

# Research on Export Flow and Potential of Agricultural Products in China Based on Machine Learning Algorithm

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**Abstract:** The MLR (multiple linear regression) method in machine learning algorithm is a comprehensive method to study the correlation of variables, and it is also an important measure to study the relationship between variables by using linear fitting method. By combining qualitative analysis with quantitative analysis, this paper will use MLR model to make an empirical analysis of the determinants of agricultural trade flow, and use the estimated parameters to calculate the agricultural trade potential of China. The results show that the economic scale and distance have an important influence on the export flow of agricultural products in China, indicating that the economic scale is an important factor affecting the export flow of agricultural products. Regional trade arrangements have dual effects of trade transfer and trade creation, and free trade arrangements have created favorable conditions for trade expansion between countries with different demand and income levels. China's exports to Russia, Thailand, Singapore, the Philippines, Malaysia and Indonesia are in a state of deficiency, and there is still potential for developing agricultural products exports to these countries.

**Key words:** Machine Learning; Multiple Linear Regression; Agricultural Products; Trade Potential

## 1. Introduction

With the continuous development of international trade, the accompanying environmental pollution problem is becoming more and more serious, and the impact of trade liberalization on the environment is becoming a hot issue in academic circles. The main export markets of China's agricultural products are Asia and Europe, and the main import

markets are North America and Asia. The import of agricultural products in China does not show a clear trend of land-intensive products or labor-intensive products, and the market access conditions in China are improving [1-2]. China's agricultural production has inherent advantages in resource endowment and labor force, and has a strong price competitive advantage in the international market. The establishment of FTA (Free trade area) requires member countries to reduce barriers such as tariffs, which also provides an important opportunity for the expansion of China's agricultural exports. Based on the FTA established in China, it is of great practical significance to study the pulling effect of FTA on China's agricultural exports.

FTA is one of the important forms of regional economic integration, and its basic theoretical basis is the theory of regional economic integration. According to the degree of integration, regional economic integration organizations can be divided into preferential trade arrangements, FTA, customs union, common market, economic union and complete economic integration [3]. A large number of scholars use the traditional calculation index method to measure the trade potential between China and other countries or regions, and adjust the foreign trade policy on this basis. Literature [4]. analyzes the bilateral trade between China and major Latin American countries by calculating the degree of trade integration, similarity index of export products and trade complementarity index. Literature [5]. Through empirical analysis, the trade potential between China and importing countries is analyzed and calculated by using trade complementarity index and trade intensity index. It is found that the trade between China and Central Asia is very frequent, and the bilateral trade potential is huge. However, there are still some factors

that will have a negative impact on bilateral trade, such as fluctuation and imbalance of trade, inconvenient trade and high trade cost. Literature [6]. empirically analyzes the factors that affect China's agricultural products export to ASEAN and ASEAN trade facilitation measures through maximum likelihood estimation. Literature [7]. uses historical comparison method and international comparison method to analyze the changes of agricultural products trade in China in recent 20 years. This study uses the statistical caliber of WTO to calculate the trade balance of agricultural products in China, and further points out that China's agricultural products trade plays an increasingly important role in international agricultural products trade; The export of agricultural products in China tends to increase concentration, while the import tends to diversify.

Previous studies have focused on describing the current situation of agricultural trade in China, and due to the different statistical caliber adopted, there are certain differences in the years and quantities of agricultural trade deficit in China. The MLR (multiple linear regression) method in machine learning algorithm is a comprehensive method to study the correlation of variables, and it is also an important measure to study the relationship between variables by linear fitting method. By combining qualitative analysis with quantitative analysis, this paper will use MLR model to make an empirical analysis of the determinants of agricultural trade flow, and on this basis, use the estimated parameters to calculate the agricultural trade potential of China.

## 2. Research Method

### 2.1 Model Construction

Historically, free trade has always been considered to improve the overall welfare. Whether it is Adam Smith's theory of absolute advantage, Ricardo's theory of comparative advantage, or later Olin Heckel's theory, they are convinced of this. Free trade can increase the welfare of the world economy and realize the optimal allocation of scarce resources; The customs union and FTA have removed the trade barriers between trading countries and achieved free trade within the region, which means a net increase in world welfare [8-9].

Trade creation will have two effects: one is consumption effect. Due to the cancellation of tariffs, the members of the alliance have changed from producing and consuming products with high production costs and high prices in their own countries to importing products with low production costs and low prices in the members of the alliance, reducing consumer spending and improving the welfare of the whole society; The second is the production effect. The production resources within the alliance can be improved by reconfiguration.

The theory of cost compensation means that in order to maintain the production of products and ensure the income of producers, the price must fully compensate the cost [10]. The cost of products includes production cost, logistics cost and transaction cost. Cost and expense form the total value of goods when they flow to the consumption terminal, which is a necessary and sufficient condition for price formation. From the perspective of microeconomics, the theory of cost compensation, that is, the producer's surplus must be greater than or equal to the producer's expectation, can ensure the producer's sustainable production and trading behavior. That is, to ensure the production and circulation of products, the price must fully compensate the production cost, logistics cost and transaction cost.

MLR model is to determine the influence relationship between two or more variables by regression analysis in data statistics. The statistical method of quantitative relationship can be expressed as:

$$Y = \omega_1 X_1 + \omega_2 X_2 + \dots + \omega_n X_n + e \quad (1)$$

Where  $e$  is a normal distribution, and the error value can be determined as 0.

The process involved in MLR analysis includes: selecting related variables and creating questionnaires; Reliability and validity analysis of implementation data; Carry out correlation analysis between independent variables and dependent variables, and exclude invalid data; Use the relevant calculation program to expand MLR, so as to obtain the results.

Scholars at home and abroad have conducted extensive research on the construction of MLR model. According to their different research purposes, various exogenous variables that

affect trade flow are introduced into MLR model. With the increase of population and strong domestic demand, the number of commodities used for export trade is relatively reduced; On the other hand, under the condition of constant population, with the growth of national income, diversified consumer demand is strong and needs to be met by import trade. Therefore, trade flow should be negatively correlated with population in theory [11-12].

On the basis of previous studies, this paper measures the influence of population, geographical proximity and regional economic integration on the export potential of agricultural products between China and its main trading partners by adding dummy variables such as population, common border and regional trade arrangement, and obtains the expanded MLR model as follows:

$$\ln X_{ij} = \beta_0 + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln DG_{ij} + \beta_4 \ln D_{ij} + \beta_5 WTO_i + \beta_6 FTA_{ij} + \beta_7 EXR_i + \mu_{ij} \quad (2)$$

In the formula,  $\ln X_{ij}$  —Total agricultural trade volume exported by country  $i$  (namely China) to country  $j$  in each year;

$\ln Y_i, \ln Y_j$  —Represents the GDP; of countries  $i$  and  $j$  in each year;

$\ln DG_{ij}$  —The gap of per capita income level between  $i, j$  and China in each year;

$\ln DG_{ij}$  —  $i, j$  the geographical distance between the two countries;

$FTA_{ij}$  —FTA;

$WTO_i$  —Join WTO;

$EXR_i$  —The exchange rate of RMB against the US dollar.

On the surface, the larger the population of the importing country, the greater the potential demand for domestic demand and the more imports. However, large countries may carry out specialized production to meet diversified needs, so the impact of population on the importing country is uncertain. In order to find out whether the export of agricultural products in China conforms to the demand similarity theory, this paper uses GDP per capita as an explanatory variable.

## 2.2 Data Source

The relevant data sources used in this paper

are as follows: (1) China's animal husbandry GDP data comes from China Statistical Yearbook; China's agricultural products export data to 11 importing countries (regions) come from China Customs Statistical Yearbook over the years; The real effective exchange rate of RMB in the current period is compiled and calculated according to the International Financial Statistics Yearbook of the International Monetary Fund; The GDP and population data of trading partners adopt nominal values and come from the World Development Indicators Database of the World Bank. The border data comes from the map of People's Republic of China, and the data of China Free Trade Agreement comes from China FTA service network. The division of APEC member countries comes from the official website of APEC.

## 3. Analysis of Research Results

### 3.1 Analysis of Export Flow of Agricultural Products

After setting the final form of MLR model, based on the data of total agricultural products exported by China to Japan, Hong Kong, the United States, Vietnam, South Korea, Indonesia, Malaysia, the Philippines, Singapore, Thailand and Russia from 2010 to 2020, all the data are standardized and put into software for model estimation. The results are shown in Table 1:

**Table 1. Regression Results of MLR Model**

variable	coefficient	T value
$\ln Y_i$	0.8619***	0.7812
$\ln Y_j$	0.7999***	1.6668
$\ln DG_{ij}$	0.0787***	-4.5534
$\ln D_{ij}$	-1.8386***	-3.3771
$FTA_{ij}$	0.3793***	5.6053
$WTO_i$	0.0937***	5.4935
$EXR_i$	-0.5482***	-4.6792
constant	-5.0327***	3.5888
Adjusted R <sup>2</sup>	0.4038***	1.0907

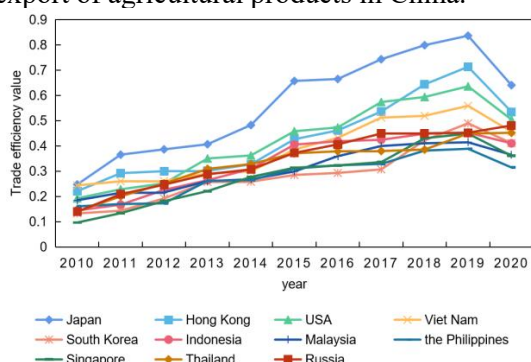
Note: \* \* \* indicates the significance level of 1%.

Economic scale and distance have an important influence on the export flow of agricultural products in China. The regression coefficients of  $\ln Y_i, \ln Y_j$  are 0.8619 and

0.7999, which shows that the economic scale is an important factor affecting the export flow of agricultural products.

Every 1% increase in China's GDP will drive the export of agricultural products to increase by 0.86%, and every 1% increase in the GDP of importing countries will drive the import of agricultural products to increase by 0.79%. It can be seen that the farther the distance between the two countries, the greater the transportation cost, and because of the particularity of short shelf life and perishable agricultural products, the requirements for transportation and storage are higher, so it is more sensitive to the impedance factor of distance.

In addition, regional trade arrangements have dual effects of trade transfer and trade creation. Free trade arrangements have created favorable conditions for trade expansion between countries with different demand and income levels. The establishment of FTA and the change of export rate have had an important impact on the export flow of agricultural products, but the pulling effect of WTO is not significant. The establishment of FTA has brought great promotion to the export of agricultural products in China. The rise of the real effective exchange rate of RMB means the appreciation of RMB, which reduces the export of agricultural products in China.



**Figure 1. Change Chart of Export Trade Efficiency Value of Agricultural Products**

Regional trade arrangements have dual effects of trade transfer and trade creation. Free trade arrangements create favorable conditions for trade expansion between countries with different demand and income levels, which further weakens the explanatory power of demand similarity theory in real economic life. This also shows that the gap between the per capita income level of China and the export destination countries will not significantly

affect the trade of agricultural products.

According to the regression results of MLR model (country level), the trade efficiency value of China's agricultural products exports to 11 countries from 2010 to 2020 is obtained. As shown in Figure 1, the range of trade efficiency is (0, 1), and the greater the value of trade efficiency, the higher the current trade efficiency of bilateral agricultural products.

We can see that in the agricultural products trade exported by China to 11 countries from 2010 to 2020, the export trade efficiency showed an upward trend. And the export efficiency of agricultural products in China and Japan has the largest change and the fastest growth, followed by Hong Kong, the United States, Vietnam and South Korea.

### 3.2 Calculation of Trade Potential

In order to evaluate whether China's agricultural exports to major trading partners (or regions) are saturated or not, and whether there is still potential to be developed, this paper will compare the simulated values of the equations with the actual export levels from the regression equations of general and classified agricultural products, so as to obtain the export potential of agricultural products to various countries (or regions).

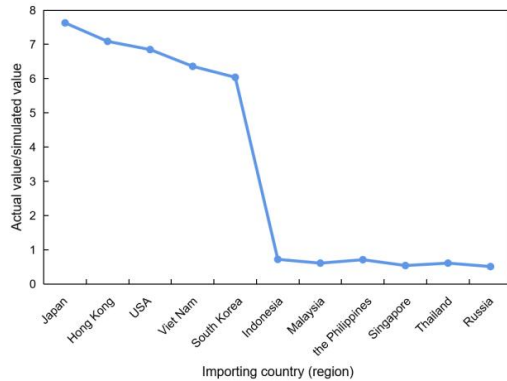
**Table 2. Estimation of Export Trade Potential of Agricultural Products**

Importing country (region)	Actual value/simulated value
Japan	7.63
Hong Kong	7.09
United States of America	6.85
Viet Nam	6.36
South Korea	6.04
Indonesia	0.72
Malaysia	0.61
the Philippines	0.71
Singapore	0.54
Thailand	0.61
Russia	0.51

The aggregate agricultural product export model is used to simulate the agricultural product export potential of China to its major trading partners in 2020. The estimated results are shown in Table 2 and Figure 2.

According to the actual level and simulation value, the trade potential relationship can be divided into three categories: huge trade

potential (actual export/simulation value  $\leq 0.8$ ), pioneering trade potential ( $0.8 < \text{actual export/simulation value} \leq 0.1.2$ ) and remolding trade potential (actual export/simulation value  $> 01.2$ ).



**Figure 2. Statistical Chart for Estimating the Export Trade Potential of Agricultural Products**

In 2020, China's exports to Russia, Thailand, Singapore, the Philippines, Malaysia and Indonesia are in a state of shortage, and there is still potential for developing agricultural products exports to these countries. To this end, we can consider breaking existing barriers and expanding economic and trade relations through preferential trade arrangements such as establishing FTA.

The pioneering trade potential, that is, the ratio is between 0.8 and 1.2. The export potential of China's agricultural products to these countries has not been fully exerted, and there is still room for further development. To further develop trade relations with this trading partner is mainly to maintain the existing positive factors and pay attention to exploring the factors that promote trade development.

Re-modeling of trade potential means that the ratio of actual export level to simulated value is greater than 1.2. China's trade potential with these countries has been exhausted. The main idea of further developing trade relations with these trading partners is to maintain the existing positive factors, and at the same time develop and cultivate other factors to promote trade development and create new export growth points.

#### 4. Suggestion

China should continue to maintain its agricultural products export market share in developed countries or regions such as Japan, the United States and Hong Kong. These

developed countries or regions have higher labor costs, while China has comparative advantages in the production and trade of labor-intensive agricultural products, and there is a strong economic complementarity between them. At the same time, the huge demand for agricultural products in these countries or regions is a potential market that all countries in the world, including China, are vying for.

Increase the import of agricultural products with comparative advantages to importing countries, and expand the export of agricultural products with comparative advantages to China. By constantly adjusting the current centralized structure of bilateral agricultural products trade, China agricultural enterprises can expand the types of agricultural products export through independent innovation or scientific research progress, thus optimizing the import and export trade structure and promoting the diversified development of agricultural products trade industries, and constantly improving the potential space of agricultural products trade between China and importing countries.

While maintaining the rapid development of foreign trade in agricultural products, we should improve the corresponding environmental protection measures, and formulate relevant agricultural environmental pollution control, punishment, preferential treatment and reward systems to achieve the coordination between the development of foreign trade in agriculture and environmental protection, so as to achieve sustainable economic development.

#### 5. Conclusion

In this paper, the agricultural data from 2010 to 2020 are selected, and based on machine learning algorithm, the MLR model of agricultural products export flow and potential in China is established, and the export flow and potential of agricultural products in China of China are analyzed. The results show that economic scale and distance have an important influence on the export flow of agricultural products in China, which shows that economic scale is an important factor affecting the export flow of agricultural products. Regional trade arrangements have dual effects of trade transfer and trade creation. Free trade arrangements create favorable conditions for trade expansion between countries with

different demand and income levels. The establishment of FTA and the change of export rate have an important impact on agricultural products export flow. Regional trade arrangements have dual effects of trade transfer and trade creation, and free trade arrangements have created favorable conditions for trade expansion between countries with different demand and income levels. During 2010-2020, the export trade efficiency of agricultural products exported by China to 11 countries showed an upward trend. In 2020, China's exports to Russia, Thailand, Singapore, the Philippines, Malaysia and Indonesia are in a state of shortage, and there is still potential for developing agricultural products exports to these countries. To this end, we can consider breaking existing barriers and expanding economic and trade relations through preferential trade arrangements such as establishing FTA.

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