Empirical study on city-Industry Integration development based on Coupling system Model：a case of Nanchang

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Abstract **- the Integrated development of new industrialization, and urbanization is the inevitable requirement of China's economic development. In recent years, the problem of City-Industry disconnection become increasingly prominent.this paper combined the Chenery - Syrquin Industrialization and Urbanization Development Model with the Coupling System Mode, took industrialization and urbanization data of Nanchang from 2009 to 2012 as sample data, calculated the development stage of industrialization and urbanization, the coupling correlation degree and the coupling development degree.We fond industrialization and urbanization development of Nanchang should get into the stage of industrialization and urbanization interact slackly,the tertiary industry promotes the urbanization process,the City-Industry integration level is still in the early development stages of moderate coupling.This shows that during the rapid development process of industrialization and urbanization in Nanchang,integration status of them don not match the economic development, industrialization and urbanization still exist low correlation degree, low level of sustainable development status.**

Keywords-industrialization; urbanization ; city-Industry Integration; Coupling system Model

1. INTRODUCTION

The report of 18th Party Congress of China pointed out that we should keep to the Chinese-style path of carrying out industrialization in a new way and advancing IT application, urbanization and agricultural modernization. In recent years, as the sustained and rapid development of economy in China,the urban scale in many places expands continuously. However, in the process of pursuing industrial expansion and urban level improvement ,there is also the problem of City-Industry disconnection.Either the pursuing the cramming development of industry accumulation area,relying on single function of the park to improve the level of industrialization, only factories no towns, or take a pancake-style of towns expansion, only incorporating the non-agricultural areas surrounding urban into the city,lack of support industries. Obviously, this kind of mismatch phenomenon of industry and urban is totally inconsistent with strategy requires of positive interaction of industrialization and urbanization. Therefore, to explore the development mode of City-Industry Integration, and promote the coordinated development of industrialization and urbanization has great practical significance.

2. RELATED LITERATURE REVIEW

A.The Concept of City-Industry Integration

Region scientist in United States Al Sadd (1959)[1] put forward the concept of industrial complex. He argues that industrial complex is a set of industrial activities in a specific location,because these are technology,production,distribution and other aspects of contacts in these activities mutually and result in significant savings.Jane Jacobs (1961)[2]emphasizd the importance of functional complex for the urban development,which has important guiding significance for breaking stereotypes of isolation between industrial layout and urban functions brought by the original functional division, and promoting the integration of industry and city. Daogang Zhang(2011)[3] defined the concept of City-Industry Integration that industry is the foundation for the development of the city, city is the carrier of industry development. Liangjun Jin(2013) [4] thought City-Industry Integration is industry developed, city talents agglomerate in the region;then fully functional, modern facilities, beautiful environment, convenient travel and so on, eventually to realize the produce promote city, city gather produce, linkage and integration development of the city and produce.

B.The Development Model of City-Industry Integration

Yongliang Jin (2012) [5] analyzed the development trend of city-level energy improved by City-Industry Integration. Combined with the urban development situation of Guangzhou, analyzed the necessity of City-Industry Integration development in Guangzhou, the current main deficiencies, and put forward targeted development proposals. Na Yao, Zhuying Li (2012)[6] introduced the concept of City-Industry complex for mountain cities represented by Sichuan Guangyuan city, builded two modes of mountain city space layout - terrace growth mode and growth pattern and river valley, and studied the practical application of City-Industry complex in mountain city. Lijian Lin,Tangwei Teng (2014)[7] provided successful reference experience for China's science and technology park City-Industry Integration development by comparing the silicon valley and Hsinchu Science Park in the similarities and differences in aspects of motivation, mode and dynamic of City-Industry Integration.

C.Calculation of City-Industry Integration

Mohamad Ibrahim Mohamad, Mohammad Ali Nekooie, R. Taherkhani, A.L. Saleh, Shaiful Amri Mansur(2012)[8] used the SWOT analysis method to study the the interaction between industrialization and urbanization. Anjie Shi, FuLiang (2013)[9]analyzed the mutual influence between industrialization and urbanization by constructing the unitary linear regression model, fond the influence of industrialization on urbanization is positive and effects of urbanization on industrialization is significant. Fei Wang (2014)[10] constructed the evaluation index system of City-Industry Integration based on analytic hierarchy process, used comprehensive weight method and four grid quadrants to calculate the City-Industry Integration degree of 20 industrial agglomeration areas in Henan.

In conclusion, the domestic and foreign scholars have widely studied the concept ,the main mode and measurement methods of City-Industry Integration from the perspective of qualitative and quantitative.Among them, the City-Industry Integration concept has not been agreed, but common opinions exists , which emphasizes the coordination and interaction of both industrialization and urbanization to achieve convergence in terms on functionality,space and time.The main mode of City-Industry Integration mainly uses the specific city new district or park as the research object,analyzes its development present situation, characteristics, influencing factors, existing problems and countermeasures.In the determination of the City-Industry Integration, the domestic scholars mainly used quantitative methods to build evaluation system of City-Industry Integration, thus to produce mathematical support for the development of City-Industry Integration.

3. THE MODEL CONSTRUCTION

A. Model Selection

Coupling is a fundamental concept in physics, which is the phenomenon that two or more systems interact and influence on each other to combinate . Similarly, In the social sciences, we can also put two social phenomenas through some condition, so combine the two to play a role objective phenomenon, which is called coupling.The nature of the different categories of economic system generated by the respective coupling elements interact with each other from the effects of the economic system is defined as a couple.

1) Industrialization Stage : According to the definition of City-Industry Integration, industrialization ,urbanization and the relationship between them is the key to explore City-Industry Integration. The most common methods of industry stage division and characteristics of each corresponding phase is the Chenery Three-stage Method,as TABLE I[11]follows.

TABLE I Flag Values at Different Stages of Industrialization

Basic Indicators	Pre-industrial Stage (1)	Implementation Phase of Industrialization			Post-Industrial Stage(5)
		Early Industrialization(2)	Mid Industrialization(3)	Late Industrialization(4)	
Per capita GDP 2005 USD（PPP）	745-1490	1490-2980	2980-5960	5960-11170	11170 above
Three Industries Value Structure	A>I	A>20% A<I	A<20%, I>S	A<10% I>S	A<10% I>S
The Proportion of Primary Industry Employment	60% above	45%-60%	30%-45%	10%-30%	10% below
Population Urbanization Rate	30% below	30%-50%	50%-60%	60%-75%	75% above

Note: A represents the primary industry, I represents the second industry, S represents the tertiary industry, PPP represents the purchasing power parity.

2) Urbanization stage: The general division of urbanization development stage is Northam (1979) summed up the urbanization development S-curve ,and accordingly divided into three phases: the initial phase of low level and slow development of urbanization, accelerated phase of sharp rise in the level of urbanization, end-stage of high level and the flat development of urbanization.The cut-off point of the three stages of urbanization is 25% and 70%.

3) The Interaction between Industrialization and Urbanization: Famous economist Hollis B. Chenery and M. Seer Kun(1989)[12] proposed development model of urbanization and industrialization. The theory outlines the relationship between urbanization and industrialization is positive correlation.The development process is from close to relaxation.At Early stage, the development of urbanization drove by industrialization, after the industrialization rate and urbanization rate reached 13%, development of urbanization began to accelerate and exceed industrialization significantly. By late industrialization, the contribution of industrialization to urbanization showed a gradual weakening trend .

But the two theories just stay on the qualitative judgment on the relationship between industrialization and urbanization , and do not give the fusion of both determination. therefore ,on the basis of these two theories, by introducing the coupling mode of industrialization and urbanization, as the quantitative analysis indicators of City-Industry Integration degree ,for the analysis of the coordination of industrialization and urbanization, mutually reinforcing relationship analysis. This article focuses mainly on the industrial point of view, and therefore it is collectively referred to industrialization.

B. Model composition

According to the existing research, there is inherent correlation synergies in the two systems of industrialization

and urbanization, the collaboration of both can be measured and explained by Coupling Development Model.The degree of coupling reflects the coordination between industrialization and urbanization. We need analysis from time logic and spatial logic of industrialization and urbanization, analysis and evaluate coupling development relations.

1) Coupling Association Model: Coupling correlation degree of industrialization and urbanization system is the association degree of two systems which promote together and common develop on space logically. Primarily coupling association coefficients of two systems can be evaluated the by perspective of quantitatively, determine the degree of coupling.

2) Coupling Development Model: Coupling association degree of industrialization and urbanization system is the logical space of two systems ,which does not reflect the level of development entirely. Therefore, in some areas, if the industrialization and urbanization are low and approaching,we can get a high coupling conclusion. Therefore, we need to use the sustainable development model to determine its coupling degree from the angel of time.

C. Model Formulation

1) Coupling Association Model: Assume that variable factor "u_i"($i=1,2,\cdots m$),"u_j"($1,2,\cdots n$)mean the system,"C" is coupling correlation between industrialization and urbanization system,so multiple systems coupling model is:

$$C_n=\{(u_1 \cdot u_2 \cdots\cdots u_n)/\prod (u_i+u_j)\}1/n \quad (1)$$

When only two systems,the coupling association model is:

$$C=\{(u \cdot w)/(u+w)2\}1/2 \quad (2)$$

TABLE II Coupling Association Model[13]

Coupling Correlation	Type of Coupling	The Stage
C=0	No Coupling	Infancy
$0<C\leqslant 0.3$	Low Coupling	Growth Stage
$0.3<C\leqslant 0.7$	Moderate Coupling	Early Stages
$0.7<C<1$	Highly Coupled	Late Stage

2) Coupling Sustainable Development Model: According to the previous definition of sustainable development model, the coupling model of sustainable development as follows:

$$D=\sqrt{C \bullet T} \quad ,T=\alpha \cdot u+\beta \cdot w \quad (3)$$

"D"is sustainable development of the coupling,"C"is coupling correlation,"T"is comprehensive evaluation index of Industrialization and urbanization,α,β are undetermined parameters,$\alpha+\beta=1$. $D\in(0,1)$,In order to better measure of coordination between the two systems.

TABLE III Coupling Sustainable Development Model[14]

Sustainable Development of the Coupling	Coupling type of Sustainable Development	Sustainable Development of the Coupling	Coupling Type of Sustainable Development
0.00-0.009	Extreme Recession Development	0.50-0.59	Transition Development
0.10-0.19	Severe Recession Development	0.60-0.69	Primary Development
0.20-0.29	Moderate Recession Development	0.70-0.79	Moderate Development
0.30-0.39	Development mild Recession	0.80-0.89	Good Development
0.40-0.49	Brink of Recession Development	0.90-0.10	Quality Development

D. Indicators Selection

Principles of indicators selection including: can be quantified, truly and objectively, industry characteristics, focused highlighting, Therefore, taking into the account availability and representativeness of data,in this paper, we use industrialization rate(IND), which is the ratio of non-agricultural in GDP. Most indicators of the level of urbanization study use the urbanization rate (UBR)to reflect the population of the urban agglomeration procession and the degree of aggregation. This article is also used by the index to indicate the level of urbanization.

Industrialization Indicators (IND)= Non-agricultural output /GDP (4)

Urbanization Index(UBR) = Urban residents / The total population (5)

4. EMPIRICAL STUDY

A.The Development Stage of Industrialization and Urbanization of Nanchang

According to the flag value of the different stages of industrialization, we can preliminary determine the stage of industrialization of Nanchang:Based on the Per capita GDP index, it rose from $ 5,807.20 to $ 9,301.39 in Nanchang between 2009 and 2012,based on the indicator of the industrial structure, in four years, the proportion of the value of Primary Industry(A) in Nanchang decreased year by year, and far less than 10%, the proportion of A dropped to 4.9% in 2012, and the proportion of Secondary Industry is greater than Tertiary Industry(I>S), the proportion Secondary and Tertiary Industry accounted for 57.9:37.2; in the Employment Structure, the employment percentage in the Primary Industry is 22.2% at the end of 2012, more than 10% and less than 30%; from the perspective of spatial structure, the Urbanization of Population of Nanchang reached 68.78% in 2012. Based on the above four indicators, it can be seen that Nanchang already in the Late industrialization of the stage implementation phase in the Chenery model.

According to the data displayed, the urbanization rate in Nanchang(URB) From 63.17% in 2009 to 68.78% in 2012, according to Northam urbanization S-curve phase , Nanchang has been already in the bottom half of the acceleration stage which is steep rising, it very close to the final stage which the level of urbanization is high and the development is gentle. As shown in TABLE IV:

TABEL IV Major Industrialized Indicators in Nanchang

Indicator / Year	Per Capita GDP (Dollar)	Value Structure of the Three Industries	The Proportion of the Employment in Primary Industry	The Proportion of Urban Population to Total Population
2009	5807.20	6.0:55.4:38.6	25.4%	63.17%
2010	6493.98	5.5:56.7:37.8	24.4%	65.71%
2011	8209.42	5.0:58.8:36.2	23.5%	67.24%
2012	9301.39	4.9:57.9:37.2	22.2%	68.78%

B.Determination of City-Industry Integration of Nanchang

According to the above analysis of the present situation of industrialization and urbanization in Nanchang, at the end of 2012, the Per Capita GDP in Nanchang reached $ 9,301.39, the Secondary Industry accounted for 57.9%, the proportion of urban population to total population is 68.78%, the industrialization process is in the Late industrialization of the stage implementation phase in the Chenery model, the Urbanization is in the bottom half of the steep rising acceleration stage of Northam Urbanization S-Curve Phase. According to Chenery-Syrquin Industrialization And Urbanization Development Model, the relationship between industrialization and urbanization of Nanchang is in the relaxing stage, namely the development speed of urbanization is faster than industrialization, the pushing effect of industrialization dispute on the urbanization is gradually fade, the Tertiary Industry is more and more important. Here we use coupling model to measure the City-Industry Integration degree of Nanchang.

According to the Coupling Association Model and Coupling Sustainable Development Model, make U=IND, W= URB,Select calculated data of Nanchang industrialization and urbanization from 2009 to 2012 as sample data,take values of the coefficients α, β are 0.5,take the sample data into formula,the calculated results are shown in TABLE V:

TABLE V The Coupling of Industrialization and Urbanization of Nanchang

Index / Year	Industrialization Rate IND	Urbanization Rate URB	Coupling Correlation Degree C	Coupling Sustainable Development Degree D
2009	0.94	0.6317	0.4903	0.6207
2010	0.945	0.6571	0.4914	0.6274
2011	0.95	0.6724	0.4926	0.6321
2012	0.951	0.6878	0.4935	0.6359

Note: The data in TABLE V resulting from the coupling model formula and data calculated in TABLE IV.

Take the year of 2009 for example, the calculation of the Coupling correlation degree of industrialization and urbanization is as follows:

$C=\{(0.94\cdot0.6317)/(0.94+0.6317)2\}\cdot1/2=0.4903$

The Coupling sustainable development degree of Industrialization and urbanization :

$D=\sqrt{0.4903\bullet0.7859}=0.6207$

$T=\alpha\cdot u+\beta\cdot w=0.5\cdot(0.94+0.6317)=0.7859$

Overall, the coupling of industrialization and urbanization of Nanchang is moderate coupling, the primary development type.By the 2012, Coupling Correlation Degree is 0.4935 and the coupling of sustainable development is 0.6359.Referring to the above Coupling Correlation Degree classification, C between 0.3-0.7 is moderate coupling, Coupling Sustainable Development Degree between 0.6-0.69 is the primary development type.Currently the City-Industry integration degree of Nanchang is still in the early stages of development. In this stage, the interactive effect of industrialization and urbanization is significant. Industrialization is the main driven force of urbanization process, urbanization promotes industrialization in turn.This phase corresponds to the the middle stage of industrialization and urbanization,which Obviously lags behind the above judgment stage of industrialization and urbanization development in Nanchang.

5. CONCLUSION

In accordance with the above qualitative analysis of the status of industrialization and urbanization in Nanchang,we can find industrialization and urbanization development of Nanchang should get into the stage of industrialization and urbanization interact slackly,the tertiary industry promotes the urbanization process.The consistent City-Industry integration degree should be highly coupling in the late development stage ,however, the actual calculated City-Industry integration level is still in the early development stages of moderate coupling. This shows that during the rapid development process of industrialization and urbanization in Nanchang, integration status of them don not match the economic development,industrialization and urbanization still exist low correlation degree and low level of sustainable development status.

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