587587, 5 % significant level. The ADF value of DEX is −4.938804, which is

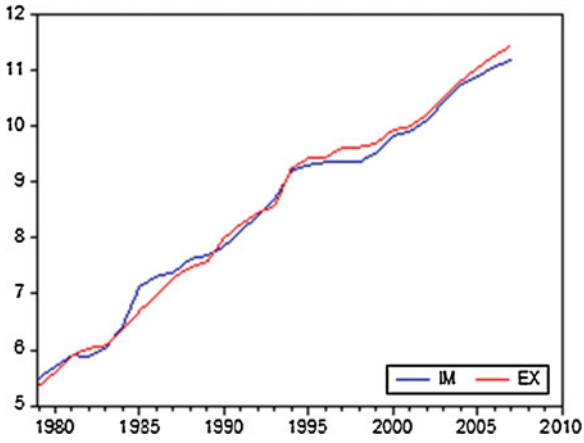

Fig. 36.1 The visual map of total imports (IM) and exports (EX)

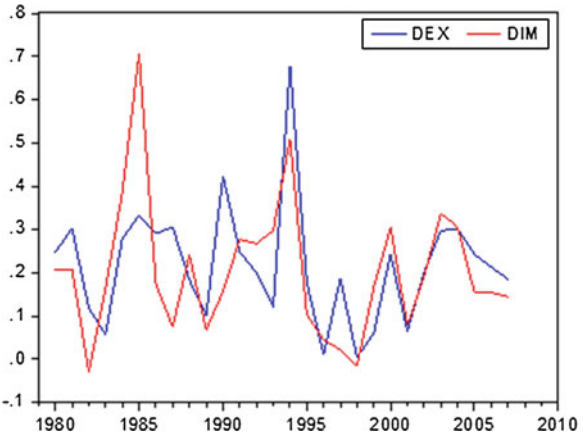

Fig. 36.2 The visual map of DIM, DEX

Table 36.1 Test results of unit root of DIM, DEX

Stationarity test of ADF	
Variable	Level of value
DIM	−3.789162
DEX	−4.938804
Significant level (%)	Critical value
1	−4.33933
5	−3.587527
10	−3.22923

less than 1 % significant level under the threshold −3.22923. In summary, it is stable of DIM and DEX when they are at the 5 % significance level.

36.4 The Establishment of the VAR Model

36.4.1 Determine of Lag Order

The maximum lag K should be determined before the establishment of VAR model. If K is too small, the error term autocorrelation will be very serious sometimes, and will lead to the nonconsistency of the estimated parameters. As a result, we need to eliminate the errors of the autocorrelation by increasing K. However, K cannot be too large, because that will lead to reduce the degrees of

Table 36.2 The value of the information criterion of the different lag order

Value of different criteria for judging						
Lag order	LogL	LR	FPE	AIC	SC	HQ
0	30.30393	——	0.000356	−2.264314	−2.166804	−2.237269
1	32.79672	4.387309	0.000403	−2.143737	−1.851207	−2.062602
2	36.86933	6.516186	0.000404	−2.149547	−1.661996	−2.014321
3	39.00260	3.071902	0.000478	−2.000208	−1.317637	−1.810892

freedom, and may directly affect the validity of the estimated parameters. This paper selects the optimal lag order based on the principle of minimum information guidelines. The information guidelines include two elements of AIC and SC: residual sum of squares, and add additional parameters for the loss of freedom. The object of it is to select certain parameters to make the value of information criterion is the minimum (Table 36.2).

Although AIC shows that $k = 2$ is the optimal lag order, which means when $k = 2$, AIC is the minimum, but the FPE, BC and HQ all show that $k = 1$ is the optimal lag order, so it selects $k = 1$ as the optimal the lag order.

36.4.2 Estimation of VAR Model

The following table shows that when the lag order is 1, the estimation results of the VAR model are: (Table 36.3).

Table 36.3 Estimation results of VAR (1)

	DEX	DIM
DEX(−1)	−0.307859	−0.390088
Standard error	(0.23724)	(0.27591)
T statistic	[−1.29766]	[−1.41380]
DIM(−1)	0.439770	0.468945
Standard error	(0.20686)	(0.24059)
T statistic	[2.12588]	[1.94918]
C	0.193076	0.192449
Standard error	(0.04954)	(0.05761)
T statistic	[3.89756]	[3.34041]
R-squared	0.158469	0.139013
Adj. R-squared	0.088341	0.067264
F-statistic	2.259725	1.937488
Akaike AIC	−1.083888	−0.781867
Schwarz SC	−0.939906	−0.637885

It is not difficult to see that some of the estimated coefficients are significant, some are not significant, but because of the VAR model does not concern the coefficient is significant or not, so these coefficients will be retained. The AIC and SC guidelines are mainly considered. Known by the figure, the lag order VAR equations are in line with the AIC and SC guidelines. The following equations are significant:

$$\mathrm{DEX} = -0.307859\,\mathrm{DEX}(-1) +^{\circ} 0.439770\mathrm{DIM}(-1) + 0.193076 \qquad (36.1)$$

$$\mathrm{DIM} = -0.390088\mathrm{DEX}(-1) +^{\circ} 0.468945d\,\mathrm{lim}(-1) +^{\circ} 0.192449 \qquad (36.2)$$

36.4.3 Test of VAR Model

Inspection of the VAR model includes two aspects: firstly, to verify the stability of the VAR model; secondly, to verify the independence of the residuals:

To test the stability of the VAR Model by whether Characteristic roots in the unit hospital.

The test results show that all the characteristic roots are in the unit circle, the VAR model satisfies the stationary assumption (Fig. 36.3).

Test the independence of the model residuals by the autocorrelogram of the residuals. We can see from the two diagrams in the left and lower right, the residuals does not have an obvious correlation, which can be considered as independent of each other (Fig. 36.4).

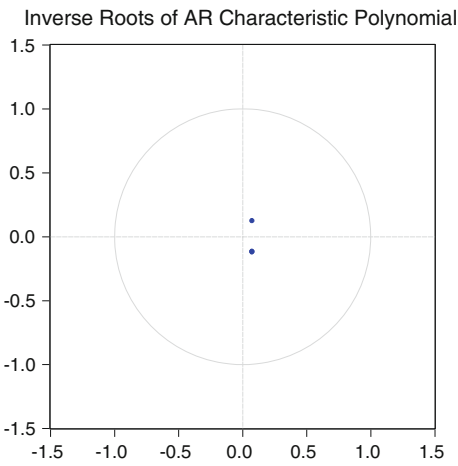

Fig. 36.3 Stability test of VAR (1)

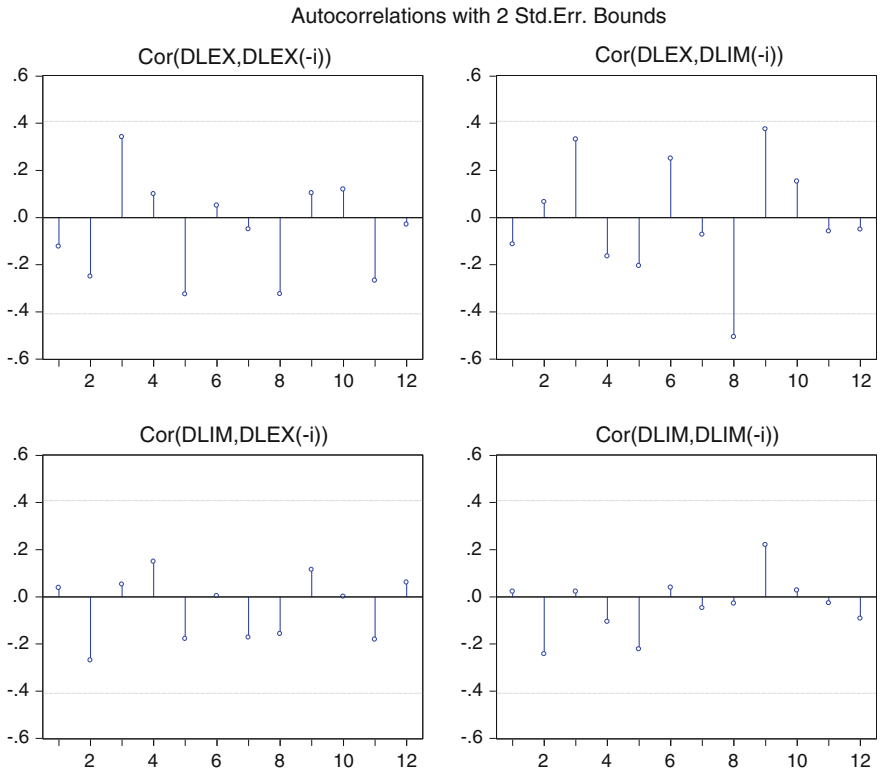

Fig. 36.4 Residuals from the correlation diagram of VAR (1)

36.5 Granger Causality Test

36.5.1 Theoretical Model

Granger causality method (Granger, Causal Relation Test) is put forward by a famous econometrician of University of California named Granger in 1969, and in the later, Hendry, Richard and some others well-developed the test method. What Granger causality says is that when the two economic variables X, Y, contain the past information, conditions are better than separate forecast Y by the past information of Y only. In other words, if variable X contribute to the variable Y and the improvement of prediction accuracy, then we say X and Y has a Grand causal relationship.

Table 36.4 Granger causality test results

Null hypothesis:	Obs	F-statistic	Prob
DIM does not granger cause DEX	27	4.51936	0.0440
DEX does not granger cause DIM		1.99883	0.1703

36.5.2 Granger Causality Test Results Under the Eviews Software

The results of the Granger causality test are very sensitive to the choice of lag order, and thus 1 is determined as the lag order for a VAR model (Table 36.4).

The test results show that the in the confidence level of 5 %, to reject DIM is not the original assumptions DEX Granger causality reasons, and to accept DEX is not the original assumptions of DIM reasons either. Therefore, the import growth rate is the Granger reason of export growth, and export growth rate is not the Granger causes of imports growth rate.

36.6 Variance Decomposition

The variance decomposition is broken down into each of the volatility of endogenous variables according to their causes (random error) of the new interest rate of each equation associated components, in order to understand the importance of the new interest rate endogenous variables.

It can be seen in Fig. 36.5, the variance decomposition results of DEX begin to stabilize from the second period. The influence comes from itself is accounted for more than 80 % of export growth forecast error. The same is DIM by more than 70 %. It can be seen from the analysis of this period, the contribution to the prediction error of variables itself is high.

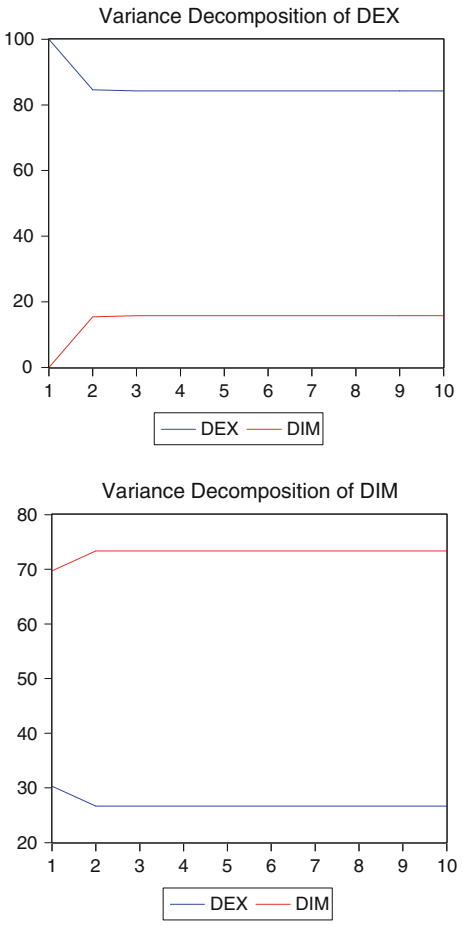

Fig. 36.5 Variance decomposition

36.7 Conclusion

1. The import growth rate of export growth Granger causes changes in export growth from changes in the growth rate of imports.
2. In the short term, the main reason of the fluctuations of the total import and export growth came from its own changes. In the long-term, the impact of imports on the export growth rate increased and remained unchanged at a later stage, and moreover, the growth rate relationship in recent 30 years is significantly higher in the direction of the total growth rate with a certain convergence.

References

1. Ren Y (2003) Inspection on the relationship of China's import and export. Mod Econ Sci 4:78–81
2. Zang W, Baimbridge M (2010) Exports, imports and economic growth in South Korea and Japan: a tale of two economies. Econ Model 1:44–45
3. Sastre L (2011) Simultaneity between export and import flows and the Marshall-Lerner condition. Econ Model 3:29–32