Effects of Fiscal and Tax Policies on Stimulating the Development of Advanced Manufacturing Industry Clusters

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Abstract. Industrial clusters are crucial in promoting the specialised division of labour and aggregation of innovative resources, serving as a crucial pathway for China's endeavour to become a major manufacturing powerhouse and elevate its industries to the high end of the value chain. Advanced manufacturing industry clusters symbolise an advanced form of deepening the industrial division of labour and agglomeration development, with internationally competitive advanced manufacturing industry clusters being key indicators of a manufacturing superpower. To verify the economic siphon effects of local fiscal and tax incentives on industrial clusters, this study used a dynamic panel simultaneous equation model for analysis. The results revealed a two-way stimulating dynamic between the local fiscal and tax incentives and the development of advanced manufacturing industry clusters, along with a certain degree of time lag .

Keywords: Advanced manufacturing industry · Industrial clusters · Incentive policies · Fiscal and tax incentives · Economic effects

1 Introduction

The 14th Five-Year Plan prioritizes the expedited development of a robust manufacturing sector and a high-quality nation, while bolstering the competitive advantage of the manufacturing industry and fostering its high-quality growth. The development of advanced manufacturing industry clusters in China has played a pivotal role in ensuring stable economic growth in the industrial sector, enhancing the core incentives of the manufacturing industry and facilitating high-quality development [1]. Concentrated in key areas and critical links of the industrial chain [2], these clusters have demonstrated remarkable resilience, exceptional innovation capabilities and unmistakable leadership, thereby becoming a vital force in achieving sustained industrial growth, bolstering the core incentives of the manufacturing sector and safeguarding the stability of industrial supply chains [3]. Therefore, it is imperative to examine the impact of local fiscal and tax incentives on industrial clusters [4] and to further refine the support system for cluster policies, particularly in the realms of finance and taxation [5, 6].

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2 Model Design, Variable Selection and Data Sources

2.1 Model Design and Estimation Methodology

The fiscal and tax incentives and the development of advanced manufacturing industry clusters are analysed as explained variables as well as explanatory variables. A simultaneous equation model can be established for analysis as follows:

$$\begin{cases} ma_{it} = \alpha_0 + \alpha_1 fc_{it} + \sum \alpha X_{it} + \mu_{1i} + \varepsilon_{1it} \\ fc_{it} = \beta_0 + \beta_1 ma_{it} + \sum \beta X_{it} + \mu_{2i} + \varepsilon_{2it} \end{cases} \quad (1)$$

Where ma_{it} represents the degree of development of advanced manufacturing industry clusters in province i in year t, fc_{it} represents the intensity of fiscal and tax incentives in province i in year t, α and β represent the coefficients to be estimated, X_{it} represents a series of control variables, μ_{1i} and μ_{2i} represent individual effects and ε_{1it} and ε_{2it} represent the random error terms.

This study employs the system generalised method of moments estimation.

2.2 Variable Selection and Data Sources

Variable Selection

(1) Degree of Development of Advanced Manufacturing Industry Clusters (ma). This study adopts the approach proposed by Zhang Xiaodi and Wang Yongqi and uses an agglomeration index based on the gross value of the industrial output from different sectors for the analysis as shown below: [7]

$$ma_i = \frac{1}{n} \sum_{j=1}^{n} \frac{\text{Gross industrial product of } j \text{ industry of } i \text{ Province/GDP of } i \text{ Province}}{\text{Gross industrial product of national } j \text{ industry/National GDP}}$$

Focusing on 25 sub-sectors such as the automobile manufacturing industry, this study uses data on the gross industrial output value from industrial enterprises above a certain size. As the gross industrial output value is not disclosed in some years of the statistical yearbooks, it is substituted with the gross industrial sales output value, which is equally representative and similar in value.

(2) Intensity of Fiscal and Tax Incentives (fc). From the perspective of the government encouraging technological innovation, this study measures the willingness of local fiscal and tax incentives and constructs the following indicator:

fci = Fiscal and tax incentives$_{it}$/Enterprise R&D expenditure$_{it}$.

Fiscal and tax incentives = Fiscal and tax investment in R&D + Tax deduction for technological R&D.

This study uses the ratio of 'fiscal and tax support' to the internal R&D expenditure of enterprises as an indicator.

(3) Control Variables. Enterprise Technology R&D Expenditure (tc), expressed as the proportion of R&D expenditure in industrial enterprises to main business income. Industrial Enterprise Technical Personnel Input (tl), expressed as the proportion of R&D technical personnel to the average number of employees in industrial enterprises. Transportation Infrastructure (tp), expressed as the proportion of road mileage to the land area. Level of Economic Development (lnpgdp), expressed as the logarithm of the per capita GDP [8]. Foreign Investment Status (fdi), expressed as the proportion of foreign direct investment to total fixed asset investment in society. Degree of Urbanisation (urb). Degree of Nationalisation (na), the value of industrial sales output of state-owned enterprises expressed as a proportion of the GDP. The sample data is trimmed at 1% and 99% quantiles to remove the influence of outliers.

Data Sources
This study focuses on 30 provincial-level administrative regions in China. The data are sourced from relevant statistical yearbooks, and the missing data are supplemented through interpolation.

3 Empirical Analysis

3.1 Model Testing

Before estimating the model, it is important to ensure that all panel data are stationary to prevent 'spurious regression'. This study uses LLC, Breitung, IPS with different root statistics, ADF–Fisher and Hadri–LM to conduct panel unit root tests.

It can be observed that the different testing methods yield different results, and some variables do not pass some tests. Following the approach of Hu Yanan et al., under ADF–Fisher and Hadri–LM statistics, all variables are found to reject the null hypothesis—'presence of unit roots'—suggesting that data over the sample period can be considered stationary overall [9].

The Hausman test is usually used to help select either fixed or random effects to be used in each equation of the panel data model [10]. Test results shows that the p-value is significant at 0, implying that the fixed-effects model should be used.

Analysis Using the System Generalised Method of Moments Estimation
The analysis of the static panel fixed effects model FE indicates that: (1) The core explanatory variables are not significant for ma and fc equations, indicating that the estimated results are inaccurate without considering endogeneity. (2) The first-order lagged variables L.ma and L.fc are significant, suggesting the existence of a time lag in the development of advanced manufacturing industry clusters and the fiscal and tax incentives.

Based on the analysis outcomes obtained from SYSGMM, it can be concluded that AR(1) statistics for ma and fc equations pass the significance test, indicating the existence of a first-order autocorrelation in the random error terms. However, AR(2) statistic does not pass the significance test, indicating the absence of a second-order autocorrelation.

The Hansen statistic does not pass the significance test. Therefore, the null hypothesis—'all instrumental variables are valid'—is accepted, which indicates that SYSGMM is more appropriate for this analysis.

Estimation Results
The estimation results show that the regression coefficients of the lagged variables for the Degree of Development of Advanced Manufacturing Industry Clusters and Intensity of Fiscal and Tax Incentives are significant, indicating a significant two-way promotion effect between them. Furthermore, the multiphase lagged variables of L.ma, L.fc and other relevant control variables influence the current ma and fc, suggesting that there is a time lag associated with the development of advanced manufacturing industry clusters and fiscal and tax incentives have a certain degree of time lag.

Robustness Tests
Heteroskedasticity Robust Standard Error Test. This study uses robust standard errors to re-regression the dynamic panel model estimated by SYSGMM and compares the results. After employing heteroskedasticity-robust standard errors, the standard errors for all variables have expanded, rendering the estimation of variable regression coefficients no longer unbiased. For the ma equation, although the regression coefficients for other control variables are no longer significant, L.ma and L2.fc remain significant, indicating that the ma equation is still robust. For the fc equation, although the significance levels of ma and L.ma have decreased, ma is still significant at the 10% level, and L.fc continues to be significant at the 1% level. The remaining control variables still display some level of significance, implying that the fc equation is robust as well.

4 Conclusions

This study reveals a two-way stimulating effect between the local fiscal and tax incentives and the growth of advanced manufacturing industry clusters. In other words, fiscal and tax incentives serve as catalysts for technological innovation within enterprises, resulting in spillover effects and fostering the development of advanced manufacturing industry clusters, albeit with limited effects. Furthermore, the presence of advanced manufacturing industry clusters stimulates local governments to implement further subsidy policies, thereby intensifying fiscal and tax incentives and increasing the burden on local fiscal and tax resources. It is also noteworthy to mention a time lag in the reciprocal impact between the fiscal and tax incentives and the development of advanced manufacturing industry clusters. Lastly, this study confirms that fiscal and tax incentives positively affect the growth of advanced manufacturing industry clusters.

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