An Empirical Analysis of the Influence Factors on the Automobile Intra-industry Trade in Guangzhou

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Abstract. As the pillar industry of Guangzhou, the automobile industry is getting larger and larger, and the level of intra-industry trade is increasing year by year. Through the empirical research of econometric models, it’s found that the automobile intra-industry trade in Guangzhou is mainly influenced by the following factors such as the average level of Guangzhou’s automobile market size, the RMB exchange rate, the scale economy of the automobile industry, the degree of trade imbalance, and R&D expenditure. Among them, the scale economy of the automobile industry and R&D expenditure are in positive correlation, while the other factors indicate a hindrance.

1. Introduction

In recent years, the automobile industry clusters have gradually appeared in the Pearl River Delta region, and the production and export volume of automobiles have been increasing year by year. Among them, Guangzhou’s automobile production ranks second in China, and its output value ranks third, next to Shanghai and Changchun in China. Since July 1, 2018, China has lowered the tariffs on automobiles and automobile components. After the tax reduction, the average tax rate for automobiles in China is 13.8\%, and the average tax rate for automobile components is 6\%. China’s further opening up will have a profound impact on the automobile intra-industry trade as well as the adjustment, transformation and upgrading of the domestic automobile industry structure.

The automobile intra-industry trade in the Guangzhou has indeed achieved good achievement, but there are still some problems. One problem lies in lagging exports with the imbalance of “high productions, large imports and few exports”. The other is the incredibly uneven development of the automobile intra-industry trade. In the entire industry, the intra-industry trade index of components is the highest, while the intra-industry trade level of automobiles is relatively low [1]. As an automobile industry cluster in Guangzhou, Huadu District still has many problems in its automobile industry trade, such as smaller scale of companies and industries compared than those in Shanghai and Changchun, fewer self-owned brands, and a lack of automobile professionals and technicians [2]. If compared with the automobile industry in developed countries, the automobile industry clusters in Guangzhou are still insufficient in development and has a long way to go. At present, the importance of the production scale is overemphasized but the R&D competence is less considered or funded [3]. Guangzhou’s automobile industry is constantly...
developing, especially in the area of components, and its intra-industry trade has formed a certain level and economic scale. However, the automobile intra-industry trade in general is in a relatively backward position. In the final analysis, it is because of backward technology that the level of automobile intra-industry trade is relatively low. Therefore, if we want to raise the level of Guangzhou’s automobile intra-industry trade, we must take the path of independent research and development, independent innovation and economies of scale [12].

Therefore, in order to promote a better development of the automobile intra-industry trade in Guangzhou, it is particularly necessary to find out the main affecting factors by constructing a model of the automobile intra-industry trade in Guangzhou.

2. Status of the Automobile Intra-industry Trade in Guangzhou

With the development of Guangzhou’s automobile industry, the level of the automobile intra-industry trade has been growing year by year. The level of intra-industry trade in 2014 was 80%, however, by the end of 2018, it had been almost the same as or even higher than that of the developed countries. The analysis results may be quite different as there are many indicators for measuring the intra-industry trade level. The most commonly used indicator to measure the level of intra-industry trade is the Gruber-Lloyd index.

2.1 Measurement Methods of Intra-industry Trade

The Gruber-Lloyd index is a representative index for measuring intra-industry trade. Its index is calculated as follows:

\[ B_j = 1 - \frac{|X_j - M_j|}{X_j + M_j} \]

In the formula, \( j \) is a specific industry, \( X_j \) and \( M_j \) represent the import value and export value of the \( j \) industry in that country, and \( B_j \) is the intra-industry trade index. The value range of G-L index is [0,1]. The two endpoint values are: when a country only imports or exports in a certain industry, it means that the country has no intra-industry trade. At this time, either \( X_j \) or \( M_j \) is zero and the GL index equals 0. When a country imports and exports in a certain industry, the level of intra-industry trade in that country reaches the maximum at this time. At this time, \( X_j = M_j \) and the GL index equals 1. However, the calculation method of this indicator cannot avoid the measurement deviation caused by trade imbalance, and Vona (1991) has made sharp criticisms on this. The above problems can be avoided only when this indicator is used to analyze intra-industry trade of a single industry. Therefore, the Gruber-Lloyd index is the best method for measuring intra-industry trade in a single industry, and is more suitable for empirical analysis of measurement.

2.2 Status Quo of Intra-industry Trade of Guangzhou Automobile Industry

According to Guangzhou Automobile Industry Yearbook, the import and export products of the automobile industry are divided into five types: components, passenger cars, trucks, cars, and SUV. The data of those five types from 2013 to 2018 are selected to calculate the G-L index.

| Year | Component | Bus | Truck | Car | SUV |
|------|-----------|-----|-------|-----|-----|
| 2013 | 0.87      | 0.51| 0.78  | 0.06| 0.07|
| 2014 | 0.85      | 0.68| 0.82  | 0.08| 0.09|
| 2015 | 0.89      | 0.69| 0.80  | 0.11| 0.13|
| 2016 | 0.92      | 0.73| 0.87  | 0.15| 0.14|
| 2017 | 0.86      | 0.63| 0.88  | 0.17| 0.20|
| 2018 | 0.91      | 0.75| 0.89  | 0.22| 0.25|

Data source: Calculated based on Guangzhou Automobile Industry Yearbook 2018
(1) The overall level of the automobile intra-industry trade is relatively high, and product differentiation is obvious. The level of intra-industry trade of automobile components and trucks is relatively high, close to 0.9, while cars and SUV are typical of inter-industry trade, which indicates that private car manufacturing is a weak point in Guangzhou. The reason is that the intra-industry trade of the entire Chinese automobile industry basically belongs to a “three-country” mode, so the entire automobile industry in Guangzhou is also developing with the general trend. The “three-country” mode of intra-industry trade mainly refers to one in which a country imports from developed countries and exports to developing countries. The gap between the low-end exported automobiles and the high-end imported products has widened, which has led to an imbalance in the automobile intra-industry trade in Guangzhou. In general, however, the automobile intra-industry trade in Guangzhou has reached a relatively high level. The average intra-industry trade index for the past six years was as high as 0.88, which was close to that of the developed countries and even far higher than that of developing countries. This shows that Guangzhou’s automobile industry is qualified enough to participate in the international division of labor, and the products such as components, trucks and buses have the capacity of scale production and international competitiveness.

The Global Innovation 1000 Survey shows that the world's automotive industry invested $16 billion in R & D in 2018, it becomes the third largest industry in R & D expenditure. Chinese companies are paying more and more attention to R & D work. Guangzhou Automobile Group invested 1.707 billion yuan in R & D.

(2) No improvement in trade balance: exports less than imports
From 2013 to 2018, Guangzhou’s automobile trade balance deteriorated year after year. For example, the trade deficit of Guangzhou’s automobiles in 2017 was as high as US $4.303 billion. In the past six years, the average trade deficit of Guangzhou’s automobiles was US $3.131 billion. The export dependence of the automobile industry is low, and the added value of exports is not high.

(3) Vertical intra-industry trade
The overall export-import price ratio of the automobile intra-industry trade in Guangzhou from 2013 to 2018 showed a downward trend, that is, the gap between the export and import prices of the intra-industry trade is gradually narrowed. It can be seen that the expansion of Guangzhou’s automobile intra-industry trade is based on vertical one. The labor factor advantage is still the basic factor for the division of labor in the automobile industry. Local automobile manufacturers mainly specialize in processes with low technological content and low added value. From a long-term perspective, the vertical intra-industry trade division has put Guangzhou’s automobile industry at a disadvantage. Therefore, in order to obtain high added value, it is necessary to upgrade the industrial structure of the automobile industry in Guangzhou.

3. Analysis of the Influence Factors on the Automobile Intra-industry Trade in Guangzhou
There are many influence factors on the automobile intra-industry trade. Zhang Yue (2009) [4] believes that they can be GDP per capita, the level of foreign direct investment, the opening up or economic integration, the scale economy, the product differentiation, and the market structure; Xu Ya (2013) [5] studies on this issue mainly from the scale economy, economic development gaps between countries, FDI, market size, and consumer preferences; Wang Jian (2009) [6] takes the index GL of the automobile and the chassis intra-industry trade in China as explained variables and the following factors as explanatory variables: (1) minimum efficient scale (MES), (2) market structure (MS), and (3) foreign direct investment (FDI). Drawing on the existing research results and combining Guangzhou’s economy, this paper builds an intra-industry trade model for its automobile industry.

3.1 Model Construction
The explained variable of the model is the level of the automobile intra-industry trade (GL index). The explanatory variables are the average level of the Guangzhou automobile market size (AGDP), the RMB exchange rate (ER), the scale economy of the automobile industry (ES), and the degree of trade imbalance...
(TI), R&D expenditure (RD). In order to make the data more stable in case of multicollinearity and heteroscedasticity, natural logarithms are taken for all variables. The measurement model constructed is as follows:

\[ \ln GL = \beta_0 + \beta_1 \ln AGDP + \beta_2 \ln ER + \beta_3 \ln ES + \beta_4 \ln TI + \beta_5 \ln RD + \epsilon \]

\[ (-1.23, 0.28) (-9.78, 0.00) (-5.05, 0.00) (4.9, 0.01) (-6.65, 0.00) (2.93, 0.04) \]

In the brackets, the former is the T value, and the latter is the P value. \( R^2 = 0.97, F = 20.27, \) and \( DW = 2.014. \)

Among them, \( \beta_0 \) is a constant term and \( \epsilon \) is an error term. A method of least square regression was performed by using data from various economic indicators in Guangzhou from 2000 to 2018. The measurement results show that the value of the determination coefficient and the modified determination coefficient obtained by the multiple regression equation are higher. R-squared is 97% showing that the regression equation fits well. The significant level (\( a = 0.05 \)) corresponds to the F-test cut-off value (6.09 \( F = 20.27 \)), which is higher than 6.09, proving that the independent variable has a significant effect on the dependent variable. The significant level (\( a = 0.05 \)) corresponds to a T-test cutoff value is 2.776. The T value of most variables is higher than 2.776, which also has a significant effect. The DW value is 2.014, and the value corresponded by the significant level (\( a = 0.05 \)) falls between du=3.149 and 4-du =4-3.149 = 0.851, so it is deduced that there is no autocorrelation in the regression model.

Table 2 Indicator Selection, Data Source and Variable Description

| Indicator | Influence Factors | Meaning | Data Source |
|-----------|------------------|---------|-------------|
| GL        | exports and imports | Guangzhou automobile intra-industry trade index | Guangzhou Automobile Industry Yearbook (2013-2018) |
| AGDP      | Guangzhou automobile market size | Guangzhou’s GDP per capita | Guangzhou Economic Statistical Yearbook |
| ER        | the RMB exchange rate | the average annual RMB exchange rate | China Industry Information Website [http://www.cnii.com.cn/](http://www.cnii.com.cn/) |
| ES        | the scale economy of the automobile industry | the number of large and medium-sized automobile manufacturers in Guangzhou | China National Statistical Yearbook (2013-2018) |
| TI        | the degree of trade imbalance | trade balance of automobiles in Guangzhou | Mechanical Industry Yearbook (2013-2018) |
| RD        | R&D expenditure | Amount of R&D expenditures of automobile enterprises in Guangzhou | Guangzhou Machinery Industry Yearbook (2013-2018) |

Data source: Guangzhou Import and Export Statistics Website [http://www.gzeco.cn/index.htm](http://www.gzeco.cn/index.htm)

3.2 Analysis of Inspection Results

The AGDP coefficient is -11.99, which means that for every 1% increase in the average level of the Guangzhou automobile market size, the G-L index will decrease by 11.99%. The reason may be that as the GDP per capita of Guangzhou rises every year, people are paying more and more attention to the quality of cars, and preferring to buy cars of foreign brands, so that the number of imported cars also increases
accordingly; the ER coefficient is -7.48, which indicates that for every 1% increase in the average annual exchange rate of the RMB, the GL index will fall by 7.48%. Studies show that the appreciation of the RMB has an adverse effect on the export of automobiles in Guangzhou as it promotes the growth of automobile imports. The coefficient of the ES variable is 5.12, which indicates that for every 1% increase in the level of scale economy of the automobile industry in Guangzhou, the GL index will increase by 5.12%. The two parts are positively correlated due to the increase in the economic benefits of the former. With the increase of automobile production, its long-term average total cost will gradually decrease, and the product’s technical content will gradually be improved, and finally make the product more diversified. The coefficient of TI variable is -0.46, which indicates that the trade imbalance has a negative correlation with the automobile intra-industry trade in Guangzhou. The small coefficient has a limited impact on the level of intra-industry trade in the automobile industry. The coefficient of RD variable is 1.16, which indicates the R&D expenditure of the automobile industry in Guangzhou has a positive correlation with the development of intra-industry trade. When more money is invested, the product categories will tend to diversify and their technological content will increase greatly. This will stimulate people’s desire to buy and promote the level of automobile intra-industry trade.

4. Conclusions

In summary, the main factors affecting the level of automobile intra-industry trade in Guangzhou are five aspects: the average level of Guangzhou’s automobile market size, the RMB exchange rate, the scale economy of the automobile industry, the degree of trade imbalance and R&D expenditure. Among them, the scale economy of the automobile industry and R & D expenditure are in positive correlation, while the other factors indicate a hindrance. In order to promote the development of automobile intra-industry trade in Guangzhou, improvements can be made in the following areas.

It’s essential to improve the level of science and technology to remove imbalance in the intra-industry trade. Specifically speaking, firstly, we must improve the status of the division of labor in the industrial value chain. We need to focus on the research and development of core automotive components, actively guide the component manufacturers and the automobile manufacturers to cooperate with each other, and strengthen cooperation with international automobile companies. At present, automobile companies in Guangzhou have close cooperation relationships with Honda, Toyota, and Dongfeng Nissan, however, if we want to improve the research and development level of the core technology of Guangzhou's domestic independent brands, we need to strengthen the competitiveness of automobile companies, increase the output and export volume of automobiles and automobile products, focus on innovation, and expand the scale of the automobile industry, closely cooperate with foreign companies such as Hyundai Motor and Renault Motors; Secondly, we must build independent innovation R&D centers. The government or the car makers start the research and development of auto parts, which will drive the innovation of automobile production. Moreover, we must strengthen cooperation with foreign companies to develop local unique automobiles. Finally, we must cultivate and introduce talents for scientific researches. The government should formulate a comprehensive talent reserve plan to retain outstanding talents in the city and attract elites such as foreign and international students who are willing to come to Guangzhou’s automobile enterprises for research and development.

It’s essential to expand the average level of market size. Guangzhou Municipal Government promulgated Guide Catalogue for Foreign Investment Industries in 2012 the extensive economic development mode was no longer suitable for the Guangzhou local automobile industry, the mainstream economic growth mode for the automobile industry is to adopt new manufacturing technologies, improve production machinery and equipment. We should make use of modern technology and equipment and scientific management methods to increase the output of the automobile industry, improve total factor productivity, and eventually achieve more returns to scale. For another, we must strive to improve the production technology of the production workshop. In addition, we can enlarge and strengthen the independent brands of leading enterprises before driving other relatively small automobile companies so
as to optimize and reorganize the Guangzhou automobile industry.

It’s essential to improve the quality of cars in Guangzhou to meet the needs of people. As Guangzhou’s GDP per capita has been increasing year by year, people are paying more and more attention to the quality of cars, whereas “low-price, low-quality and low-grade” is the inherent label of Guangzhou cars in people’s eyes. Therefore, we must improve the quality of local cars, increase consumer confidence, build an image of “high quality, high-grade and high performance-price ratio”, attract more consumers, and gradually expand the automobile market of Guangzhou.

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