Algorithm Research on Manufacturing Agglomeration under the Background of Regional Integration Based on GMM Model

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Abstract. With the development of the process of regional integration, the manufacturing industry is also changing. This has attracted more attention. However, in the background of regional integration, there are relatively few empirical studies investigating the degree of manufacturing agglomeration. This paper selects nine cities in the Pearl River Delta, Guangdong Province, China from 2007 to 2017 as our sample. We use the Difference GMM Model to explore the impact of government support and labor concentration on manufacturing agglomeration. The measurement results show that both government support and labor concentration have a positive correlation with the degree of manufacturing agglomeration. Government support and labor concentration have different significance levels and coefficients for manufacturing agglomeration. In order to promote the increase in the agglomeration of the urban manufacturing industry, the increase in labor concentration will be more effective than government support.

1. Introduction
Facing the new background of economic development, the government wants to further promote the development of regions. It is a common measure to promote the upgrading of the industrial structure and to improve the efficiency of economic development. Our country has issued various planning outlines and supporting policies to promote regional integration. These policies and measures are aimed at further promoting the integration and specialization of regional manufacturing. The integration and specialization of the division of labor will release the strong scale effect brought by agglomeration. With the great attention and unified planning of the central government, our country is vigorously constructing four regional coordinated development strategies in terms of regional integration. On the one hand, the realization of regional integration is to solve the problem of the free flow of regional commodities. On the other hand, the realization of regional integration should solve the problem of market and industry segmentation through various refined policy measures. Through these measures, it is hoped that the full flow of capital, talents, natural resources and other elements can be promoted. In the period before the formal implementation of the regional integration strategy, one region and another region were in a state of segmentation in the talent and goods market. There is not much connection between regions. However, from an industrial point of view, the types of manufacturing industries selected for development in each region are almost the same. This leads to wasteful repetitive construction in the area. Similar products are produced in all regions. While making all elements flow more efficiently, it also needs to conserve natural resources. Taking the road of sustainable development, we should shift from single-region development to multi-regional coordinated development. The manufacturing industry with traditional endowment advantages is being
eroded by other emerging countries or regions\textsuperscript{[4]}. In this way, if we want to get out of the predicament, we need to take some measures. We need to reconsolidate and release the scale effect brought by the agglomeration of manufacturing under the premise of efficient regional division of labor and cooperation. At present, the development of manufacturing industries in the nine cities in the Pearl River Delta overlaps, which has caused a bottleneck in the degree of manufacturing agglomeration. Moreover, there is a phenomenon of waste of resources, it is urgent to break the barriers of the market. Reasonable planning for manufacturing enterprises will reduce unnecessary competition, promote the free flow of production factors, and increase the degree of agglomeration. These measures and methods will help release economies of scale and further promote high-quality economic development.

In the background of regional integration, what role do the government and labor play in manufacturing agglomeration? This is the main content we will explore in the following paper.

2. Method and Econometric Model

Individuals' current behaviors will be affected by their own behaviors in the past to some extent, and so is the manufacturing agglomeration, which is the main research object of this paper. In other words, the degree of manufacturing agglomeration depends on the previous path\textsuperscript{[5]}. In the model of this paper, the explained variables with a lag of one period are considered. This paper also considers the possible endogenous problems between explanatory variables. In this case, the efficiency of generalized moment estimation is higher than that of the two-stage least square method. Considering the aforementioned situation, this paper chooses the generalized moment estimation method of dynamic panel model. The generalized moment estimation model can also be abbreviated as GMM. Acemoglu D chose the Difference GMM estimation method when examining the effect of per capita income on democracy\textsuperscript{[6]}. Specifically, the Difference GMM will be used to estimate the model in this paper below. As a comparative analysis, the Ordinary Least Squares and Two-Way Fixed-Effects Model are also used for empirical testing to illustrate the robustness of empirical testing. The Ordinary Least Squares and Two-Way Fixed Effects Models can also be abbreviated as OLS and FE respectively. Taking into account the length and main content of this article, the Ordinary Least Squares and the Two-Way Fixed-Effects Model are not listed and related explanations. The coefficient $\beta_2$ and coefficient $\beta_4$ are important objects of concern in this paper. $\alpha$ is a constant term. $\mu_i$ stands for individual effect. $\xi_{it}$ is the random disturbance term. The dynamic panel model of this paper is as follows:

$$LQ_{it} = \partial_{it} + \beta_1 LQ_{i,t-1} + \beta_2 GOV_{it} + \beta_3 INDUSTRY + \beta_4 LABOR_{it} + \beta_5 X_{it} + \mu_i + \xi_{it}$$

11 2 3 4 5

(1)

3. Variables and Data Sources

The main relevant data of the nine cities involved in this paper are mainly derived from the annual statistical yearbooks of Guangdong Province and the data published by the statistics of each city. In addition, this paper additionally uses the CEIC and EPS databases to supplement the data of individual years. The CEIC database comes from Central Asia Economic Data Co., Ltd. The EPS database, also known as Economy Prediction System, is a professional data service platform of Beijing Forcast Information Technology Co., Ltd. Due to the completeness and availability of data, this paper selects 11 years of data from 2007 to 2017, and uses 9 cities as samples.

In the background of researching regional integration strategy, different references choose different indicators to measure the degree of manufacturing concentration. Among them, indicators such as spatial Gini coefficient, industrial concentration, and location quotient are all commonly used. Therefore, this paper follows the practice of relevant references and selects the manufacturing location quotient of nine cities as the explained variable. From the perspective of related research on manufacturing agglomeration, many Chinese scholars have adopted location quotient indicators to measure the level of regional manufacturing agglomeration\textsuperscript{[7]}. The advantage of location quotient is that it can eliminate the different factors of regional scale and more truly reflect the spatial distribution of geographical elements. The location quotient can be used to judge whether a specialized department has been formed in a certain area\textsuperscript{[8]}. In the formula, $i$ represents the i-th industry and $j$ represents the j-th city. The $x_{ij}$ represents the number of employees in the j-th city i industry. The formula for location quotient is as follows:
After calculation by Stata software, we get the location quotient of the nine cities. Guangzhou's manufacturing location quotient fell from 1.32 in 2007 to 0.96 in 2017. To a certain extent, it reflects the decline in the degree of manufacturing agglomeration and advantages, but there are still certain advantages in the region. This should be due to the continuous increase in the proportion of the service industry and the reduction in the proportion of the manufacturing industry. During this period, Shenzhen's manufacturing agglomeration has increased, and its value has increased from 1.60 in 2007 to 1.90 in 2017. It can be found that it is continuously expanding its own manufacturing advantages. In addition, the improvement of the two cities of Dongguan and Foshan is very significant. Dongguan's manufacturing location quotient increased from 1.19 in 2007 to 2.93 in 2017. Foshan's manufacturing location quotient increased from 1.62 in 2007 to 2.49 in 2017. On the one hand, due to Dongguan's location advantages and relatively complete industrial manufacturing system, it can better undertake the manufacturing industries that have migrated from Guangzhou and other places. On the other hand, the Dongguan Municipal Government has also vigorously promoted infrastructure construction and supported the construction of industrial cluster. Due to the implementation of the regional integration policy, Guangzhou and Foshan have cooperated more closely. Foshan promotes its manufacturing industry to develop better with various factories and relatively cheap labor. Foshan City is also expanding other manufacturing areas and international market shares. The degree of manufacturing agglomeration has increased in Zhongshan. The location quotient of Zhongshan's manufacturing industry has risen from 2.09 in 2007 to 2.36 in 2017. However, Zhuhai's manufacturing location quotient dropped from 2.31 in 2007 to 1.89 in 2017. Among them, the manufacturing location quotients of Huizhou, Zhaoqing and Jiangmen during the study period did not change significantly, but only slightly increased. The above-mentioned statistics about the manufacturing location quotient of each city are in line with the development profile of recent years. The figure below shows the time trend chart of location quotients in nine cities:

![Figure 1](image_url)

**Figure 1.** The level of location quotient in the nine cities.
The level of manufacturing agglomeration in a region often depends on the level of agglomeration in the previous year. Therefore, this paper also uses the one-period lag variable of the location quotient as an explanatory variable to describe such a path-dependent variable relationship. Then, there are important explanatory variables in the research of this paper. Government support is used to describe the support of various local governments to the economy, measured by the proportion of local fiscal expenditures in their GDP\cite{9}. Government support is abbreviated as GOV. The labor concentration index is used to measure the concentration level of manufacturing labor employment in the city. It is measured by the ratio of the city’s manufacturing labor force to the urban labor force. Labor concentration is abbreviated as LABOR.

Next are some control variables. The economic development level indicator is the proportion of each city's GDP in Guangdong Province. The level of economic development is abbreviated as ED. The industrialization level uses the ratio of total industrial output to GDP. It describes the level of urban industrialization. The level of industrialization is abbreviated as INDUSTRY. Next is the degree of openness, which uses the ratio of total import and export to GDP. The degree of openness is abbreviated as OPEN. The market demand index is used to measure the relative demand of a regional market. It is calculated as the proportion of regional per capita GDP to the national per capita GDP. Market demand index is abbreviated as MARKET. The urbanization rate is measured by the proportion of the urban population in the total population. The urbanization rate is abbreviated as CITY. Among them, Table 1 below is the descriptive statistics of each variable:

| Variables | Mean   | Standard Deviation | Min    | Max    |
|-----------|--------|--------------------|--------|--------|
| LQ        | 1.9892 | 0.5100             | 0.9258 | 2.9302 |
| GOV       | 0.3236 | 0.6190             | 0.0554 | 2.2205 |
| ED        | 0.0102 | 0.0089             | 0.0023 | 0.0271 |
| INDUSTRY  | 0.4649 | 0.0892             | 0.2539 | 0.6302 |
| LABOR     | 0.5566 | 0.1445             | 0.2338 | 0.8131 |
| OPEN      | 1.3635 | 0.7508             | 0.3184 | 3.4741 |
| MARKET    | 2.4660 | 1.2123             | 1.2163 | 10.7076|
| CITY      | 0.7894 | 0.1765             | 0.4037 | 1.0000 |

4. Empirical Regression

After selecting appropriate econometric models and variables, we empirically tests the impact of government support and labor concentration on manufacturing agglomeration. This paper has selected the Difference GMM measurement Model that is suitable for this paper. However, Table 2 below successively reports the estimation results of OLS, Two-Way Fixed Effects, and the Difference GMM Model. On the one hand, it is possible to compare the coefficient changes under different models\cite{10}. On the other hand, this can prove the robustness of the model. Among them, due to the strict exogenous assumptions of the OLS Model and the strict assumptions of the disturbance term. This makes the results of its regression not very consistent with the actual situation. Then countless econometricians worked hard to make the model assumptions more and more in line with reality\cite{11}. For example, the hypothesis of the Difference GMM Model selected in this paper is more in line with the reality.

From the regression coefficient of the Two-Way Fixed Model, the coefficient of industrialization level is 0.407, and it has passed the 10% significance test. This shows that the increase in the level of industrialization will increase the degree of manufacturing agglomeration. The regression coefficient of labor concentration is 3.287 and it is significant at the 1% significance level. The coefficient supported by the government is positive, but it fails the significance test. This may be caused by the choice of model. From the results of the Difference GMM regression. The coefficient of industrialization level is 0.651, which has not changed much compared with the Two-Way Fixed Model. The significance level is changed from 10% to 5%, which further confirms the positive correlation between the level of industrialization and the degree of manufacturing agglomeration.
The regression coefficient of labor concentration is 3.247. Compared with the Two-Way Fixed Model, there is no significant change in the regression coefficient value, and it still passes the 1% significance test. This shows that the positive correlation between labor concentration and manufacturing agglomeration is relatively stable and significant. At this time, the coefficient of government support is positive and significant at the 10% significance level. The above empirical evidence well confirms the view of this paper that government support and labor concentration can promote manufacturing agglomeration. Finally, both the coefficient and significance of the empirical test indicate that the role of labor concentration in promoting manufacturing agglomeration is greater than government support.

Table 2. Empirical Test of Three Models.

|            | OLS      | FE       | GMM      |
|------------|----------|----------|----------|
| L.LQ       | 0.080**  | 0.083**  | 0.090*** |
|            | (-3.08)  | (-2.96)  | (-4.21)  |
| GOV        | 0.007    | 0.16     | 0.370*   |
|            | (-0.51)  | (-1.04)  | (-2.42)  |
| ED         | -0.415   | 1.833    | -3.032   |
|            | (-0.38)  | (-0.17)  | (-0.23)  |
| INDUSTRY   | 0.225**  | 0.407*   | 0.651**  |
|            | (-2.65)  | (-2.24)  | (-2.85)  |
| LABOR      | 3.347*** | 3.287*** | 3.247*** |
|            | (-37.32) | (-32.14) | (-28.9)  |
| OPEN       | -0.020*  | -0.025   | -0.05    |
|            | (-2.55)  | (-1.19)  | (-1.88)  |
| MARKET     | -0.01    | -0.007   | -0.003   |
|            | (-1.68)  | (-1.01)  | (-0.57)  |
| CITY       | 0.096*   | 0.435    | -0.161   |
|            | (-2.15)  | (-1.36)  | (-0.69)  |
| cons       | 0.059    | -0.169   | 0.435    |
|            | (-1.35)  | (-0.52)  | (-1.38)  |

Notes: The standard deviation of the regression coefficient is in parentheses; *** means significant at the 1% level, ** means significant at the 5% level, and * means significant at the 1% level.

5. Conclusion and Suggestion

The nine cities in the Pearl River Delta are an important part of the national-level regional coordinated development strategy of the Guangdong-Hong Kong-Macao Greater Bay Area. Based on the regional development strategy and "Made in China 2025", through empirical testing, several suggestions are made for the agglomeration of manufacturing industries in the nine Pearl River Delta cities. This paper uses the dynamic panel data of nine cities in the Pearl River Delta from 2007 to 2017 and uses the GMM Model to conduct empirical research. The paper empirically tests the influence of government support and labor concentration on manufacturing agglomeration in the background of regional integration[12]. In the choice of measurement model and method, panel data is selected and fixed effects are considered. On the one hand, the Two-Way Fixed Effect is selected through testing, and on the other hand, the dynamic panel data is estimated by the Difference GMM Model. In the choice of control variables, there are control variables such as the degree of openness and the level of economic development to ensure the reliability and robustness of the empirical results. Whether it is a Two-Way Fixed Model or a Difference GMM Model, the regression result coefficients are not much different, and all have passed the significance level test. The regression results show that there is a positive correlation between the level of urban industrialization and manufacturing agglomeration. The reason for this phenomenon is that the increase in the level of industrialization means an increase in the proportion of manufacturing, which is conducive to the realization of the economic externality of manufacturing agglomeration[13]. Because of the data integrity, this paper has some points that can be
improved. For example, if this paper can obtain the enterprise data of each city's manufacturing sub-industries, it can explore the impact of government support and labor concentration on different manufacturing sub-industries.

In general, the marginal contribution of this paper has three points. The first point is that the labor force engaged in manufacturing in the region largely affects the degree of manufacturing agglomeration. The empirical results show that there is a significant positive correlation. This is also in line with the actual situation. If the local government wants to further promote the level of manufacturing agglomeration in the region, it needs to propose and implement a talent policy in order to attract talents and use talents to drive the improvement of manufacturing productivity. The second point is that city government support is another important factor that affects the degree of manufacturing agglomeration. Empirical test shows that it is a positive correlation. This shows that if the local government wants to promote the increase in manufacturing agglomeration, the government's financial support is necessary. The third point is that compared with direct government support, increasing labor concentration is a more effective way to promote manufacturing agglomeration.

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