

Study on the Influencing Factors of Value Added of China's Auto Exports--Taking Trade with EU as an Example

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Abstract. After entering the 21st century, global trade has gradually changed from the traditional independent production of import and export to the global cooperative division of labor, and the production division of labor of each country has gradually become clearer, which also brings about the repeated flow of intermediate products in the international arena, and this has become especially obvious in the automobile industry. Since there are a large number of raw materials and intermediate products flowing in and out of the automotive industry, the traditional method of accounting for total trade value has become difficult to accurately calculate the real trade benefits of each country and is therefore no longer applicable to today's situation. The EU region, as the birthplace of the auto industry, has a huge auto market and is an important region for China to develop overseas markets in the future. This paper measures the value added of China's auto exports to the EU using the value added trade law from the background of China's auto exports to the EU, and explores the micro and macro factors that currently affect the value added of China's auto exports to the EU, which has positive guiding significance for China's auto exports to the EU market in the future.

Keywords: foreign trade; value-added exports; automotive industry; influencing factors.

1. Introduction

With the continuous development of global industrial integration process, global value chain has gradually become a popular direction for international trade application as well as research. Due to the proposed global value chain, the production of a product is no longer completed by a single country autonomously, but is divided by several countries, each responsible for a part of intermediate products and finally synthesized into a complete product. As an industry that requires multiple countries to participate in production, the automotive industry naturally also widely applies global value chains, and the manufacture of a car needs to rely on multiple countries to provide the support of parts and components. Facing this situation, if we follow the traditional trade statistics method, i.e., reflecting the trade profit gained by a country by measuring the import and export value of a country's products, it is not very accurate and may easily lead to double counting and thus the illusion of excess trade surplus. The calculation of value added can solve this problem and give a more realistic response to China's auto exports.

Since 2005, China has become the second largest trading partner of the EU as well as the first largest source of imports. In recent years, the export trade volume between China and the EU has been in a rising state, and according to the data of Eurostat in early 2021, the trade of goods between China and the EU in 2020 showed a two-way growth trend, and in 2020 alone, China exported 383.5 billion euros of goods, in an environment where the EU's import and export trade is on a downward trend, China is growing against the tide, replacing the US as the EU's largest trading partner. From the perspective of export categories, although the export value of automotive does not rank in the forefront of China's export trade to the EU, but in recent years there has been a significant growth trend, especially in the past two years, China's new energy vehicles booming, the export trade value of new energy vehicles growth rate compared to about 2015 has increased significantly. In 2020 alone, the monthly export volume of China's cars reached the level of 100,000 units, of which about 17% were sold to the EU, and a total of 169,500 cars were exported to the EU in the year, up 40% compared with 2019, of which about 40,000 were new energy vehicles, which to a certain extent can reflect the importance of China's auto industry to the EU market in recent years, as well as the large layout of export trade, and also side reflects the fact that China's auto industry is gradually transforming from parts to whole vehicles.

Understanding the development of EU auto industry and market, and studying the factors influencing the value added of auto exports will help accelerate the pace of China's auto enterprises to enter the EU auto market and open up new growth points in overseas markets. Therefore, this paper analyzes the impact of various factors on China's auto export value added from macro and micro perspectives by establishing a regression model, and then provides some theoretical support to further rationalize the development direction of China's auto industry and improve China's auto export market share in the EU.

2. Relevant Theories

2.1. Value-added trade concept

The meaning of value-added trade is the added value absorbed by the final consumption of a country directly or indirectly by the importing country, initially proposed by Stehrer, and later enriched by Johnson and Noguera and proposed the concept of VAX-C. Today's value added trade is calculated in a way that excludes the case where a single country exports an intermediate product and then imports that product back into the country in a more complete form.

2.2. Value added accounting methods

There are many ways to account for value added, and the rationale is to decompose total exports or bilateral trade of multiple countries through input-output tables, and then calculate the value added from other countries to separate domestic value added. The value added accounting approach was first proposed by Hummels et al. in 2001, when Hummels proposed the HIY value added accounting method, which relies on the input-output table of the country to decompose the value of exports into domestic value added and foreign value added, and proposes the VS indicator to quantify the level of vertical specialization of a country^[1]. This method has far-reaching implications for value added accounting, but it also has more problems.

So, a few years later, Koopman proposed the KWW method based on the secondary development of the HIY accounting method^[2], and later in 2014 by proposed the nine-part method, in which the nine-part method divides the total amount of national trade exports into nine parts for calculation and obtains the VS and DC indicators, which can clearly account for the country's value added and can be applied to many practical situations, but still cannot measure The most versatile and accurate value-added accounting method today is Zhi Wang, Shang-Jin Wei, and Kunfu Zhu's "Quantifying International Production Sharing at the Bilateral and Sector Levels" published in 2018. Sector Levels", which stands on the production perspective rather than the supply perspective and is able to divide the country's production activities into industrial chain and non-industrial chain production activities, which facilitates the subsequent accounting.

3. Analysis of micro-level influencing factors on the value added of China's auto exports to the EU

In order to explore the possible factors affecting the value added of China's auto exports at the micro level, this paper conducts an empirical analysis with the help of regression models in econometrics, and analyzes its impact on the value added of exports by measuring the microeconomic indicators of auto enterprises.

Generally speaking, the higher the operating profit, the more frequent the auto trade exports, and the higher the value added^[3]. Thus, in this section, the regression model is established with the value added of automobile exports as the explanatory variable and the enterprise operating profit as the core explanatory variable. The dependent variable is the value added of exports, and the independent variables are the micro indicators of enterprises. The six companies with the highest domestic export car sales in 2020: SAIC, Changan Automobile, Great Wall Motor, Dongfeng Motor, Jianghuai Automobile, and China National Heavy Duty Truck are selected, using the financial indicators of

operating income, financial expenses, operating profit, total profit, total assets, and total liabilities. Detailed data are shown in Table 1.

Table 1. Top 6 Chinese car companies' export volume in 2020

Rank	Car Company	Sales (million units)
1	SAIC	32.2
2	Chery Automobile	11.4
3	Changan Automobile	8.2
4	Geely	7.3
5	Great Wall Motor	7
6	Dongfeng Motor	6.9

Data source: China Association of Automobile Manufacturers

Using value added export as the dependent variable and operating income, financial expense, operating profit, total profit, total assets and total liabilities as the independent variables, multiple linear regression analysis was done and the results are shown in Table 2 below. In addition to the financial expense significance $p=0.152$ is greater than 0.05, the significance of other independent variables are less than 0.05, that is, there is a significant impact on the dependent variable. Among them, the regression coefficients of total profit and total liabilities are negative, i.e., less than 0. This indicates that total profit and total liabilities have a negative effect on the value added of exports, and when total profit and total liabilities increase, it may lead to a decrease in the value added of exports. The regression coefficients of other independent variables are greater than 0 indicating that there is a positive influence on the value added of exports, and when they increase, it may affect the value added of exports to increase.

Table 2. Results of the analysis of micro-influencing factors on the value added of China's exports of automobiles to the EU

Variables	Regression coefficient	Standard deviation	t	p	95% confidence interval	
Operating income	0.001	0.0003	2.71	0.027	0.0001	0.002
Financial expenses	0.029	0.018	1.58	0.152	-0.013	0.072
Operating profit	0.031	0.01	3.23	0.012	0.009	0.053
Total profit	-0.037	0.012	-3.08	0.015	-0.064	-0.009
Total assets	0.001	0.0003	3.26	0.012	0.0003	0.002
Total liabilities	-0.001	0.001	-2.79	0.024	-0.003	-0.0003
Constant term	-181.429	85.5	-2.12	0.067	-378.591	15.733

4. Analysis of macro-influencing factors on the value added of China's auto exports to the EU

Taking into account the actual situation of auto export data in this paper, this paper measures the value added of China's auto exports to the EU based on the perspective of value added trade, drawing on the non-competitive input-output model of Xu Juxiang and Fang Qi Yun^[4]. The core of this method is to construct a non-competitive input-output analysis table, where the term "non-competitive" refers to the distinction between domestic intermediate inputs and foreign intermediate inputs on the basis of the general input-output table. 2000-2014 value added of auto exports is calculated as shown in Table 3, and is used as the explanatory variable in this empirical study. This indicator can reflect the status of China's auto exports from the perspective of value added and has a direct representative effect. The explanatory variable in the empirical evidence is denoted by Y.

Table 3. Measurement results of value added of China's auto exports to EU from 2001-2014

Year	Value added/\$million
2000	97.94
2001	123.93
2002	160.49
2003	246.62
2004	509.16
2005	676.24
2006	1143.50
2007	1927.47
2008	3273.52
2009	2300.05
2010	3759.57
2011	4301.53
2012	4319.37
2013	5177.97
2014	5705.31

Data source: Calculated from WIOD database

4.1. Selection of indicators and data sources

The accounting data in this paper are obtained from the World Input-Output Database (WIOD), which provides data on trade in intermediate and final goods among 27 EU countries, collecting a total of 15 years of observations from 2000-2014.

The macro effects are divided into two main parts: country-level and industry-level, and the selected explanatory variables are: factor endowment comparative advantage, technological innovation, foreign investment, economies of scale, and industry size.

(1) Comparative advantage of factor endowments

Compared with the developed economies in the EU, China is a labor-rich country; therefore, this thesis uses the labor productivity indicator to indicate the comparative advantage of factor endowment. The higher the labor productivity, the greater the added value of automotive products exported to the EU, and labor productivity has a positive effect on the added value of automotive exports. The labor productivity of China's automotive industry is equal to the industrial value added of the automotive industry / the average annual number of employees in the automotive industry^[5]. Labor productivity is denoted by X1 in this thesis.

(2) Technological innovation

In this thesis, the research and experimental development expenditure of industrial enterprises above the size of the automotive industry is selected as a proxy variable for technological innovation, and the data are obtained from the China Statistical Yearbook of previous years.

(3) Foreign investment

In this paper, 49% of the net fixed assets of foreign invested enterprises are used as FDI indicators^[6], where foreign invested enterprises include Hong Kong, Macao and Taiwan invested enterprises and foreign invested enterprises. Foreign investment is represented by X3 in this thesis.

(4) Economies of scale

Regarding the selection of economy of scale indicators, this paper draws on the article of Jiang Xi and Liu Xichen^[7] to study the value added of China's manufacturing exports and its influencing factors, and the proxy variable of economy of scale is: the ratio of sales revenue of large and medium-sized enterprises of automotive products to the total number of enterprises of automotive products, and the data are obtained from the China Industrial Statistical Yearbook, and economy of scale is denoted by X4 in this thesis.

(5) Industry size

This paper adopts the total exports of Chinese auto products to the EU in previous years to indicate the scale of auto product exports, and the data comes from the China Automotive Industry Yearbook of the Chinese Ministry of Commerce, and the scale of exports is represented by X5 in this thesis.

4.2. Empirical Process

Table 4. Descriptive statistics of the data

Variables	Name	Observed Value	Mean Value	Standard Deviation	Minimum Value	Maximum Value
Value added of auto exports	Y	15	2248.18	2012.44	97.94	5705.31
Comparative advantage of factor endowment	X1	15	196928.00	93356.64	53635	353077
Technological innovation	X2	15	344.15	249.36	58.60	794.40
Foreign investment	X3	15	501.51	246.98	196.51	1020.56
Economy of scale	X4	15	62937.64	35133.53	15307.14	114087.30
Industry size	X5	15	38.94	25.81	5.54	76.25

This paper mainly uses Stata 15 software to conduct smoothness test and co-integration test on the data of explanatory and explanatory variables, establish corresponding regression models, analyze the relationship between explanatory and explanatory variables, and establish model support for theoretical research. Let the value added of automobile exports be the explanatory variable Y, and the comparative advantage of factor endowment, technological innovation, foreign investment, economy of scale, and industry size be the explanatory variables, denoted by X1, X2, X3, X4, and X5, respectively.

4.2.1 Plausibility test

Before regression, a unit root test is required to ensure the smoothness of the variables so as to prevent the appearance of pseudo-regression. There are various ways of unit root tests, including ADF test and PP test, and this paper uses ADF test, and the results are shown in Table 5 below.

Table 5. ADF test

Variables	Z(t)	1%	5%	10%	p
Value added of automobile exports	-2.942	-4.38	-3.6	-3.24	0.149
Comparative advantage of factor endowment	-1.769	-4.38	-3.6	-3.24	0.7197
Technological innovation	-2.371	-4.38	-3.6	-3.24	0.3953
Foreign investment	-1.082	-4.38	-3.6	-3.24	0.932
Economy of scale	-2.973	-4.38	-3.6	-3.24	0.1398
Industry size	-2.714	-4.38	-3.6	-3.24	0.2303

The original hypothesis of the ADF test is that the data has a unit root. The results in the above table show that the p-values of value added of automobile exports, comparative advantage of factor endowment, technological innovation, foreign investment, economies of scale and industry size are all greater than 0.05 and the original hypothesis of having unit root is accepted. A first-order difference is needed to test whether the difference of each variable is smooth or not before proceeding with the test.

The results of the first-order differencing of the data are shown in Table 6.

Table 6. ADF test results after first-order differencing

Variables	Z(t)	1%	5%	10%	p
Value added of automobile exports	-5.820	-4.38	-3.6	-3.24	0.000
Comparative advantage of factor endowment	-4.344	-4.38	-3.6	-3.24	0.0027
Technological innovation	-3.437	-4.38	-3.6	-3.24	0.0466
Foreign investment	-3.622	-4.38	-3.6	-3.24	0.0280
Economy of scale	-4.198	-4.38	-3.6	-3.24	0.0045
Industry size	-3.931	-4.38	-3.6	-3.24	0.0110

From the above table, it can be seen that the ADF test values of the variables after first-order differencing are all less than the critical value of -3.6 at 5%, and all of them cannot reject the original hypothesis (original hypothesis: existence of unit root) at 5% confidence level, and there is no unit root, and the data are smooth and can be tested for cointegration.

4.2.2 Cointegration test

The cointegration test is to examine whether there is a long-term equilibrium relationship between the independent variables and the dependent variable, and only when there is an equilibrium relationship can regression be performed, otherwise there will be a pseudo-regression. The cointegration test used in this thesis is the E-G two-step method, in which the least squares regression of the variables is performed in the first step to obtain the residual series u . In the second step, the unit root test is performed on the residual series u . If the residual series u is smooth, it indicates that the variables pass the cointegration test and there is a long-term equilibrium smooth relationship between Y and X_1 - X_5 , and the regression results are shown in Tables 7 below.

Table 7. Cointegration test

Variables	Regression coefficient	Standard deviation	t	p	95% confidence interval	
Comparative advantage of factor endowment	-0.007	0.003	-2.620	0.028	-0.012	-0.001
Technological innovation	4.206	1.995	2.110	0.064	-0.307	8.719
Foreign investment	-2.627	1.166	-2.250	0.051	-5.265	0.011
Economy of scale	0.037	0.019	1.950	0.083	-0.006	0.080
Industry size	32.661	13.066	2.500	0.034	3.104	62.218
Constant term	-165.992	329.874	-0.500	0.627	-912.218	580.234
F=169.31, R ² =0.9895, adjusted R ² =0.9837						

The significance of the statistic F is less than 0.05, indicating that the equation as a whole is significant; the adjusted R^2 is 0.9837, indicating that the equation fits well, with a goodness of fit of 98.37%.

Next, the residual series u is tested for smoothness, and if it is smooth, it passes the cointegration test, indicating that OLS regression analysis can be performed.

Table 8. Residual test results

Variable	Z(t)	1%	5%	10%	p
Residuals u	-3.373	-4.38	-3.6	-3.24	0.0899

The ADF value of the residual term u is less than the critical value at the 10% significance level, indicating that it passes the test at the 10% significance level and the residual term is smooth, i.e., there is a long-term cointegration relationship between the explanatory variables and the explained variables, and the OLS regression analysis is valid.

4.2.3 Model regression

Based on the results of the above analysis, the regression model is organized as follows.

$$Y = -165.992 - 0.007 * X_1 + 4.206 * X_2 - 2.627 * X_3 + 0.037 * X_4 + 32.661 * X_5$$

At 0.05 level of significance, X_1 factor endowment comparative advantage and X_5 industry size have a significant effect on the dependent variable, and X_2 technological innovation, X_3 foreign investment, and X_4 economies of scale have a significant effect on the dependent variable at 0.1 level of significance.

4.3. Analysis of empirical results

Based on the existing research literature, this thesis selected five influencing factors, namely, comparative advantage of factor endowment, technological innovation, foreign investment, economies of scale, and industry size, and empirically tested the factors influencing the value added of China's exports of automotive products to the EU by establishing a regression model. Firstly, the variables were subjected to ADF smoothness test and EG two-step cointegration test, and the treated series passed the unit root test and cointegration test, and then the series were regressed, and the regression results found that: among the five influencing factors, the two factors of factor endowment comparative advantage and industry size have significant effects on the value added of China's exports of automotive products to the EU at the 0.05 level, and factor endowment comparative advantage has a negative effect on the dependent variable, industry size has a positive effect on the dependent variable, where industry size has the largest effect on the value added of exports, followed by technological innovation and foreign investment, and economy of scale and factor endowment comparative advantage have the smallest effect on the value added of auto exports; the three factors of technological innovation, foreign investment and economy of scale have a significant effect on the value added of Chinese automotive exports to the EU at the 0.1 level, while foreign investment has a negative effect on the dependent variable and technological innovation and economy of scale have a positive effect on the dependent variable.

5. Conclusions and Policy Recommendations

5.1. Conclusion

This paper explores the factors influencing the value added of China's auto exports to the EU from two perspectives, micro and macro, with the help of multiple linear regressions, and obtains the following conclusions.

At the micro level, operating revenue, total assets, and operating profit show a boosting effect on the value added of auto exports, while total profit and total liabilities show a dampening effect. Among them, for every 1 percentage point increase in the core explanatory variable operating profit, the value added of exports increases by 0.031 percentage points on average, and the level of export trade of domestic automobile enterprises can be judged to a certain extent by the level of operating profit.

From a macro perspective, technological innovation, economies of scale, and industry scale subsystem help to increase the value added of automobile exports, and factor endowment comparative advantage and foreign investment subsystem are not conducive to the export trade of automobiles to the EU. Thus, it seems that the development of domestic automobile enterprises cannot be fundamentally driven by means of introducing foreign investment and increasing labor input. What we really need to do is to expand the market scale and cultivate loyal customers, and the core is to insist on scientific and technological research and development and have our own "mastery".

5.2. Policy Recommendations

Based on theoretical analysis, empirical analysis and conclusions, this paper puts forward the following policy recommendations.

(1) Strengthen the linkage between financial institutions and automobile enterprises

Enrich financial products related to auto export services, improve the speed of business approval and speed up the operational efficiency of financial institutions; set up green policy banks for enterprises to alleviate financing difficulties and lack of capital channels; guide the layout of auto industry, encourage auto export investment and construction, and increase financial support for auto export enterprises in economically backward regions to make up for geographical disadvantages and ensure coordinated development of auto export industry.

(2) Improve the system regulations related to the promotion of auto export

The government, as an important role in regulating the development trend of the auto industry, should increase the help for domestic auto brands. For example, it should establish a public information platform to publicize export policies and relevant regulations to avoid unnecessary losses caused by the seizure of cars during transportation; cultivate the awareness of independent property rights and independent brands, and the government should tilt toward domestic brands in procurement, take the lead and play an exemplary role to enhance the self-confidence of national brands.

(3) Set up special funds for science and technology and tax relief policies

Formulate incentive policies for scientific and technological innovation, open up green channels for automobile enterprises that dare to innovate and challenge; give subsidies to enterprises for the introduction of high-tech talents and appropriate tax relief for innovative automobile enterprises; improve the policy of pre-tax deduction of R&D expenses, encourage enterprises to strengthen overseas R&D investment, give export enterprises permanent relief policies for R&D investment in overseas markets, and allow enterprises to set up an annuity system for R&D investment to guarantee

(4) Promote the full integration of the automobile industry into the carbon market

In order to cope with global climate change, we should continue to improve the automotive industry chain and promote the full inclusion of the automotive industry in the carbon market, in response to the call of "ecological priority". At the same time, relevant studies have shown that the implementation of carbon trading policy has a catalytic effect on the total factor productivity of enterprises, which is mainly due to the pressure of environmental regulation, on the one hand, stimulating the technological innovation of enterprises, and on the other hand, selling the surplus carbon emission rights to scarce enterprises for profit, thus increasing the profits of enterprises and enhancing the competitive advantage of automobile exports.

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