An Empirical Research on the Agglomeration Relationship between Automotive Industry and Talents

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Abstract: Automotive industry is talent-intensive, for which strong mutual influence between industrial agglomeration and talent agglomeration is expected. Structural equation model is established based on the analysis of automotive industrial agglomeration and talent agglomeration endogenous measurable indicators. The correlation between automotive industrial agglomeration and talent agglomeration is analyzed using the data of China's 28 provincial-level administrative units over the recent 5 years. The study suggests that automotive industry agglomeration and talent agglomeration both pose positive effects on each other, and the influence of the former on the latter is greater than the latter on the former. Based on our analysis, we recommend that talent agglomeration should be promoted through multiple ways to realize industrial agglomeration.

Keywords: Automotive industry, Industrial agglomeration, Structural equation method, Talents agglomeration

1 Introduction

Resource agglomeration is the prerequisite to achieve the optimal allocation of resources and an important performance of high efficiency of economic operation [1，2]. China will implement the "Made in China 2025" strategy alongside an "Internet Plus" plan, based on innovation, smart technology, big data, cloud computing, the mobile Internet and so on. By the way, more efforts will be made to boost the integrated growth of productive services and the manufacturing sector, and improve the level and core competition of the manufacturing sector.

Industrial agglomeration is one of the world's mainstream model of economic development, and it is a strong driving force to promote regional economic development and enhance the competitiveness of industry, furthermore, it is the fundamental law of the world automotive industry development [3, 4]. Automotive industry agglomeration (AIA) is the inherent requirement to implement development. Firstly, automotive industry is a typical assembly manufacturing and each link involves different technology such as machinery, electronics, chemical industry, materials and so on. The automotive industry has a great connection effect following the vehicle product research, manufacturing and sales [5]. Thirdly, clustering maximizing production can help enterprises to reduce costs and make them better to meet the personalized needs of consumers. Industrial agglomeration development model is most suitable for long industry chain and circuitous complex industrial production way, these features are only suitable for manufacturing, and the automotive industry is most typical representative in the manufacturing industry [6]. This implies that industrial agglomeration is the most suitable for automotive industry meanwhile the development of automotive industry is the most in need of industrial agglomeration.

The phenomenon of industrial agglomeration is often accompanied by the phenomenon of talent agglomeration. Automotive talents play an important role in the development of automotive industry, and high quality talent is the key to realize China's automotive industrial independent innovation in the increasingly fierce competition environment [7, 8]. The Nobel Prize winner Krugman's "core-periphery" theory revealed the mutual relationship between talent agglomeration and industry agglomeration from the centrifugal and centripetal [9]. Sun's research showed that the industrial agglomeration and talent agglomeration is not independent from each other, but complement each other and promote each other. On the one hand, industrial agglomeration causes talents agglomeration. On the other hand, talent agglomeration can accelerate industrial talent development, so as to promote industrial agglomeration [10].

This paper focuses on exploring the endogenous index influence of AIA and automotive talent agglomeration (ATA). Firstly, the correlation between AIA and ATA is built by the structural equation modeling (SEM). Secondly, quantitative research and empirical study are conducted from perspective of effective synergy drive automotive industry development.

2 SEM Framework

The origins of SEM stem from factor analysis and path analysis. By integrating the measurement (factor analysis)

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and structural (path analysis) approaches, a more generalized analytical framework is produced, called SEM. In the past two decades SEM has quickly pervaded various fields, such as psychiatry, psychology, sociology, economics and so on [11].

The advantages of SEM include, but are not limited to, the ability to take into account measurement errors; model multiple dependent variables simultaneously; test overall model fit; estimate direct, indirect and total effects; test complex and specific hypothesis; handle difficult data [12].

Model identification is a fundamental consideration while specifying a SEM model. Two necessary conditions should always be checked which will provide a means for verification of identification [11].

The general structural equation model can be expressed by three basic equations:

$$\eta = \mathrm{B}\eta + \Gamma\xi + \zeta \quad (1)$$

$$Y = \Lambda_y \eta + \varepsilon \quad (2)$$

$$X = \Lambda_x \xi + \delta \quad (3)$$

The structural model (1) establishes the relationships or structural equations among latent variables η and ξ. The components of η and ξ are endogenous and exogenous latent variables, respectively. The latent variables η and ξ are connected by a system of linear equations with coefficient matrices B and Γ, as well as a residual vector ζ, where Γ represents effects of exogenous latent variables on endogenous latent variables, B represents effects of some endogenous latent variables on other endogenous latent variables, and ζ represents the regression residual terms. The equations (2) and (3) represent measurement models that define the latent variables from the observed variables.

The model estimation of SEM is on the foundation of maximum likelihood (ML) estimate. The ML estimator has five important properties. Firstly, ML estimates are unbiased, consistent and efficient. Secondly, the distribution of the parameter estimate approximates normal distribution as sample size increases. Thirdly, ML function is usually scale free. Finally, the ML fitting function $F_{ML}\left(\hat{\theta}\right)$ multiplied by $(n-1)$ approximates a χ^2 distribution under the assumption of multivariate normality and large sample size, and the model χ^2 can be used for testing overall model fit.

Model modification must be justified on a theoretical basis and empirical findings that are it should be both statistics-driven and theory-driven. In application of SEM, in the case of the initial model may be somewhat mis-specified, the possible sources of lack of model fit need to be assessed to determine what is specifically wrong with the model specification, then modify the model and re-test it using the same data.

3 AIA and ATA relevance model

3.1 The selection of variables

(a) The measurement of AIA

There are many measurements of industrial agglomeration, including *HTI* index, industry concentration, space coefficient and so on. In order to get the objectively reflection of industrial concentration degree, *HTI* is selected as the following format

$$HTI_{it} = S_{it} \Big/ \sum_{i=1}^{n} S_{it} \quad (4)$$

while S_{it} is the associated value for period t region i (vehicle production and automotive industrial output), n is the number of Chinese provincial administrative unit.

(b) The measurement of ATA

Automotive talents mainly include in basic and applied researchers in colleges universities and research institutes, automotive technology and R&D personnel in the enterprises, the enterprise operation and management personnel, automotive sales and service personnel and business performance significantly entrepreneur. Based on the analysis of previous studies, the automotive industry talents amount and fund input are selected as automotive talents observe variables.

3.2 Model formulation

Based on the above analysis, definitions of the variable involved in the model are shown in Tab. 1.

Tab. 1 Variable description

Latent variable	Observe variable
AIA	Vehicle production agglomeration index
	Automotive industrial output agglomeration index
ATA	Automotive industry talents fund input
	Automotive industry talents amount

The AIA and ATA SEM can be expressed in Fig. 1:

In the measurement model shown in Fig. 1, there are two latent variables ξ_1 and ξ_2, each of which is measured by a set of observed indicators. Observed variables x_1 and x_2 are indictors of the latent variable ξ_1, and x_3 and x_4 areindictors of the latent variable ξ_2. $\delta_i (i = 1,2,3,4)$ are the error items.

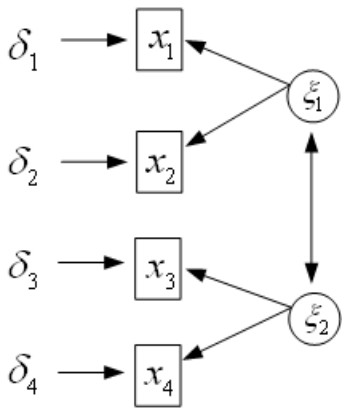

Fig.1 AIA and ATA model

3.3 Data collection and processing

In view of the SEM to the requirement of sample size, thus panel data and time series data are combined in this study to improve the accuracy of the model. Variable data of 5 years (from 2009 to 2013) in 31 provincial level administrative units are collected from China's national bureau of statistics and China automotive industry yearbook.

Due to the province of Tibet, Qinghai and Ningxia do not product vehicles, so we choose the data of the other 28 provincial level administrative units. In addition, due to the lack of automotive industrial output data of Hainan province in 2012, and data correction processing has been carried on the original data by interpolation method.

4 ATA and AIA model analysis

4.1 The selection of variables

The overall model evaluation should be done before interpreting the parameter estimates. Numerous model fit indices have been developed and some mainly indices are chosen. The χ^2 statistic is the original fit index for structural models. Goodness-of-fit index (GFI) expresses the variance matrix fitness for theory model and the sample data. Root mean square error of approximation (RMSEA) statistic: RMSEA is one of the most important tests of model fit.

Tab. 2 SEM model verification

Testing statics	Testing Results	Adaptation Standard
χ^2	1.161	
df	1	χ^2/df <3
χ^2/df	1.161	
GFI	0.995	0.9<GFI<1 The bigger GFI means better
RMSEA	0.038	RMSEA<0.05 well fitted RMSEA<0.08 reasonable fitted

The verification criteria, AIA and ATA model in SEM are shown in Tab. 2. The fitted results of the key criteria have achieved the appropriate adaptation and standards. This indicates that the SEM model is well fitted and qualified to be used in the research of this paper's topic.

4.2 Model fitting

As Tab. 3 shown positive effect vehicle production agglomeration index and automotive industrial output agglomeration index both have positive effect to AIA and their coefficient are 1.000 and 1.364. Furthermore automotive industry talents fund input and automotive industry talents amount benefits the ATA. The impacts coefficients are 1.000 and 0.896, respectively.

As can be seen from Tab. 4, there is a positive affect between AIA and ATA. AIA impacts automotive talent by the influence coefficient of 0.624, while the vice influence coefficient is 0.333.

Tab. 3 Fitting results of SEM

Endogenous measurable variables	AIA				ATA			
	Estimate	S.E.	C.R.	P	Estimate	S.E.	C.R.	P
Vehicle production agglomeration index	1.000	—	—	—				
Automotive industrial output agglomeration index	1.364	0.218	6.271	***				
Automotive industry talents fund input					1.000	—	—	—
Automotive industry talents amount					0.896	0.053	17.000	***

*** means that the regression weight in the prediction is significantly different from zero at the 0.001 level

Tab. 4 Correlation between endogenous variables

Impact path	Path coefficient	P
AIA→ATA	0.624	***
ATA→AIA	0.333	***

4.2 Result analysis

There is a positive promotion between AIA and ATA.

(a) Automotive talents can be attracted by AIA.

ATA need to be depends on AIA. AIA in specific local areas will create many job opportunities, and this inevitably leads human capital gathered around. The agglomeration of the automotive industry has increased the competition in the region. In order to survive in a competitive market, on one hand the enterprise must introduce professional and talented people as far as possible. On the other hand, developing new techniques and markets through the advantages of human resource and company capital helps to get high market share rate. Therefore the AIA is also attractive to automotive talents out of the industry area.

(b) ATA helps to promote the development of AIA.

ATA provide a good basis for clear and professional division of labor force. It makes the talents focusing more on their own work and improves the working efficiency. ATA will generate good talent effect, which is great significant for improving continuous innovation of the automotive industry. Therefore it will have an important impact on the development of the regional automotive industry as soon as effective measures to taken to enhance the agglomeration ability of automotive talents.

(c) AIA and ATA should organic interaction and jointly promote the development of China's automotive industry.

Currently under intense global competition, automotive industry has been in the critical period of industrial upgrading and restructuring. A shortage of highly qualified and highly skilled staff has become an important constraint. The Government should create a favorable policy environment, legal environment, humanistic environment and living environment for the automotive talents. Only in a suitable environment can the potential of the talents be stimulate extremely. Then the development of AIA can be further promoted by the advantage of the talent agglomeration and finally enhanced and maintained the competitive advantages.

Knowledge and technology spillover inspired by ATA makes the automotive industry obtain the new technology with the lowest cost, acquire new technology and dynamic industries in the shortest time, improve management and production efficiency. This helps the automotive industry cumulating the advantages and accounting dominant markets. The automotive industry will be gradually surrounded by the cooperated industry and suppliers and finally grows to be a larger automotive cluster.

Therefore under the background of the "Internet Plus", strengthen the training of cutting edge technology, shaping the ability of innovation and enhance the role of AIA and ATA will significantly promote the development of the automotive industry.

5 Conclusion

The relevance of automotive industrial agglomeration and talents agglomeration is refined according to structural equation modeling based on the China's automotive industry. Depending on the observe variables, a rich data is collected through 28 provincial level administrative units in five years to give a quantitative analysis to latent variables. The comprehensive analysis demonstrates AIA and ATA have strong relevance, and the influence of the former on the latter is greater than the latter for the former. Moreover, some policy suggestions are proposed from the perspective of improving the development of the automotive industry through promoting the role of AIA and ATA each other.

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