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Factors Influencing the Trade Deficit of Dairy in China: An empirical analysis based on revealed comparative advantage

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Abstract: *With the improvement of people's living standards and changes in dietary structure, as well as the significant reduction of dairy tariffs and the abolition of dairy export subsidies after joining the WTO, China has become a net importer of dairy products since the mid-1990s, with a trade deficit in dairy products. Increase yearly. Through factor analysis, this paper found that the driving factors of China's dairy trade deficit can be summarized into two major factors. The first major factor is the dairy market factor, including population, GDP, domestic dairy production, dairy consumption, international dairy prices and tariff; The second major factor is the substitute factor, including the consumer price index for meat and poultry and the consumer price index for eggs. Through regression analysis, it is found that population, GDP, domestic dairy product output, dairy product consumption, international dairy prices, tariffs are positively correlated with the dairy product trade deficit, while the meat and poultry consumer price index and egg consumer price index are negatively correlated with the dairy product trade deficit. At present, we should make overall plans and focus on the key points to improve the quality of dairy products supply from the perspective of the dairy market, stimulate market demand for dairy products, and improve the international trade environment for dairy products; increase the promotion of dairy products from the perspective of dairy substitutes and focus on expanding the rural consumer market. The above suggestions are not only conducive to narrowing the trade deficit of dairy products, but also helping China's dairy industry to successfully break through the 2020 epidemic and survive the crisis.*

Keywords: *dairy products, trade deficit, influencing factors, factor analysis, weighted OLS*

1. Introduction

With the development of China's economy and the improvement of people's living standards, dairy products have gradually become a necessary food for people's life. At the same time, with China's accession to the World Trade Organization, dairy trade continues to develop, China's dairy imports rank first in the world, and dairy trade has always maintained a large trade deficit. After the Sanlu milk powder scandal broke out in 2008, under the influence of the quality and safety incident of dairy products, consumers' confidence in domestic dairy products declined, and the purchase price of raw milk continued to rise. As a result, the import volume of fresh milk, milk powder and the products increase rapidly, the trade deficit is increasing, and the import market concentration is high, which poses a serious threat to the safety of China's dairy industry. When novel coronavirus broke out from December 2019 to 2020, global trade declined for the second time since the mid-1980s, and the new economic situation will have a new impact on dairy trade.

The domestic research on dairy products mainly began in the late 1990's. Most of the studies are based on theoretical analysis, but there are few articles on the experimental analysis of dairy products through the establishment of experimental models. With regard to dairy trade, scholars have done more and more research in recent years, which is helpful to analyze the specific factors affecting China's dairy import trade in practice. At the same time, there are few empirical studies on the factors affecting China's dairy import trade, not many practical factors are considered, and the analysis is not comprehensive enough. Therefore, based on the combination of theoretical and empirical analysis, through the processing of the collected data and SPSS, R software, this paper uses the method of factor analysis to classify the factors that affect the dairy trade deficit, and then quantitatively explores the relationship between the dairy trade deficit and its influencing factors after eliminating the heteroscedasticity in sample regression fitting. And on this basis, combined with previous studies, in view of the current epidemic environment, the relevant suggestions were put forward from the perspective of dairy market

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and substitutes.

2. Research methods

2.1 Variable selection

There are many factors affecting the normalization of dairy trade deficit. Based on the existing research results and combined with reality, nine indicators such as dairy trade deficit, population, GDP, domestic dairy production, dairy consumption, meat and poultry consumer price index, egg consumer price index, international dairy price and tariff from 2005 to 2018 were selected for factor regression analysis. The specific explanatory variables are as follows:

(1) Market capacity.

(2) Market supply.

(3) Market demand.

(4) International market.

(5) Substitutes.

2.2 Research principle of factor analysis

Factor analysis is one of the statistical methods, which turns the complex relationship between many variables into multiple comprehensive indicators. The basic principle is that the correlation is used as the basis to group multiple indicators, so that the grouping variables have greater correlation within the group and less correlation between groups. Each grouping variable is a common factor with clear economic significance: the core formula is:

$$X_i = a_{i1}F_1 + a_{i2}F_2 + \ldots + a_{im}F_m + \varepsilon_i, i = 1,2,3,\cdots, p$$

Where: xi represents the original variable; F1, F2, …, Fm denotes a common factor, εi is a special factor of xi, and aij is a factor load, which represents the load of the I factor on the j factor, which reflects the dependence of xi on Fj on the one hand and the relative importance of xi on Fj on the other. Expressed in a matrix as:

$$X = AF + \varepsilon$$

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1m} \\ a_{21} & a_{22} & \cdots & a_{2m} \\ \vdots & \vdots & & \vdots \\ a_{i1} & a_{i2} & \cdots & a_{pm} \end{bmatrix} = (A_1, A_2, \cdots, A_m)$$

$$X = \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_p \end{bmatrix} \qquad F = \begin{bmatrix} F_1 \\ F_2 \\ \vdots \\ F_m \end{bmatrix} \qquad \varepsilon = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_p \end{bmatrix}$$

The aij in the model represents the load value of the factor, that is, the load of the I index on the j common factor, which represents the importance of the variable to the common factor, and the higher its value, the more important it is for the common factor that affects the dairy trade deficit. Without considering random factors, the factor analysis model can be expressed as follows:

$$X = AF$$

Through the matrix operation, the values of each common factor can be obtained:

$$F = A^{-1}X$$

ISSN 2616-5902 Vol. 3, Issue 4: 22-26, DOI: 10.25236/AJBM.2021.030406

2.3 Multiple regression analysis model setting

Multivariate OLS regression model is a commonly used method in mathematical models to explore the quantitative relationship between variables and their influencing factors. The law between unknown quantities and multiple independent variables is expressed by linear algebraic equations, and a statistical method is used to establish mathematical model equations among multiple variables. Specifically, taking the extracted principal components F1 and F2 as independent variables and dairy trade deficit as dependent variables, a binary linear OLS regression equation is established.

$$Y = \beta + aF1 + bF2 + \varepsilon i$$

2.4 Data source

Data are from 2005 to 2018, population, GDP, meat and poultry consumer price index, egg consumer price index from the "China Statistical Yearbook"; domestic dairy production, international dairy prices from the "China Dairy Yearbook"; dairy consumption, tariffs, dairy trade deficit from the website of the National Bureau of Statistics. (note: some of the data are obtained by collation and processing)

3. Results and analysis

3.1 Analysis on the factors of Dairy Trade deficit in China

Correlation can measure the relationship between variables, and the existence of a certain correlation between factors is the premise of factor analysis. This paper uses SPSS Statistics23.0 for analysis, after inputting the above independent variables and dependent variables, using the data standardization function of the software itself to eliminate the influence of different types of data dimensions, and carry on the related operation to the above data. By using the dimensionality reduction operation of SPSS software, the correlation coefficient matrix can be obtained (As shown in Table 1).

Table 1: Coefficient correlation matrix

		x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8
correlation	x_1	1.000	0.996	0.952	0.976	-0.244	-0.216	0.811	0.911
	x_2	0.996	1.000	0.933	0.965	-0.229	-0.188	0.819	0.907
	x_3	0.952	0.933	1.000	0.990	-0.177	-0.220	0.810	0.951
	x_4	0.976	0.965	0.990	1.000	-0.164	-0.162	0.819	0.950
	x_5	-0.244	-0.229	-0.177	-0.164	1,000	0.667	0.012	-0.104
	x_6	-0.216	-0.188	-0.220	-0.162	0.667	1.000	-0.152	-0.120
	x_7	0.811	0.819	0.810	0.819	0.012	-0.152	1.000	0.786
	x_8	0.911	0.907	0.951	0.950	-0.104	-0.120	0.786	1.000

The component score coefficient matrix is given in Table 2, according to which the expression of each factor can be written directly. The values of comprehensive variables F1 and F2 can be obtained by the operation of SPSS software. Through the above methods, the variables that affect the dairy trade deficit can be reduced to get two comprehensive factors F1 and F2.

Table 2: Component score coefficient matrix

Variable	F_1	F_2
x_1	0.173	-0.030
x_2	0.174	-0.015
x_3	0.176	-0.005
x_4	0.182	0.019
x_5	0.057	0.554
x_6	0.050	0.540
x_7	0.170	0.080
x_8	0.181	0.052

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3.2 Multiple regression Analysis of the influencing factors of China's Dairy Trade deficit

Use R software to solve the regression results, as shown in Table 3 below:

Table 3: Model summary

Model	Coefficient	Standardization coefficient	Std.Eorror	t	P value
	β1	-0.04206	0.06154	-0.683	0.5085
	F_1	0.86865	0.03017	28.787	1.04e-11
	F_2	-0.13560	0.06272	-2.162	0.0535
	R side	**Modified R party**	**F-statistic**	**Residual error**	**P value**
	0.9872	0.9849	424.6	0.01465	3.868e-11

The results show that after the weighted least square method, the modified R has passed the F test of 0.9849 (P = 3.868e-11 < 0.01), which shows that the overall interpretation ability of the model is significantly improved after eliminating heteroscedasticity. On the other hand, under the standardized data, the first common factor (P = 1.04e-11 < 0.01), that is, the dairy market factor, has a significant impact on the trade deficit; similarly, the second common factor (P = 0.0535 < 0.1) is also significant, which shows that dairy substitutes have a certain impact on the trade deficit, which is in line with the economic law.

The regression equation is:

$$Y = 0.86865* F_1-0.13560* F_2-0.04206$$

This means that for every point increase in F1, the dairy trade deficit increases by an average of 0.86865 points, while for every point increase in F2, the dairy trade deficit decreases by an average of 0.1356 points. Because the principal component is a comprehensive variable obtained from the synthesis of various influencing factors, in order to more intuitively analyze and judge the effect of each specific factor on the dairy trade deficit, therefore, the principal component is substituted into the regression equation with the expression of the corresponding independent variables, and the regression equation is obtained after finishing.

$$Y=0.1543X_1+0.1532X_2+0.1536X_3+0.1555X_4-0.0256X_5-0.0298X_6+0.1368X_7+0.1502X_8-0.04206$$

From the above regression equation, it can be seen that the coefficients of population (X1), GDP (X2), domestic dairy production (X3), dairy consumption (X4), international dairy price (X7) and tariff (X8) are positive, indicating that these variables are positively correlated with the agricultural trade deficit (Y), that is, the larger these variables, the greater the dairy trade deficit. The coefficients of meat and poultry consumer price index (X5) and egg consumer price index (X6) are negative, which is negatively correlated with dairy trade deficit (Y), indicating that the larger these variables, the smaller the dairy trade deficit. In other words, the population (X1), GDP (X2), domestic dairy production (X3), dairy consumption (X4), international dairy prices (X7) and tariffs (X8) increased by one percentage point respectively, and the dairy trade deficit (Y) increased by 0.1543, 0.1532, 0.1536, 0.1555, 0.1368 and 0.1502 percentage points respectively. The consumer price index of meat and poultry (X5) and the consumer price index of eggs (X6) increased by 1 percentage point, and the trade deficit of dairy products decreased by 0.0256 and 0.0298 percentage points.

4. Conclusion

The trade deficit of dairy products in China has become a norm and shows an expanding trend. Driven by many factors, this deficit will not be eliminated temporarily and will continue to exist for a long time. Through factor analysis, this paper finds that the driving factors of China's dairy trade deficit can be summarized into two major factors, the first is the dairy market factors, including population, GDP, domestic dairy production, dairy consumption, international dairy prices and tariffs, and the second is dairy substitutes, including meat and poultry consumer price index and egg consumer price index. Among the two principal component factors, the dairy market factor has a more significant impact on the dairy trade deficit than the dairy substitute factor. Among the dairy market factors, the dairy consumption representing the market demand has the most significant impact on the dairy trade deficit. Among the factors of dairy substitutes, the effects of the two kinds of substitutes on the trade deficit of dairy products are similar. Through regression analysis, population (X1), GDP (X2), domestic dairy production (X3), dairy consumption (X4), international dairy price (X7) and tariff (X8) were positively correlated with dairy trade deficit (Y), while meat and poultry consumer price index (X5) and egg consumer price index

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(X6) were negatively correlated with dairy trade deficit (Y). In view of the impact of different factors on the dairy trade deficit, and then determine the optimization direction of dairy trade.

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