# Tobacco Industry Agglomeration and Industrial Pollution Emission: Nonlinear Test Based on Panel Data

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**Abstract:In the past 40 years, the agglomeration of tobacco industry plays a vital role in economic growth in China. Meanwhile, the rapid economic development has paid serious environmental and energy costs.Based on the panel data of 31 provinces in China from 2005 to 2015, this paper uses the differential GMM method to empirically test the relationship between the agglomeration of tobacco industry and industrial pollution emissions. The study found that the spatial agglomeration of the tobacco industry has a significant negative impact on industrial wastewater, sulfur dioxide and industrial dust emissions. Capital labor, enterprise scale, and pollution control investmentall have a significant impact on pollution emissions.Therefore, the increase in the agglomeration of China's tobacco industry is conducive to reducing industrial pollution emissions.**

**Keywords: agglomeration effect; tobacco industry; pollution discharge**
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## INTRODUCTION

In the past 40 years,China's tobacco industry has achieved steady and rapid growth. In 2019, the entire industry achieved 513.113 billion yuan in industrial and commercial taxes and profits, an increase of 55.926 billion yuan, an increase of 12.23%, and taxes and fees of 416.34 billion yuan, an increase of 86.46 billion yuan, an increase of 26.21%. However, the rapid economic development has paid serious environmental and energy costs. [1,2]

In China's economic development, industrial agglomeration has become a typical empirical fact. The academic circles have not reached a unified conclusion on the impact of the tobacco industry's agglomeration on environmental pollution.This article attempts to answer this question through an empirical study of the impact on tobacco industry agglomeration and industrial pollution emissions.[1,2,3,4]

The new economic geography theory regards the spatial aggregation structure as the result of the game of two forces (centripetal force and centrifugal force). [5]Centripetal force comes from local market effects, companies choose to gather in locations with larger market scales. The agglomeration generated by the agglomeration of a large number of enterprises further attracts more enterprises to concentrate in this location. When the scale of agglomeration brought about by external economic effects breaks

through a certain limit, the excessive competition and market crowding effect caused by excessive agglomeration will result in a decline in corporate income, and ultimately choose to decentralize operations and generate centrifugal force. Specifically, when transportation costs and transaction costs are reduced, a large number of external effects of the spatial aggregation of enterprises will further attract more enterprises to agglomerate in space. The externalities generated by enterprises due to spatial agglomeration provide a platform for the exchange of technology and knowledge between enterprises within the region, mutual learning and reference to promote enterprise technological innovation capabilities, and ultimately improve industrial production efficiency; in contrast, the separation of enterprise space makes external The effect is reduced.

The positive externalities brought about by economic agglomeration will reduce the unit cost of enterprise production.[6]The main reasons include the reduction of transportation costs per unit distance after the concentration of economic activities. Convenient business information will reduce transaction costs. Public goods (mainly infrastructure) can exert significant economies of scale and so on.[7] A large number of companies in the same industry or different industries conduct production activities in one area, so that companies can share knowledge spillovers and a more skilled labor market in this area; knowledge spillovers between different industries are an important source of original innovation; At the same time, the various facilities and equipment in areas with high concentration of economic activities are often more complete, so that each activity subject can share local facilities, which reduces the use cost of a single user; again, the agglomeration of diversified economic activities can make production factors There is a better match between users and owners. For example, for labor factors, economic agglomeration can reduce the cost of retraining workers to adapt to new positions after their careers and the cost caused by enterprises not being able to hire workers in time.

While producing positive externalities, agglomeration will also produce negative externalities, the congestion effect. Agglomeration may have a congestion effect due to environmental pollution, space and resource constraints, and congested traffic, telecommunications, and storage facilities.[8,9,10,11]When the degree of agglomeration is small, the positive externalities generated are greater than the negative externalities. Knowledge spillover effects, production specialization, sharing of advanced infrastructure in the location, and reduction of transportation costs can all promote production efficiency and economic growth. However, as the degree of agglomeration increases, the local economy cannot carry too many enterprise production, resulting in vicious competition among enterprises, which makes the negative externalities of industrial agglomeration surpass the positive externalities, which has an adverse effect on the economy. Therefore, the positive and negative externalities brought about by economic agglomeration exist and act simultaneously, which is the result of the combined effect of the promotion effect and the congestion effect.

China's tobacco industry has strong particularity in the national economy. It is in the the state of industry monopoly. It is for the above two reasons that adjusting the industrial structure, changing the direction of economic development, and improving the production efficiency of the entire industry are of great significance to the Chinese tobacco industry. Use industrial agglomeration to achieve specialized division of labor, form a skilled labor market, have forward and backward linkages with the local market, and have knowledge spillover effects. Among them, the professional services generated by the front-to-back association between the mature labor market and the industry have declined the production cost, and the agglomeration of the industry has promoted the development of the enterprise. The agglomeration of industries brought about by knowledge spillovers is a point influencing the agglomeration and development of the tobacco industry.[12]

Environmental pollution is accompanied by economic growth, and the existing research on environmental pollution and industrial agglomeration is quite

divided.Due to technological innovation and knowledge spillover effects, enterprises adopt more environmentally friendly production technologies and agglomeration can alleviate environmental pollution. "N" curve reflectsthe change of air pollution and manufacturing agglomeration. Industrial agglomeration has a threshold effect on environmental pollution.[13,14]

## MODEL SETTING AND VARIABLE DESCRIPTION

### Model Setting

The new economic geography model believes that under the interaction of local spillover effects, local market scale effects and crowding effects, there is an alternating development trend between spatial agglomeration and environmental pollution. The article draws on the method and constructs a dynamic panel data model to introduce spatial agglomeration variables into the Solow economic growth model to verify the relationship between the spatial agglomeration of the tobacco industry and industrial pollution emissions.

$$E_{it} = \beta_0 + \beta_1 E_{it-1} + \beta_2 A_{i,t} + \gamma X_{it} + \mu_i + \varphi_t + \varepsilon_{it} \quad (1)$$

Among them, $\mu_i$ and $\varphi_t$ are the fixed effects that do not change with time and province, respectively, $\varepsilon_{it}$ is a random error term; Eit represents the pollution emissions of the i-th industry in year t; A is the index vector of the spatial agglomeration measurement of the tobacco industry, which specifically includes the geographical concentration index ($agc_{i,t}$), spatial agglomeration level ($g_{i,t}$) and market potential ($mp_{i,t}$) indicators; Xit represents other control variables.

### Variable Description

(1) Industrial pollutant discharge: three pollution discharge indicators: industrial wastewater discharge (10,000 tons) water, sulfur dioxide discharge (tons) so2 and industrial dust discharge (tons) dust. Due to cancle the impact of scale differences on industry emissions levels, the author adopts pollution emissions per unit of total output.

(2) Indexes of spatial agglomeration of tobacco industry:

Index of geographic concentration (agc). Based on the Ellison-Glaeser spatial agglomeration index (EG index), a new index of geographic concentration was constructed by using the method:[15]

$$agc = \frac{GC}{GC^{\max}} = \left(\sum_{i=1}^{n} |s_{i-} a_i|\right) \Big/ 2(1 - a_{\min}) \quad (2)$$

Where,

$s_i$= the proportion of output of i sub-regions to that of the whole region;

$a_i$= the proportion of i sub-region area to the whole region area;

$a_{\min}$ = the area share of the smallest sub-region in an area;

In $GC = \sum_{i=1}^{n} |s_i - a_i|$, in order to reduce the total error, squared EG is treated as absolute value. By using the adjusted index of geographic concentration by the comparability of GC indexes in different regions can be improved, and the differences due to the size of sub-regions can be weakened.[15]

The concentration level of tobacco industry(p). According to another method, the spatial agglomeration level of tobacco industry is expressed by s employment density of tobacco industry in provinces and cities to total s employment of tobacco industry in the whole country, that is:[16]

$$g_{js} = l_{js} / (l_{cs} S_j)$$

Where,

$S_j$ =the area of the province;

$l_{js}$ = the employment number of tobacco industry in j Province;

$l_{cs}$ =the total employment of tobacco industry in China.

The index also examines the distribution pattern of tobacco industry among regions and sectors.

Market potential index(mp).

The development between regions will affect each other. For example, the regions with faster development will have positive external effects on the growth of the surrounding regional economy, that is, there is a spatial spillover effect. Market potential index is used to describe the degree of correlation between different regions when regional agglomeration occurs. Using the paper regards the potential of regional market as the weighted average sum of purchasing power of the market around it.[17]The relationship between weights and distances is inverse.

$$mp_i = \sum_{i \neq j} I_j / d_{ij} + I_i / d_{ii} \quad (3)$$

Where,

$I_j$=the income of region j;

$d_{ij}$ =the distance between regions i and j;

$d_{ii}$ =the internal distance of provincial region, that is, $d_{ii} = 0.66\sqrt{are_i / \pi}$ ,are represent the areas of provincial regions.

(3) Other control variables: capital to labor ratio (ten thousand yuan/person) kl; the average size of the enterprise (100 million yuan) fs, this article is based on the total industry; pollution control investment (ten thousand yuan), this article uses the current year's operating cost of sewage treatment facilities in various industries, wexp, to reflect the investment in sewage treatment[17,18,19,20].

## ANALYSIS OF MEASUREMENT RESULTS

The article performs differential GMM estimation on the model, and the results are shown in Table 1. (1) is listed as a benchmark model that does not include the spatial agglomeration variables of the tobacco industry and compares it with other models; (2)~(4) Listed as the regression results after the introduction of geographic concentration index (agc), industry intensity level (g) and market potential index (mp) three productive service industry spatial agglomeration variables; columns (5) and (6) gradually introduce production The regression result of the sex service industry density and market potential index. Through the specific analysis of the spatial agglomeration variables of the tobacco industry, the article can fully understand the influence of the spatial agglomeration changes of the tobacco industry on industrial pollution emissions.

Introducing the geographic concentration index (agc), industry concentration level (g) and market potential index (mp), the spatial agglomeration of the productive service industry has a significant negative impact on industrial wastewater, sulfur dioxide and industrial dust emissions. This shows that the increase in industrial agglomeration is conducive to reducing the emissions of these three pollutants. Agglomeration has brought about a knowledge spillover effect, which has led more companies to adopt more environmentally friendly production technologies. The knowledge spillover effect plays an important role in economic growth. This effect can make some relatively small companies accept the impact of large-scale R&D investment and jointly improve production efficiency. The knowledge spillover effect is affected by the range of spatial distance. One of the external economic agglomeration is to promote the diffusion of knowledge and the formation of new technologies. In places with high economic agglomeration, different companies can learn from each other, and the impact of R&D investment made by some companies can spread to those companies that are not capable of R&D through spillover effects. Economic agglomeration can strengthen competition between enterprises, promote effective communication and exchange of information, decline the information transmission, and improve the absorption of knowledge. Places with a higher degree of economic agglomeration usually have higher industrial diversification, and the agglomeration of many companies that are not directly related to each other in the space is more likely to give birth to new things. The reasons why agglomeration can alleviate environmental pollution are: First, the positive externalities brought about by industrial agglomeration will promote the technological progress of enterprises. Enterprises will realize the innovation of production process, and the process innovation can make the production process more intensive, reduce resource input, improve energy utilization efficiency, thereby reducing pollution emissions per unit of output; secondly,

industrial agglomeration promotes the division of labor among enterprises Collaboration is conducive to the formation of more complete resources. The use of the network to develop a circular economy increases the utilization of material resources, extends the flow chain of material resources in the system, thereby reducing pollution emissions; finally, the enterprises provides convenience for centralized pollution control.[21,22]

The introduction of control variables found that capital labor (kl), enterprise size (fs) and pollution control investment (wexp) all have a significant impact on pollution emissions. Enterprises with a high proportion of capital and labor. Economies of scale are conducive to technological progress and thereby reduce environmental pollution. Large enterprises have more funds and technology to invest in pollution control, thereby reducing environmental pollution[23,24,25].

**Table1**

**The Relationship between the Spatial Agglomeration of Tobacco Industry and Environmental Pollution Discharge**

| Explained variable | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | $\Delta E_{it}$ | $\Delta E_{it}$ | $\Delta E_{it}$ | $\Delta E_{it}$ | $\Delta E_{it}$ | $\Delta E_{it}$ |
| $lnagc_{it}$ | | -25.20*** (-3.22) | | | -105.45*** (-20.01) | -537.8*** (-25.11) |
| $lng_{it}$ | | | -4.60*** (-6.09) | | -1379.2*** (-2.39) | -29.88*** (-6.55) |
| $lnmp_{it}$ | | | | -22.9*** (-3.53) | | -47.77*** (-8.25) |
| **kl** | -0.066*** (4.99) | -0.773*** (-8.75) | -6.772*** (-29.88) | 0.066*** (4.35) | -0.718* (-7.06) | -7.99*** (-25.89) |
| **fs** | -0.024 (-0.021) | -5.889*** (-5.50) | 39.77*** (9.23) | -0.095** (-0.57) | -5.761*** (-2.98) | 29.33* (21.77) |
| **wesp** | -0.201*** (28.77) | -0.385 (0.798) | -0.028 (0.023) | -0.054*** (0.017) | -0.028 (0.030) | -0.033 (0.055) |
| **Constants** | 0.426 (0.127) | 0.856 (0.312) | 7.130 (2.268) | 1.780*** (0.287) | 0.333 (0.241) | 2.176*** (0.621) |
| **Wald Test** | 521.90 *** | 978.21 *** | 710.93 *** | 998.97 *** | 6532.01 *** | 2273.88 *** |
| **Samples** | 220 | 212 | 215 | 211 | 237 | 208 |

Note: *, **, *** mean significant at the 10%, 5%, and 1% significance levels respectively; the regression coefficients in parentheses are the corresponding parameter standard deviations.

## CONCLUSION

This paper uses the differential GMM method to empirically test with agglomeration of tobacco industry and industrial pollution emissions. This paper found that the spatial agglomeration effect of the producer tobacco industry has a positive externality on industrial pollution emissions. This shows that the centripetal force brought by spatial agglomeration is higher than the centrifugal force, the spatial agglomeration force is greater than the dispersion force, and the excessive spatial agglomeration brings Diffusion transfer did not appear. In the study of the dispersion of spatial agglomeration indicators, it is found that the spatial agglomeration of the productive service industry has a significant

negative impact on industrial wastewater, sulfur dioxide and industrial dust emissions. This shows that the increase in industrial agglomeration reduced the emissions of these three pollutants. Capital labor, enterprise scale, and pollution control investment all have a significant impact on pollution emissions.

## Conflicts of Interest Disclosure Statement

This research is not funded by any organization related to tobacco production.

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