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On the Evolution Rule for Regional Industrial Structure Based on the Stochastic Process Theory

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Abstract
This paper studied the regional industrial structure evolution rules by the theory of stochastic process. The regional industrial structure changes depend on market demands, technological progress and production factors flow, policy value orientation and other factors which are random variables (RVs). Regional industrial structure evolves as a stochastic process and this process is influenced by the market demand, technological progress and production factors flow, the policy value orientation and other RVs.

Key words: Regional industrial structure; Evolution rule; Stochastic process

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INTRODUCTION

The major factors which restrict the stable, rapid, sustainable development of economic are structural issues. Regional economic development depends largely on the rationality of regional industrial structure. The optimized and upgraded industrial structure is the internal variables of economic growth. The imbalance of the industrial structure seriously hinders the normal development of the regional economy. Therefore, it is optimized industrial structure that promotes the economic quality and improves regional motivation, an important path to improve the regional economic competitiveness. However, the effort to adjust the industrial structure is far from satisfactory. The main reason resides in the cognition deficiency of the industrial structure evolution rule. The evolution of regional industrial structure, as an objectively existence, follows certain rules. To find out its evolution rule, we should not only describe and analyze industrial structure evolution process representation, but also its regularity and the causation. Only by the way, can we analyze and study of the essence of regional industrial structure evolution and effectively solve the new topic that has emerged in the regional industrial structure adjustment under the influence of the global financial crisis, global climate change, human survival environment degradation and other effects. In the regional industrial structure evolution rule, there still exist many mysteries need us to explore.

1. THE ESSENCE OF THE INDUSTRIAL STRUCTURE EVOLUTION

In fact, the regional industrial structure changes depend on market demands, resource potentials, technological progress, production factors flow, the policy value orientation and other factors, these factors themselves are RVs, they are all the internal variables that decide the essence of the industrial structure evolution. Therefore, regional industrial structure evolution actually is a stochastic process that is influenced by the market demands, resource potentials, technological progress and production factors flow, the policy value orientation and other RVs[1].

1.1 RV Set $\{X_i(t)\}$ of Regional Industrial Structure Evolution

Industrial system is made of several traditional industries and new industries form in a region in a period, as time goes on, regional industrial structure evolves from a state to other state under a common associated integrated influence of the various factors (variables) , this evolution shows the compositions of each industry departments and the Proportional relation changes in industry system, This evolution also contains formation of some emerging industries and elimination of some declining industries. The formation and development process of some industry departments is a process that social capital and labor aggregate and constantly change the combination patterns in the industry departments under the action of the market mechanism. When an industry department was eliminated by the market, its industrial capital and labor would outflow and gradually decline and even leave this industrial system through the property right market and labor market. Therefore, industrial capital and industrial labor are the two internal variables that decide the industrial development; they are also the basic internal variables that decide the state of a regional industrial structure. For a concerned industry, because the two variables would increase and decrease or flow at any time through market, obviously, they are RVs. Denote industrial capital RVs by $X_K(t)$, denote industry labor RVS by $X_L(t)$.[2]

1.2 Transition Probability and Matrix of the RVs

1.2.1 Transition Probability and Matrix for the Industrial Capital

According to stochastic process theory, we assume that $X_K(t)$ is the total capital at time t in a region industry (composition of n industry departments), and it has following construction: $\{X_{1,K}(t), X_{2,K}(t), X_{3,K}(t), ..., X_{i,K}(t), ..., X_{n,K}(t)\}$.

At time t+1, the total capital becomes $X_K(t+1)$ in this region industry (composition of m industry departments), and it has following distribution: $\{X_{1,K}(t+1), X_{2,K}(t+1), X_{3,K}(t+1), ..., X_{j,K}(t+1), ..., X_{m,K}(t+1)\}$.

Obviously, during the interval time when t→(t+1), Industrial capital goes $X_K(t) \rightarrow X_K(t+1)$, the probability of $X_{i,K}(t) \rightarrow X_{j,K}(t+1)$ is:

$$P\{X_{i,K}(t) \rightarrow X_{j,K}(t+1)\} = P\{X_{j,K}(t+1)/X_{i,K}(t)\} = p_{K(j/i)}$$

where $1 \le i \le n, 1 \le j \le m$, which shows the transition probability that industrial capital $X_{(i,K)}(t)$ in some i industry at time t becomes $X_{(j,K)}(t+1)$ in j industry at next step t+1. We denote R_1, R_2, R_3 by the Emerging, continued, eliminated industry set, respectively.

We suppose that $|R_1|=u$, $|R_2|=h$, $|R_3|=v$, So we have the following block transition probability matrix:

$$P_K = \begin{array}{c} \\ R_{1K}(t) \\ R_{2K}(t) \\ R_{3K}(t) \end{array} \begin{array}{c} \begin{array}{ccc} R_{1K}(t+1) & R_{2K}(t+1) & R_{3K}(t+1) \end{array} \\ \begin{bmatrix} I & 0 & 0 \\ P_{KR_1} & P_{KR_2} & P_{KR_3} \\ 0 & 0 & I \end{bmatrix} \end{array} \quad (1)$$

where I is the unit matrix of approximate dimension.

$$P_{KR_1} = \begin{array}{c} \\ R_{21,K}(t) \\ R_{22,K}(t) \\ \vdots \\ R_{2i,K}(t) \\ \vdots \\ R_{2h,K}(t) \end{array} \begin{array}{c} \begin{array}{cccccc} R_{11,K}(t+1) & R_{12,K}(t+1) & \cdots & R_{1e,K}(t+1) & \cdots & R_{1u,K}(t+1) \end{array} \\ \begin{bmatrix} p_{K(R_{11}/R_{21})} & p_{K(R_{12}/R_{21})} & \cdots & p_{K(R_{1e}/R_{21})} & \cdots & p_{K(R_{1u}/R_{21})} \\ p_{K(R_{11}/R_{22})} & p_{K(R_{12}/R_{22})} & \cdots & p_{K(R_{1e}/R_{22})} & \cdots & p_{K(R_{1u}/R_{22})} \\ \vdots & \vdots & & \vdots\ \vdots & \vdots\ \vdots & \\ p_{K(R_{11}/R_{2i})} & p_{K(R_{12}/R_{2i})} & \cdots & p_{K(R_{1e}/R_{2i})} & \cdots & p_{K(R_{1u}/R_{2i})} \\ \vdots & \vdots & & \vdots\ \vdots & \vdots\ \vdots & \\ p_{K(R_{11}/R_{2h})} & p_{K(R_{12}/R_{2h})} & \cdots & p_{K(R_{1e}/R_{2h})} & \cdots & p_{K(R_{1u}/R_{2h})} \end{bmatrix} \end{array}$$

$p_K(R_{1e}/R_{2i})$ is the probability that the industrial capital in i Continued industry at time t evolve to the e emerging industry at time t+1. When v>h we add zero raw in P_{KR1} Otherwise; we add zero column.

$$P_{KR_2} = \begin{array}{c} \\ R_{21,K}(t) \\ R_{22,K}(t) \\ \vdots \\ R_{2i,K}(t) \\ \vdots \\ R_{2h,K}(t) \end{array} \begin{array}{c} \begin{array}{cccccc} R_{21,K}(t+1) & R_{22,K}(t+1) & \cdots & R_{2j,K}(t+1) & \cdots & R_{2h,K}(t+1) \end{array} \\ \begin{bmatrix} p_{K(R_{21}/R_{21})} & p_{K(R_{22}/R_{21})} & \cdots & p_{K(R_{2j}/R_{21})} & \cdots & p_{K(R_{2h}/R_{21})} \\ p_{K(R_{21}/R_{22})} & p_{K(R_{22}/R_{22})} & \cdots & p_{K(R_{2j}/R_{22})} & \cdots & p_{K(R_{2h}/R_{22})} \\ \vdots & \vdots & & \vdots\ \vdots & \vdots\ \vdots & \\ p_{K(R_{21}/R_{2i})} & p_{K(R_{22}/R_{2i})} & \cdots & p_{K(R_{2j}/R_{2i})} & \cdots & p_{K(R_{2h}/R_{2i})} \\ \vdots & \vdots & & \vdots\ \vdots & \vdots\ \vdots & \\ p_{K(R_{21}/R_{2h})} & p_{K(R_{22}/R_{2h})} & \cdots & p_{K(R_{2j}/R_{2h})} & \cdots & p_{K(R_{2h}/R_{2h})} \end{bmatrix} \end{array}$$

$$P_{KR_3} = \begin{array}{c} \\ R_{21,K}(t) \\ R_{22,K}(t) \\ \vdots \\ R_{2i,K}(t) \\ \vdots \\ R_{2h,K}(t) \end{array} \begin{array}{c} \begin{array}{cccccc} R_{31,K}(t+1) & R_{32,K}(t+1) & \cdots & R_{3s,K}(t+1) & \cdots & R_{3v,K}(t+1) \end{array} \\ \begin{bmatrix} p_{K(R_{31}/R_{21})} & p_{K(R_{32}/R_{21})} & \cdots & p_{K(R_{3s}/R_{21})} & \cdots & p_{K(R_{3v}/R_{21})} \\ p_{K(R_{31}/R_{22})} & p_{K(R_{32}/R_{22})} & \cdots & p_{K(R_{3s}/R_{22})} & \cdots & p_{K(R_{3v}/R_{22})} \\ \vdots & \vdots & & \vdots\ \vdots & \vdots\ \vdots & \\ p_{K(R_{31}/R_{2i})} & p_{K(R_{32}/R_{2i})} & \cdots & p_{K(R_{3s}/R_{2i})} & \cdots & p_{K(R_{3v}/R_{2i})} \\ \vdots & \vdots & & \vdots\ \vdots & \vdots\ \vdots & \\ p_{K(R_{31}/R_{2h})} & p_{K(R_{32}/R_{2h})} & \cdots & p_{K(R_{3s}/R_{2h})} & \cdots & p_{K(R_{3v}/R_{2h})} \end{bmatrix} \end{array}$$

$p_{K(R3s/R2i)}$ is the probability that the industrial capital in i Continued industry at time t evolve to the s eliminated industry at time t+1. When v>h, we add zero raw inP_{KR3}; Otherwise, we addzero column.

In this region, the relation between the industrial total capital $X_K(t)$ at time t and $X_K(t+1)$ at time t+1 is:

$$X_K(t+1)=X_K(t)+\Delta X_K\ (t \rightarrow t+1) \quad (2)$$

Where $\Delta X_K(t \rightarrow t+1)$ is the increment sum from the social capital investment in this industry system and the foreign direct investment in the industry at this interval time?

1.2.2 Transition Probability and Matrix for the Industrial Labor

We assume that $X_L(t)$ is the total labor at time t in a region industry (composition of n industry departments), and it has following construction: $\{X_{1,L}(t), X_{2,L}(t), X_{3,L}(t), ..., X_{i,L}(t), ..., X_{n,L}(t)\}$.

At time t+1, the total labor is $X_L(t+1)$ in this region industry (composition of m industry departments), and it has following construction: $\{X_{1,L}(t+1), X_{2,L}(t+1), X_{3,L}(t+1), ..., X_{j,L}(t+1), ..., X_{m,L}(t+1)\}$.

Obviously, during the interval time when $t\rightarrow(t+1)$, industrial labor goes $X_L(t)\rightarrow X_L(t+1)$, the probability of $X_{i,L}(t)\rightarrow X_{j,L}(t+1)$ is: $P\{X_{i,L}(t)\rightarrow X_{j,L}(t+1)\}=P\{X_{j,L}(t+1)/X_{i,L}(t)\}=p_{L(j/i)}$.

Where $1\le i\le n, 1\le j\le m$, this shows the transition probability that industrial labor $X_{i,L}(t)$in some i industry at time t evolve to some j industry at time t+1. So we have the following block transition probability matrix:

$$P_L = \begin{array}{c} \\ R_{1L}(t) \\ R_{2L}(t) \\ R_{3L}(t) \end{array} \begin{array}{c} \begin{array}{ccc} R_{1L}(t+1) & R_{2L}(t+1) & R_{3L}(t+1) \end{array} \\ \begin{bmatrix} I & 0 & 0 \\ P_{LR_1} & P_{LR_2} & P_{LR_3} \\ 0 & 0 & I \end{bmatrix}_{3r\times 3r} \end{array} \quad (3)$$

$$P_{LR_1} = \begin{array}{c} \\ R_{21,L}(t) \\ R_{22,L}(t) \\ \vdots \\ R_{2i,L}(t) \\ \vdots \\ R_{2h,L}(t) \end{array} \begin{array}{c} \begin{array}{ccccc} R_{11,L}(t+1) & R_{12,L}(t+1) & \cdots & R_{1e,L}(t+1) & \cdots & R_{1u,L}(t+1) \end{array} \\ \begin{bmatrix} p_{L(R_{11}/R_{21})} & p_{L(R_{12}/R_{21})} & \cdots & p_{L(R_{1e}/R_{21})} & \cdots & p_{L(R_{1u}/R_{21})} \\ p_{L(R_{11}/R_{22})} & p_{L(R_{12}/R_{22})} & \cdots & p_{L(R_{1e}/R_{22})} & \cdots & p_{L(R_{1u}/R_{22})} \\ \vdots & \vdots & & \vdots\ \vdots & \vdots\ \vdots & \\ p_{L(R_{11}/R_{2i})} & p_{L(R_{12}/R_{2i})} & \cdots & p_{L(R_{1e}/R_{2i})} & \cdots & p_{L(R_{1u}/R_{2i})} \\ \vdots & \vdots & & \vdots\ \vdots & \vdots\ \vdots & \\ p_{L(R_{11}/R_{2h})} & p_{L(R_{12}/R_{2h})} & \cdots & p_{L(R_{1e}/R_{2h})} & \cdots & p_{L(R_{1u}/R_{2h})} \end{bmatrix} \end{array}$$

$p_{L(R1e/R2i)}$ is the probability that the industrial capital in i Continued industry at time t evolve to the e emerging industry at time t+1.

$$P_{LR_2} = \begin{array}{c} \\ R_{21,L}(t) \\ R_{22,L}(t) \\ \vdots \\ R_{2i,L}(t) \\ \vdots \\ R_{2h,L}(t) \end{array} \begin{array}{c} \begin{array}{ccccc} R_{21,L}(t+1) & R_{22,L}(t+1) & \cdots & R_{2j,L}(t+1) & \cdots & R_{2h,L}(t+1) \end{array} \\ \begin{bmatrix} p_{L(R_{21}/R_{21})} & p_{L(R_{22}/R_{21})} & \cdots & p_{L(R_{2j}/R_{21})} & \cdots & p_{L(R_{2h}/R_{21})} \\ p_{L(R_{21}/R_{22})} & p_{L(R_{22}/R_{22})} & \cdots & p_{L(R_{2j}/R_{22})} & \cdots & p_{L(R_{2h}/R_{22})} \\ \vdots & \vdots & & \vdots\ \vdots & \vdots\ \vdots & \\ p_{L(R_{21}/R_{2i})} & p_{L(R_{22}/R_{2i})} & \cdots & p_{L(R_{2j}/R_{2i})} & \cdots & p_{L(R_{2h}/R_{2i})} \\ \vdots & \vdots & & \vdots\ \vdots & \vdots\ \vdots & \\ p_{L(R_{21}/R_{2h})} & p_{L(R_{22}/R_{2h})} & \cdots & p_{L(R_{2j}/R_{2h})} & \cdots & p_{L(R_{2h}/R_{2h})} \end{bmatrix} \end{array}$$

$$P_{LR_3} = \begin{array}{c} R_{21,L}(t) \\ R_{22,L}(t) \\ \vdots \\ R_{2i,L}(t) \\ \vdots \\ R_{2h,L}(t) \end{array} \begin{bmatrix} p_{L(R_{31}/R_{21})} & p_{L(R_{32}/R_{21})} & \cdots & p_{L(R_{3s}/R_{21})} & \cdots & p_{L(R_{3v}/R_{21})} \\ p_{L(R_{31}/R_{22})} & p_{L(R_{32}/R_{22})} & \cdots & p_{L(R_{3s}/R_{22})} & \cdots & p_{L(R_{3v}/R_{22})} \\ \vdots & \vdots & & \vdots\ \vdots & \vdots\ \vdots & \\ p_{L(R_{31}/R_{2i})} & p_{L(R_{32}/R_{2i})} & \cdots & p_{L(R_{3s}/R_{2i})} & \cdots & p_{L(R_{3v}/R_{2i})} \\ \vdots & \vdots & & \vdots\ \vdots & \vdots\ \vdots & \\ p_{L(R_{31}/R_{2h})} & p_{L(R_{32}/R_{2h})} & \cdots & p_{L(R_{3s}/R_{2h})} & \cdots & p_{L(R_{3v}/R_{2h})} \end{bmatrix}$$

$p_{L(R3s/R2i)}$ is the probability that the industrial capital in i Continued industry at time t evolve to the s eliminated industry at time t+1. In this region industry, the relation between the industrial total capital $X_L(t)$ at time t and $X_L(t+1)$ at time t+1 is:

$$X_L(t+1)=X_L(t)+\Delta X_L(t\rightarrow t+1) \quad (4)$$

Where $\Delta X_L(t\rightarrow t+1)$ is the increment sum from the social labor inputs in this industry system and the foreign direct labor inputs in this industry at this interval time.

2. THE DRIFT RULE OF THE PRODUCTION ELEMENTS

2.1 The Drift Rule of the Industrial Capital

Under the market economy condition, an important market rules is equivalence capital must obtain equivalence profits. If capital in an industry department would not get the same amount of profit, interest would drive it from low interest industry department to the profit high industry department.

In some region industry at time, total industrial capital $X_K(t)$ has n industry department:

$$X_K(t)=[(X_{1,K}(t)\ (X_{2,K}(t)\ ...\ X_{i,K}(t)\ ...\ X_{n,K}(t)] \quad (5)$$

$$X_K(t) = \sum_{i=1}^{n} X_{i,K}(t) \quad (6)$$

Total industrial capital has the distribution structure in every industry department is:

$$G_K(t)=[(g_{1,K}(t)\ g_{2,K}(t)\ ...\ g_{i,K}(t)\ ...\ g_{n,K}(t)] \quad (7)$$

Where $g_{i,K}(t)= x_{i,K}(t)/x_K(t)$

In some region industry at time t+1, total industrial capital $X_K(t+1)$ has m industry department:

$$X_K(t+1)=[X_{1,K}(t+1)\ X_{2,K}(t+1)\ ...\ X=_{j,K}=(t+1)\ ...\ X_{m,K}(t+1) \quad (8)$$

$$X_K(t+1) = \sum_{j=1}^{m} X_{j,K}(t+1) \quad (9)$$

Total industrial capital has the distribution structure in every industry department is:

$$G_K(t+1)=[g_{1,K}(t+1)\ g_{2,K}(t+1)\ ...\ g_{j,K}(t+1)\ )\ ...\ g_{m,K}(t+1)] \quad (10)$$

Where $g_{j,K}(t+1)=x_{j,K}(t+1) / x_K(t+1)$, during $t\rightarrow t+1$, industrial capital in i industry department evolve to j industry department by the transition probability $p_{ij,K}$ and transition probability matrix P_K. Therefore, the drift process of the industrial capital RV is ,
and the drift rule reflected in process is:

$$X_K(t+1)=X_K(t)*P_K+\Delta X_K(t+1) \quad (11)$$

$$\Delta X_K(t+1)=[\Delta X_{1,K}(t+1)\ \Delta X_{2,K}(t+1)\ ...\ \Delta X_{j,K}(t+1)\ ...\ \Delta X_{m,K}(t+1)]$$

For $\Delta X_{j,K}(t+1)$ establish GM (1,1) model based on time series:
$\{\Delta x_{j,K}(t-6), \Delta x_{j,K}(t-5), \Delta x_{j,K}(t-4), \Delta x_{j,K}(t-3), \Delta x_{j,K}(t-2), \Delta x_{j,K}(t-1), \Delta x_{j,K}(t)\}$

$$\frac{d(\Delta x_{j,K})^{(1)}}{dt} + a(\Delta X_{j,K})^{(1)} = u \quad (12)$$

$$\text{Or} \quad (\widehat{\Delta x_{j,K}})^{(0)}(t+1) = -a\left((\Delta x_{j,K})^{(0)}(1) - \frac{u}{a}\right) e^{-at} \quad (13)$$

Where $\begin{bmatrix} a \\ u \end{bmatrix}=B^TB^{-1}B^TZ_N$ [3]

The changes of the distribution structure of the total industrial capital among industrial departments are

$\{G_K(t) \xrightarrow{\tau,\theta} G_K(t+1), t\epsilon T, \Omega\}$

Where τ, θ are market mechanism and Government industrial policy value orientation ,respectively.

2.2 The Drift Rule of the Industrial Labor

"People go to high, water flows downwards" is a natural law. By the establishment and consummation of the labor market, the industrial labor would transfer labor from remuneration low industrial departments to labor remuneration high industrial departments.

In some region industry at time t, total industrial labor $X_L(t)$ has industry department is:

$$X_L(t)=[X_{1,L}(t)\ X_{2,L}(t)\ ...\ X_{i,L}(t)\ ...\ X_{n,L}(t)] \quad (14)$$

$$X_L(t) = \sum_{i=1}^{n} X_{i,L}(t) \quad (15)$$

Total industrial labor has the distribution structure in every industry department is:

$$G_L(t)=[g_{1,L}(t)\ g_{2,L}(t)\ ...\ g_{i,L}(t)\ ...\ g_{n,L}(t)] \quad (16)$$

Where $g_{i,L}(t)=x_{i,L}(t)/x_L(t)$

In some region industry at time t+1, total industrial labor $X_L(t+1)$ has m industry department:

$$X_L(t+1)=[X_{1,L}(t+1)\ X_{2,L}(t+1)\ ...\ X_{j,L}(t+1)\ ...\ X_{m,L}(t+1)] \quad (17)$$

$$X_L(t+1) = \sum_{j=1}^{m} X_{j,L}(t+1) \quad (18)$$

Total industrial labor has the distribution structure in every industry department is:

$$G_L(t+1)=[g_{1,L}(t+1)\ g_{2,L}(t+1)\ ...\ g_{j,L}(t+1)\ ...\ g_{m,L}(t+1)] \quad (19)$$

Where $g_{j,L}(t+1)=X_{j,L}(t+1)/X_L(t+1)$

during t→t+1, industrial labor in i industry department evolve to j industry department by the transition probability $p_{L(j/i)}$ and transition probability matrix P_L. Therefore, the drift process of the industrial labor RV is $\{X_L(t) \xrightarrow{P_L} X_L(t+1), t\epsilon T, \Omega\}$, and the drift rule reflected in process is:

$$X_L(t+1)=X_L(t)*P_L+\Delta X_L(t+1) \quad (20)$$

$\Delta X_L(t+1)=[\Delta X_{1,L}(t+1)\ \Delta X_{2,L}(t+1)\ ...\ \Delta X_{j,L}(t+1)\ )\ ...\ \Delta X_{m,L}(t+1)]$

For $\Delta x_{j,L}(t+1)$ establish GM (1, 1) model based on time series:

$\{\Delta x_{j,L}(t-6), \Delta x_{j,L}(t-5), \Delta x_{j,L}(t-4), \Delta x_{j,L}(t-3), \Delta x_{j,L}(t-2), \Delta x_{j,L}(t-1), \Delta x_{j,L}(t)\}$

$$\frac{d(\Delta X_{j,L})^{(1)}}{dt} + a(\Delta X_{j,L})^{(1)} = u, \quad (21)$$

Or $$\widehat{(\Delta x_{j,L})}^{(0)}(t+1) = -a\left((\Delta x_{j,L})^{(0)}(1) - \frac{u}{a}\right)e^{-at} \quad (21)$$

The changes of the distribution structure of the total industrial labor among industrial departments are $\{G_L(t) \xrightarrow{\tau,\theta} G_L(t+1), t\epsilon T, \Omega\}$.

Where τ, θ are market mechanism and Government industrial policy value orientation ,respectively.

3. CHANGE RULE OF INDUSTRIAL SYSTEM OPERATION MODE

Under the market mechanism, the action of operation mode of regional industry system Ω_i at time t depends on the industrial capital $X_{i,K}(t)$, industrial labor $X_{i,L}(t)$, technological progress $X_{i,A}(t)$ and other variables, in the industry system these variables has the following combination :

$f(X_{i,A}(t), X_{i,K}(t), X_{i,L}(t)/X_{i,A}(t), X_{i,K}(t), X_{i,L}(t) \in \Omega_i(t), t \in T)$

According to Cobb – Douglas production function model, the action of operation mode of regional industry system Ω_i at time t is:

$$Y_i(t)=X_{i,A}(t)*[X_{i,K}(t)]^{\alpha(t)}*[X_{i,L}(t)]^{\beta(t)} \quad (23)$$

Where α(t) and β(t) is the elasticity of $X_K(t)$ and $X_L(t)$ with respect to $Y_i(t)$, respectively. When $\alpha(t)+\beta(t)>1$, this shows that industry is Increasing Return to Scale, its technology progress will accelerated, Innovation ability and self-development capabilities will increased, Other industries capital and labor force will flow to this industry department in the next period; when $\alpha(t)+\beta(t)<1$,this shows that i industry is Decreasing Return to Scale, its technology progress will decelerated, innovation ability and self-development capabilities will declined, its capital and labor force will flow to other industry departments in the next period; when $\alpha(t)+\beta(t)=1$, this shows that i industry is Constant Return to Scale, its capital and labor force will be in this industry department for a period of time and watch the industry development situation, once conditional changed , it would go to other industry departments profit higher. similarly, the action of operation mode of regional industry system Ω_i at time t+1 is:

$$Y_i(t+1)=X_{i,A}(t+1)*[X_{i,K}(t+1)]^{\alpha(t+1)}*[X_{i,L}(t+1)]^{\beta(t+1)} \quad (24)$$

During t→t+1, the change rule of the action of operation mode is:

Where τ, θ are market mechanism and government industrial policy value orientation, respectively. Under the associated action and comprehensive effects of the market mechanism and the government industrial policy value orientation, this change process is realized by the industrial capital, industrial labor and industrial technology development and other factors that associated changes occurred in accordance with established target.

Management as the behavior process enlarges the

$$\left\{[f_t((X_A(t), X_K(t), X_L(t)), \Omega(t), T)] \overset{\tau,\ \theta}{\Longrightarrow} \left[f_{t+1}\left((X_A(t+1), X_K(t+1), X_L(t+1)), \Omega(t+1), T\right)\right]\right\}$$

industrial system function, entrepreneurs and managers always try to cultivate and expand market space by technological innovation and system innovation, in order to achieve $\alpha(t)$ and $\beta(t)$, they strive to change $\alpha(t)$ and $\beta(t)$ so as to realize the transition and change from $f_t(\cdot)$ to $f_{t+1}(\cdot)$.

4. THE EVOLUTION RULE OF REGIONAL INDUSTRIAL STRUCTURE

Because of industrial capital, industrial labor and technology progress and other RVS, under the associated action and comprehensive effect of the Market mechanism and industrial policies, the state obey stochastic process drifts subject to stochastic process along with the change of market economy, in consequence, according to (11), (20) and (24), regional industrial structure also obey the evolution of the stochastic process that decided by the industrial capital and industrial labor input.

We assume that regional industry system at time has an industry departments, the state of the industrial structure $G_Y(t)$ is:

$$G_Y(t)=[g_{1,Y}(t)\ g_{2,Y}(t)\ \dots\ g_{i,Y}(t)\ \dots\ g_{n,Y}(t)] \qquad (25)$$

Where $g_{i,Y}(t+1)=Y_i(t+1)/\sum_{i=1}^{n} Y_i(t+1)$.
For three industries, we have: $G_Y(t)=[g_{1,Y}(t)\ g_{2,Y}(t)\ g_{3,Y}(t)\ ]$, where $g_{i,Y}(t+1)=Y_i(t+1)/\sum_{i=1}^{n} Y_i(t+1)$.

During the interval t→t+1, the state of the industrial structure evolves from $G_Y(t)$ to $G_Y(t+1)$. At time t+1, there are m industry departments in the regional industry system and the state of the industrial structure $G_Y(t+1)$ is:

$$G_Y(t+1)=[g_{1,Y}(t+1)\ g_{2,Y}(t+1)\ \dots\ g_{j,Y}(t+1)\ \dots\ g_{m,Y}(t+1)] \qquad (26)$$

Where $g_{j,Y}(t+1)=Y_j(t+1)/\sum_{j=1}^{m} Y_j(t+1)$.
The rule and the evolution of the regional industrial structure is: $\left\{G_Y(t) \xrightarrow{X_K(t), X_L(t), X_A(t), \tau, \theta} G_Y(t+1)\right\}$.

5. THE EMPIRICAL ANALYSIS TO THE STOCHASTIC EVOLUTION OF THE REGIONAL INDUSTRIAL STRUCTURE

On the basis of statistical data, Using Delphi Method to select 30 experts$\sum_{j=1}^{m} Y_j(t)$ing evaluation, we obtained transition probability matrix of the 2008 Guangxi industrial capital and industrial labor in three industries

$P_K =$

	The first	The second	The third
The first	0.51	0.01	0.48
The second	0.01	0.73	0.26
The third	0.02	0.13	0.85

$P_L =$

	The first	The second	The third
The first	0.90	0.01	0.09
The second	0.13	0.67	0.20
The third	0.12	0.25	0.63

The 2008 Guangxi industrial capital is 2725.9923 billion Yuan,[4] the distribution in three industries is
$X_K(2008)=[100.7149\quad 1426.8853\quad 1198.3921]$,
$G_K(2008)=[3.69\%\quad 52.35\%\quad 43.96\%]$,

The 2008 Guangxi industrial Industry labor is 2799 million, and the distribution in three industries is:
$X_L(2008)=[1528\quad 424\quad 847]$,
$G_L(2008)=[54.59\%\quad 15.15\%\quad 30.26\%]$,
Using the grey forecasting model GM (1, 1):
$\Delta\widehat{X}_K(2009) = -a\left(\Delta X_K(2003) - \frac{u}{a}\right) e^{-at}$
We got the increment of the 2009 Guangxi industrial capital
$\Delta\widehat{X}_k(2009) = 1619.6633(\text{Billion yuan})$,
And the increment vector of 2009 Guangxi industrial labor:
$\Delta\widehat{X}_K(2009) = [39.4588\quad 515.7838\quad 1102.6930]$,
The distribution structure of the total industrial capital increment in three industries is
$\Delta\widehat{G}_K(2009) = [2.38\%\quad 31.11\%\quad 66.51\%]$,
Using the similar method, we built grey forecasting model
$\Delta\widehat{X}_L(2009) = -a\left(\Delta X_L(2003) - \frac{u}{a}\right)e^{-at}$
we obtained the increment of the 2009 Guangxi industrial labor
$\Delta\widehat{X}_L(2009) = 50.49(\text{million})$,
The increment vector of the 2009 Guangxi industrial labor
$\Delta\widehat{X}_L(2009) = [6.8061\quad 28.7894\quad 14.8946]$,
The distribution structure of the total industrial labor increment in three industries is
$\Delta\widehat{G}_L(2009) = [13.48\%\quad 57.02\%\quad 29.50\%]$,
In consequence, we obtained respectively the 2009 regional industry capital and industrial labor distributions state:
$\widehat{G}_K(2009) = [0.0328\quad 0.4397\quad 0.5275]$,
$\widehat{G}_L(2009) = [0.5473\quad 0.1826\quad 0.2701]$,
According to the historical data, we received the Guangxi three industries technical progress factor A and the output elasticity α, β of the industrial capital and industrial labor, respectively :

$A = [0.1863\quad 0.3978\quad 0.2286]$,
$\alpha = [0.3828\quad 0.8632\quad 0.6238]$,
$\beta = [0.8933\quad 0.4283\quad 0.5897]$,

According to Cobb - Douglas production function model (20), we obtained the 2009 Guangxi added value in three industries (billion Yuan) :

$\hat{Y}_{2009} = \begin{bmatrix} 1462.2421 & 3408.2785 & 2872.1836 \end{bmatrix}$,

We received the regional industrial structure:

$\hat{G}^{(Y)}_{2009} = \begin{bmatrix} 18.89\% & 44.02\% & 37.09\% \end{bmatrix}$.

Statistical data shows that the 2009 Guangxi actual added value in three industries (billion Yuan) is[5]

$Y_{2009} = \begin{bmatrix} 1458.49 & 3381.54 & 2919.13 \end{bmatrix}$,

Actual industrial structure is

$G^{(Y)}_{2009} = \begin{bmatrix} 18.80\% & 43.58\% & 37.62\% \end{bmatrix}$,

We can see, the theoretical prediction results $\hat{G}^{(Y)}_{2009}$ is very close to the Actual data $G^{(Y)}_{2009}$. Therefore, using the stochastic process theory and method to study of regional industrial structure evolution and its rule, to observe and analyze the essence of the change in industrial structure, is a very good way.

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