

Research on the application of ARMA model in China's trade economic development

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Abstract

The slowing down development of China's foreign trade brings significant impact to its regional economy, which makes many middle and small-sized export enterprises facing with business crisis and even bankruptcy. In this paper, a deep analysis on the development status of China's trade economy was conducted with ARMA model. The short-term development trend and causes of China's trade economy were predicted and analyzed. Results demonstrated that China's imports will decrease while export will keep increasing. The balance of trade in China will decrease and the total volume of foreign trade will decline. This indicates the depression of China's trade economy, which is against China's economic development. To improve the export structure and facilitate the rapid development of trade economy, China is suggested to adopt various measures, such as optimizing fiscal policy, promoting technology upgrading, enhancing export management and perfect import-export infrastructures. Meanwhile, China shall expand domestic demand vigorously to offset impact of trade economic slowdown on regional economy.

Keywords: ARMA model, trade economy, application research, decision reference

1 Introduction

Although the world economy recovers after the financial crisis, the international trade market still remains in downturn with grim situation. Trade economy not only is an important goal of opening to the outside world, but also can facilitate economic development and increase production level of China. With a big population but few land resources, China is in severe shortage of many resources, such as energy which is the basis of economic development. Therefore, developing trade economy is an important measure to offset China's resources and economic deficiencies. In 2013, the total volume of imports and exports of China reached 4,160 billion dollars, ranking the first in goods export in the world. It accounted for 45.39% of GDP. Among them, 24.11% was contributed by goods export. This reflects that trade economy has become very important to China's economy. It is of important practical significance to study the trade economic development.

2 Development status of China's trade economy

Although the world economy recovered gradually in 2013, the international market still remains in downturn, thus resulting in the difficult foreign trade development. In 2013, the total volume of imports and exports in China was 4,160 billion dollars, with 7.6% growth. China became the first trade power in the world. As the first country whose total volume of goods trade exceeds 4,000 billion dollars, China is the miracle in the world trade development history. The exports were 2,210 billion dollars, showing 7.9% growth. It accounted for 11.8% of global exports and

was 0.7% higher than that in 2012. China's exports ranked first for five successive years in the world. The imports valued 1,950 billion dollars, showing 7.3% growth. It accounted for 10.3% of global imports and was 0.5% higher than that in 2012. China's imports ranked second for five successive years in the world. The trade surplus was 259.75 billion dollars, occupying 2.8% of GDP. Moreover, the general foreign trade of China in 2013 increased by 9.3% to 2,200 billion dollars, 52.8% of the total volume of foreign trade and 0.8% higher than that in 2012. The processing foreign trade was increased by only 1.1% to 1,360 billion dollars, 32.6% of total the total volume of foreign trade and 2.2% lower than that in 2012. This implies that China's guidance on attention shift from processing trade to technology trade achieved positive progress. Among the processing foreign trade, 11.9% was contributed by middle and west China, showing 2.1% growth than that in 2012 and 8.9% growth than that in 2008. Other foreign trade increased by 18.3% to 610 billion dollars, taking up 14.5% of the total volume of foreign trade.

Facing with the tightening demand and fierce market competition, import and export enterprises adopt transformation actively. They increase investment to technology R&D, brand building and quality management. This further increases technology content and value added of export commodities, thus providing strong support to the stable export growth of commodities. Exports of 7 kinds of labor-intensive products, including textile, clothing, bag, footwear, toy, furniture and plastic products, reached 461.8 billion dollars, increasing by 10.3% (2.4% higher than the overall export growth). Exports of mechanical and elec-

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trical products were 1,265.5 billion dollars, increasing by 7.3% and accounting for 57.3% of the total exports. Viewed from the internal export structure of mechanical and electrical products, automatic data processing equipment (ADPE) export reduced slightly, but appliance export increased slowly and some mechanical equipment export increased quickly, becoming a new growth point of mechanical and electrical products export. Specifically, aircraft exports increased by 76.1%, accompanied with 13.5% growth in mechanical handling equipment and parts as well as 12.4% growth in textile machinery and parts. High-tech product exports increased by 9.8% to 660.3 billion dollars, 29.9% of the total exports and 0.5% up compared to that in 2012.

Generally, China's foreign trade with developed countries increases slowly. In 2013, China's foreign trade with America, EU and Japan increased by 2.1% to 1,392.6 billion dollars, which was equal to 33.5% of the total foreign trade volume, 1.7% lower compared to that in 2012. To be more specifically, China's foreign trades with America and EU were 559.1 billion dollars and 521 billion dollars, increasing by 2.1% and 7.5%, respectively. China's foreign trade with Japan was 312.6 billion dollars, decreasing by 5.1%. On the contrary, China's foreign trade with emerging economies generally maintained a quick growth. However, China's foreign trade with some emerging economies declined to a certain extent after August and September. This is caused by the financial market turmoil and economic slowdown of these emerging economies. In 2013, China's foreign trade with ASEAN, South Africa, Brazil and Russia increased by 10.9%, 8.6%, 5.3% and 1.1% respectively, but China's foreign trade with India decreased by 1.5%.

Middle and west China plays an increasing important role in trade economy. In 2013, middle and west China contributed 562.6 billion dollars of the total foreign trade volume, increasing by 14.3% (6.7% higher than the growth of total foreign trade volume). Its proportion in the total foreign trade volume increased to 13.5% from 12.7% in 2012. The exports of middle and west China increased by 17.1%, 9.2% higher than the total exports. Yunnan, Ningxia, Guizhou, Gansu, Chongqing and Henan achieved more than 20% growth in exports. Export growth of Yunnan and Ningxia even reached as high as 59.3% and 55.5%. The foreign trade of East China was 3,597.7 billion dollars, increasing by 6.6%. Exports of east China achieved 6.9% growth.

3 Application of ARMA model in China's trade economic development

3.1 THEORY OF ARMA MODEL

ARMA model, or called as autoregression moving average model, was a precise time series forecasting method established by BOX and Jenkins. It believes that some time series are a group of random variables depending on time. Although a single variable composing time series is

uncertain, the whole series vary according to certain law. As a result, the future development of such time series can be forecasted. Due to the forecast error, it is impossible to forecast continuously based on the predicted value, but only can make short-term forecast.

1) Autoregression model (AR model): if the time series y_t is the function about its former time series and stochastic term:

$$y_t = \varphi_1 y_{t-1} + \varphi_2 y_{t-2} + \dots + \varphi_p y_{t-p} + \mu_t,$$

y_t is the p -order autoregression sequence. $\varphi_1, \varphi_2, \dots, \varphi_p$ are autoregression coefficients. Let B^k to be the lag operator and then:

$$B^k y_t = y_{t-k}.$$

Then, the AR model can be rewritten as:

$$y_t = \varphi_1 B y_t + \varphi_2 B^2 y_t + \dots + \varphi_p B^p y_t,$$

$$\varphi(B) = \varphi_1 B + \varphi_2 B^2 + \dots + \varphi_p B^p.$$

It can be further simplified into:

$$\varphi(B) y_t = \mu_t.$$

2) Moving average model (MA model): if y_t is the linear function of its former series and former error term:

$$y_t = \mu_t - \theta_1 \mu_{t-1} - \theta_2 \mu_{t-2} - \dots - \theta_q \mu_{t-q},$$

y_t is called as q -order moving average model. $\theta_1, \theta_2, \dots, \theta_q$ are moving average coefficients. Similarly, let B^k to be the lag operator and then:

$$\theta(B) = 1 - \theta_1 B - \theta_2 B^2 - \dots - \theta_q B^q.$$

It can be further simplified into:

3) ARMA model: if y_t is the function of the error of its current and former stochastic terms as well as former series:

$$y_t = \varphi_1 y_{t-1} + \varphi_2 y_{t-2} + \dots + \varphi_p y_{t-p} + \mu_t - \theta_1 \mu_{t-1} - \theta_2 \mu_{t-2} - \dots - \theta_q \mu_{t-q}.$$

y_t is called as the (p, q) -order ARMA model.

3.2 APPLICATION OF ARMA MODEL

Firstly, ARMA model has to analyze its lag orders to get p and q (Table 1). AR (7) MA (2) can be implemented to variables. Secondly, the least square method is implemented by taking variables as dependent variables and AR(1), AR(2), AR(3), AR(4), AR(5), AR(6), AR(7), MA(1) and MA(2) as independent variables. The calculated parameters are listed in Table 2. ARMA has no strict requirements on T and tail probability (P). Therefore, there are only three main parameters, namely,

correlation coefficient, AIC and SC. Finally, dependent variables are forecasted by the ARMA model. Results are shown in Figures 1-4.

TABLE 1 p and q for model analysis

Orders	Imports & Exports	Exports	Imports	Balance
p	7	7	7	6
q	2	2	2	2

TABLE 2 Basic parameters for model forecast

Parameters	Balance	Exports	Imports	Imports & Exports
Adjusted R-squared	0.9054	0.9862	0.9890	0.9832
Akaike info criterion	18.3686	20.2353	19.7202	21.6793
Schwarz criterion	18.4600	20.6597	20.1445	22.1037

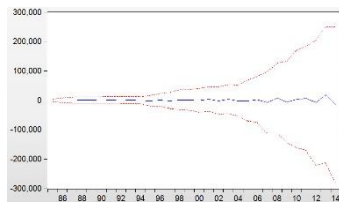


FIGURE 1 Balance of trade forecast in 2014

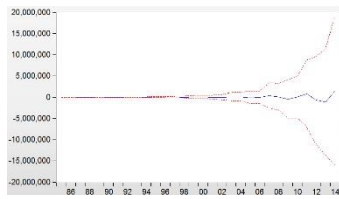


FIGURE 2 Export forecast in 2014

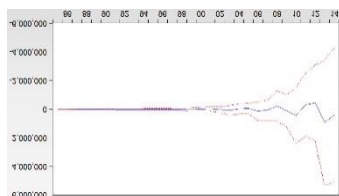


FIGURE 3 Import forecast in 2014

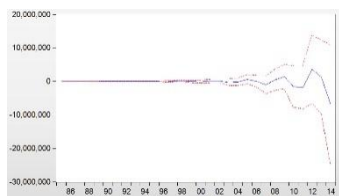


FIGURE 4 Foreign trade forecast in 2014

In Figure 1, the center line represents the forecasted balance of trade, which indicates that the balance of trade will decline in 2014. This agrees with China's trade economic development logic. China has maintained trade surplus for a long time, which brought a lot of trade conflicts with many developed countries. Main causes of balance reduction of trade are analyzed. Firstly, Chinese

government is committed to coordination to eliminate trade conflicts and adopts various measures to reduce balance of trade and inhibit the increasing trade deficit. Secondly, China's economy has experienced rapid development and now enters into stable development. This will slow down the trade economic development, thus decreasing balance of trade. Thirdly, the chronic trade deficit intensifies the trade conflicts between China and developed countries. Developed countries will take various measures against China's export development, thus influencing the balance of trade finally.

China's export forecast is shown in Figure 2. The center line reflects that China's export shows a growth trend. There are three causes of China's export growth trend. Firstly, although China's economy enters into stable development, its growth rate is still higher compared to the world economic development. The rapid development of production speed can facilitate export to a certain extent. Secondly, although China pays close attentions on trade balance, it still seems partial to export development, because export can drive region economic development significantly and China still faces with excess capacity in many industries. Thirdly, China is improving the pattern of production continuously. It takes a certain time to transform from labor-intensive product export to technology-intensive product export. Therefore, export will increase continuously.

China's import forecast is shown in Figure 3, which presents a declining trend. There are four main causes of import reduction. Firstly, the world economic slowdown decreases the world's production capacity, thus weakening export capacity of other countries. Secondly, China depends less on import with the enriching production. Thirdly, China, though has entered into the WTO, still has various protection policies to domestic enterprises, which are great barriers for the entry of foreign products. Fourthly, China's policy of promoting domestic demand goes against import. China's subsidy program for rural purchases is only available to domestic products, which is against marketing of foreign products in China.

China's foreign trade forecast is shown in Figure 4, which presents a declining trend. This indicates the gap between China's export growth and import reduction. This is the reason of the reduced balance of trade in China. Such declining trend of China's foreign trade reflects that China's trade economy will face with recession caused by three reasons:

- 1) the world economic recession;
- 2) effect of China's economic development strategies;
- 3) China's economic development trend.

4 Conclusions and suggestions

Based on above analysis, China's import will decline, while export will keep increasing. The balance of trade in China will decrease and the total volume of foreign trade will decline, indicating China's trade economy downturn.

This is against China's economic development. Favorable trade economic development shall include rapid development both import and export, reduced balance of trade, but continuous growth of total foreign trade volume. To achieve this goal, China shall:

- 1) Facilitate import development through financial policy adjustment. Firstly, import tariff of some commodities shall be adjusted. According to China's current economic development need, provisional tax rates can be adopted to reduce import tariff of energy sources. This can facilitate imports and offset our energy shortage. Additionally, import tariff of rare living goods in China but closely related to people life shall be lowered appropriately. This can improve the living standard in China and increase imports. To improve China's production level and product quality, import tariff of some advanced equipments and parts shall be adjusted appropriately. Key attentions shall be paid to lower import tariff of some products which are needed in primary energy sources and emerging industries but couldn't be produced in China or poor quality of domestic-made ones. China is encouraged to give certain tariff preference to commodities importing from underdeveloped countries. This not only can win their economic and political supports, but also can facilitate import and improve our balance of trade. Tariff reduction to underdeveloped countries shall be accelerated and expanded. Meanwhile, imports from members of free trade zone can be accepted according to practical situations of the free trade zone. Secondly, China can promote imports through financial support. China has set special funds for foreign trade. To promote imports, Chinese government is suggested to increase financial support, provide subsidies on interest payment to encouraged imports, and expand or adjust supports appropriately. Moreover, government shall guide and establish various business platforms with expanded import function, encourage to providing public services (e.g. import communication meeting), and continuously increase support to imports from developing countries.
- 2) Promote product upgrading and improve export structure. Firstly, China shall propel transformation and upgrading of processing trade. Government shall keep stable policies for processing trade, improve macro environment for technology and industrial transformation, increase confidence of investors, control trade companies with high energy consumption, high pollution but low value added, and guide transformation and derivation of processing toward high-end industries. These can improve China's trade structure comprehensively and help to produce high-quality products. Secondly, China shall establish and perfect domestic trading platform, cultivate enterprises with good reputation and conditions, encourage enterprises to building self-owned brands, and create good domestic marketing channels. Actually, government also can improve export structure and promote product upgrading through tax policies. On one hand, favorable tax treatment shall be offered to high-tech products. On the other hand, additional taxes shall be collected from enterprises with low technology level and value added as well as high pollution risks. Thirdly, China shall attach high attention on service and technology export development. According to experiences of foreign countries, technology and service export can increase value added of exports, protect our resources and prevent drain of our rare resources.
- 3) Enhance foreign trade management. Firstly, China shall optimize import management, including:
 - a. eliminating unreasonable restrictions and measures;
 - b. lowering trade cost, reducing catalogues concerning automatic import licensing commodity management;
 - c. promoting online application actively;
 - d. accelerating online verification between electronic data of automatic import licensing and the customs;
 - e. increasing online verification efficiency, and implementing scientific and effective regulation. Secondly, China shall impel smooth connection between imports-exports and domestic goods, including:
 - i encouraging domestic circulation enterprises to participate in international trade;
 - ii supporting qualified enterprise to integrate imports and domestic circulation business;
 - iii encouraging domestic commercial enterprises to sell foreign brand articles of consumption as agencies and develop platforms for below-the-line promotional activities to break monopoly and realize full competition;
 - iv following standard international practices to perfect relevant laws and regulations, and support development of departure business enjoying tax exemption;
 - v increasing import ports to special commodities (e.g. medicine) appropriately and expanding related product export;
 - vi accepting imported commodities with inspection and quarantine certificates completely without needing additional test after entered into the Chinese market.
- 4) Improve infrastructure and improve clearance efficiency. China shall:
 - a. further improve infrastructures in border ports, check and supervision facilities as well as infrastructures in border economic cooperation zones, establish a modern logistics system integrating cargo transportation, storage and processing, and increase handling capacity of ports;
 - b. improve supporting facilities in border trade places, fully implement policies about promoting economic and trade development in border

- regions, intensify economic and trade contacts with surrounding countries and regions;
- c. propel the “Construction Engineering for Improving Work Efficiency of Ports” continuously and accelerate construction of electronic ports;
 - d. accelerate standardization and electronization of trade documents greatly, facilitate sharing of trade documents and supervision information among different departments, and realize “integrated input but independent declarations” of exports and imports;
 - e. perfect consulting service platform of technical regulations and conformity assessment of import commodities;
 - f. make full use of the leading role of local people’s government and support to establish local information service platforms.

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