

# The Research of the Coupling Degree Between Social Insurance and Economic Development in China

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## ABSTRACT

This paper chooses 8 economic development evaluation indicators and 14 social insurance evaluation indicators to explore the status quo and internal coupling and coordination of social insurance and economic development investment in the 10 years from 2007 to 2016 by means of combining the principal component analysis with other relevant coordination degree models (General Coupled Coordination Model, Grey Coupled Coordination Model and Entropy Variable Equation Method). Internal coupling and coordination of shape and development speed. The results show that the two subsystems developed from extreme imbalance in 2007 to high quality coordination in 2016, but the growth rate of social insurance lagged behind the economic development slightly. Based on the above empirical analysis results, the corresponding conclusions are drawn.

**Keywords:** social insurance, economic development, coupling, coordination

## 1. INTRODUCTION

As an important part of social security, social insurance and its adaptability to social and economic development deserve wide attention. On the one hand, social insurance, as a "social stabilizer", provides a stable social environment for economic development, and to a certain extent, influences the allocation of labor resources by guaranteeing the physical, psychological and technical qualities of workers, and then influences economic development. In addition, the consumption behavior of social insurance will directly stimulate the economic development of the country or the local area. On the other hand, economic development also plays an indispensable role in the development of social insurance, that is, the necessary level of economic development is the material basis and objective conditions for the development of social insurance, and the relationship between them should be complementary, mutually reinforcing and mutually restrictive.

There are relatively few qualitative studies on the relationship between social insurance and economy. Zheng Bingwen[1] believes that the high social insurance premium rate in China will not be conducive to economic growth under the new normal. Social security, especially social insurance, has a far-reaching impact on consumption ability, confidence and risk[2]. Hu Ying and Zhang Guang[3] use relevant theories to explore the impact of social insurance on economic growth through intermediary transmission factors of consumption, savings, investment and human capital investment. In the study of the relationship between the coverage of basic old-age insurance and the level of economic development in Western China, He Jian and others[4] considered that economic level was a positive and important factor, while Zhang Luqin and Jing Qinyuan[5] analyze the impact of endowment insurance on economic growth based on the new growth theory model. Lu Chengchao et al. [7] found that the scale of social insurance has a significant short-term negative effect on economic growth based on the spatial-temporal effect and

decomposition of dynamic spatial white model. Berger and Xi Youmin[7] used computable general equilibrium model to calculate the results show that social insurance is beneficial to economic growth. Seal-in and others used dynamic models to verify the relationship between economic globalization and social insurance level[8]. Hu Ying and Ye Xiaohua's [9] social insurance fund expenditure and economic growth are two-way positive relations. However, some scholars advocate that when the level of economic development is low, residents' consumption will be restrained[10]. Previous studies mainly focused on the influencing factors and efficiency between social insurance and economic development, but lacked the interaction between social insurance and economic development. Therefore, this paper focuses on the timing study of the coupling and coordinated development of social insurance and economic development.

## 2. THE METHOD AND INDEX SYSTEM

### 2.1. The Method

#### 2.1.1. General Coupled Coordination Model

Firstly, the comprehensive evaluation model index of economic development and social insurance subsystems, efficacy function, is established. The calculation formula is as follows:

$$U_s = \sum_{j=1}^n \lambda_{sj} u_{sj} \quad (1)$$

$U_s$  represents the comprehensive evaluation index of subsystems. When  $S$  is 1 or 2, it represents the comprehensive evaluation index of economic development

subsystem and social insurance subsystem respectively.  $\lambda_{sj}$  represents the weight of index  $j$ th of subsystem  $S$  and it is calculated by principal component analysis.  $U_{sj}$  represents the  $j$ th index of the  $S$  subsystem. Linear function normalization method is used to process the data index.

$$X_{norm} = \frac{X - X_{min}}{X_{max} - X_{min}} \quad (\text{benefit-oriented indicators}) \quad (2)$$

$$X_{norm} = \frac{X_{max} - X}{X_{max} - X_{min}} \quad (\text{cost-based indicators}) \quad (3)$$

The coupling model formula is as follows:

$$C = 2 \times \sqrt{\frac{U_1 \times U_2}{(U_1 + U_2)^2}} \quad (4)$$

In the above formula,  $C$  indicates the degree of coupling between economic development and social insurance.  $U_1$  and  $U_2$  represent the comprehensive evaluation level of economic and social insurance respectively.

Without multiplying coefficient 2, the maximum value of the formula can only reach 0.5 (that is,  $U_1 = U_2$ ). In order to reflect the coordinated development level between economic development system and social insurance system, the mathematical expression of the model is as follows:

$$D = \sqrt{C \times T} \quad , \quad T = \alpha U_1 + \beta U_2 \quad (5)$$

$D$  is the coordination degree of the two systems.  $T$  represents the comprehensive coordination index of the economic development system and the social insurance system. It reflects the contribution of the economic development system and the social insurance system to the coordination degree of the two systems.  $A$  and  $B$  are the undetermined coefficients.

### 2.1.2. Grey Coupled Coordination Model

On the basis of formulas (2) and (3), the standardized differences among the indicators are calculated.

$$\Delta i(t) = |X_h(t) - X_I(t)| \quad (6)$$

Among them,  $t$  denotes the year,  $X_h(t)$  denotes the standardized economic index data and  $X_I(t)$  denotes the standardized social insurance index data. According to the standardized difference, the correlation coefficients among the indicators were calculated.

$$\epsilon_i(t) = \frac{\min \min \Delta i(t) + \rho \max \max \Delta i(t)}{\Delta i(t) + \rho \max \max \Delta i(t)} \quad (7)$$

$\epsilon_i(t)$  shows the correlation between economic development and social insurance system indicators. The average correlation data between indicators is the coupling degree between economic development system and social insurance system.

$$C(t) = \frac{1}{m \times 1} \sum_{i=1}^m \sum_{h=1}^i \epsilon_i(h)(t) \quad (8)$$

$C(t)$  is the coordination degree of economic development and social insurance, which reflects the coordination of

economic development and social insurance in the process of system development.

### 2.1.3. Entropy Variable Equation Method

Economic development and social insurance are dissipative structures, which follow the entropy equation. Entropy equation method uses the following criteria to judge the coordinated state of economic development and social insurance. Let

$$\Delta H(t) = H(t) - H(t-1) \quad (9)$$

$$\Delta I(t) = I(t) - I(t-1) \quad (10)$$

In formula (6) and (7),  $\Delta H(t)$  reflects the change of comprehensive evaluation score of economic development, and  $\Delta I(t)$  reflects the change of comprehensive evaluation score of social insurance. In the empirical analysis, there may be the following four situations.

Firstly, the situation of  $\Delta H(t) \geq 0$  and  $\Delta I(t) \geq 0$  indicates that the economy is developing continuously and social insurance is developing continuously. At this time,  $t$  (year) will fall in the first quadrant, and the two systems of economy and social insurance will be coupled and coordinated.

Secondly, the situation of  $\Delta H(t) \leq 0$ ,  $\Delta I(t) \leq 0$  indicates that both economic and social insurance are declining. At this time, the coupling system between economic development and social insurance tends to decline.

Thirdly, the situation of  $\Delta H(t) > 0$ ,  $\Delta I(t) < 0$  and  $|\Delta I(t) / I(t-\Delta t)| > \epsilon$  shows that while the economy is developing continuously, social insurance is declining dramatically. At this time, it is said that the development of economic development and social insurance are in conflict.

Finally, the situation of  $\Delta H(t) > 0$ ,  $\Delta I(t) > 0$  and  $|\Delta H(t) / I(t-\Delta t)| > \epsilon$  shows that social insurance is increasing while the economy is declining. At this time, economic development and social insurance are in conflict.

## 2.2. Index System

The indicators selected for economic development are GDP per capita (RMB), added value of tertiary industry (100 million yuan), added value of tertiary industry (%), contribution rate of tertiary industry to GDP (%), end-of-year balance of RMB savings deposits of urban and rural residents (100 million yuan), incidence rate of rural poverty (%) and consumption level index of urban residents (last year = 100), consumption level index of rural residents (last year = 100).

The indicators of the social insurance system are the income of social insurance fund (RMB 100 million), the expenditure of social insurance fund (RMB 100 million), the number of people participating in basic endowment insurance (10,000 people), the number of people participating in basic medical insurance (10,000 people), the number of people participating in unemployment insurance (10,000 people), the number of people participating in industrial injury insurance (10,000 people), and the number of people participating in maternity insurance. Numbers (tens of thousands of people), number of unemployment insurance

participants (tens of thousands of people), income of basic pension insurance fund (100 million yuan), expenditure of basic pension insurance fund (100 million yuan), income of basic medical insurance fund (100 million yuan), expenditure of basic medical insurance fund (100 million yuan), income of unemployment insurance fund (100 million yuan), and expenditure of unemployment insurance fund Output (yuan), income of industrial injury insurance fund (billion yuan), expenditure of industrial injury insurance fund (100 million yuan), income of reproductive insurance fund (100 million yuan), expenditure of reproductive insurance fund (100 million yuan), and expenditure of reproductive insurance fund (100 million yuan).

### 3. COORDINATION TIME SERIES ANALYSIS OF ECONOMIC DEVELOPMENT AND SOCIAL INSURANCE

The economic development system and the social insurance system have achieved a relatively high growth rate in 2010 and thereafter. From the comparison of economic development and social insurance score, the economic development score is slightly higher than the social insurance score in 2007-2010. After 2010, the social insurance score has increased greatly, surpassing the economic development. Scoring.

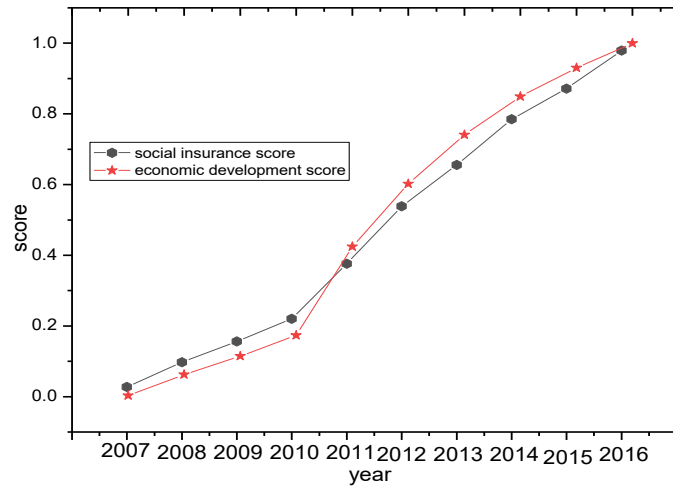


Figure 1 Economic Development and Social Insurance System Score from 2007 to 2016

#### 3.1. Analysis of General Coupling Coordination Degree

The development types of economic development and social insurance subsystems are shown in Table 2.

**Table 2** Classification Criteria for the Coordinated Development of Economic Development and Social Insurance

area	D	Contrastive relationship between U1 and U2	level	type	
harmonious development zone	0.900-1.000	①	High-quality and coordinated development of social insurance lagging behind	1	
		②	High-quality and coordinated development of social insurance and economic synchronization	2	
		③	High-quality and coordinated development type of economic lag	3	
	0.800-0.899	①	Good and coordinated development of social insurance lagging behind	4	
		②	Good coordinated development of social insurance and economic synchronization	5	
		③	Good and coordinated development type of economy lagging behind	6	
	0.700-0.799	①	Intermediate coordinated development social insurance development lagging type	7	
		②	Intermediate coordinated development social insurance develops economic synchronization	8	
		③	The economic lag type of intermediate harmonious development	9	
transition zone	0.600-0.699	①	Primary coordinated development type of social insurance lagging behind	10	
		②	Primary harmonious development social insurance develops economic synchronization	11	
		③	Primary coordinated development type of economic lag	12	
	0.500-0.599	①	Reluctantly coordinate the development of social insurance lagging behind	13	
		②	Reluctant coordinated the development of social insurance and economic synchronization	14	
		③	Reluctant coordinated development type of economy lagging behind	15	
	disorder recession zone	0.400-0.499	①	On the verge of coordinated social insurance development lagging behind	16
			②	On the verge of coordinated development, social insurance develops synchronously with economy	17
			③	On the verge of coordinated development type of economic lag	18
0.300-0.399		①	Development lag type of social insurance with slight disorders	19	
		②	Slightly disorders development type social insurance develops economy synchronously	20	
		③	The economic lag type of slight disorders development	21	
0.200-0.299		①	Moderate disorders development type social insurance development lag type	22	
		②	Moderate disorders development social insurance develops economic synchronization	23	
		③	Moderate disorders development type of economic lag	24	
0.100-0.199	①	Serious disorders of social insurance development lagging behind	25		
	②	Serious disorders development type social insurance development economic synchronization type	26		
	③	Serious disorders of the development type of economic lag	27		
0-0.099	①	Extreme disorders development type of social insurance lagging behind	28		
	②	Extreme disorders development type social insurance development economy synchronization type	29		
	③	Extremely imbalanced development type of economic lag	30		

Note:①stands for  $U1 < U2$ ,② stands for  $U1 = U2$ ,③ stands for  $U1 > U2$ .

According to the scoring results of the general coupling coordination degree model, the coupling coordination degree

and its types of economic and social insurance between 2007 and 2016 are shown in table 3.

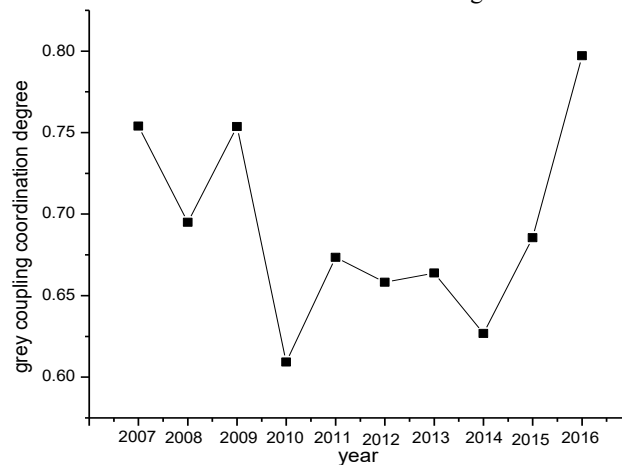
**Table 3** Coordination of Economic and Social Insurance Coupling in 2007-2016

year	U1	U2	D	Degree of coordination	type
2007	0.027	0.003	0.009	extreme disorders	30
2008	0.097	0.062	0.078	extreme disorders	30
2009	0.156	0.115	0.134	serious disorders	27
2010	0.220	0.173	0.196	serious disorders	27
2011	0.376	0.425	0.400	mild disorders	19
2012	0.539	0.602	0.570	barely disorders	13
2013	0.656	0.741	0.697	barely disorders	10
2014	0.785	0.849	0.817	good disorders	4
2015	0.871	0.931	0.901	good disorders	1
2016	0.979	1.000	0.989	good disorders	1

From Table 3, we can see that the coupling and coordination degree of economic development system and social insurance has a good development momentum in the past ten years. From the extremely imbalanced development in 2007 to the high-quality coordination in 2016 through the stages of extreme disorders, serious disorders, mild disorders, barely disorders, barely disorders and good disorders. As far as the score of the two systems is concerned, since 2011, the score of the economic development system of our country has been lower than that of the social insurance system for many years. We should try to narrow the gap between the two systems and realize the long-term stable and coordinated development of the two system.

### 3.2. Grey Coupling Coordination Degree Analysis

Based on the theory of grey coupling coordination degree mentioned above, using formulas (2) and (3), the indexes of economic development system and social insurance system are dealt with dimensionlessly. Using formulas (6) and (7), the correlation degree between the indexes of economic development and social insurance system is more than 0.6, so the reason is that the correlation degree between the indexes of economic development and social insurance system is greater than 0.6. It is concluded that economic development has a significant correlation between the two systems of social insurance. Grey coupling coordination degree can be analyzed. The curve of grey coupling coordination degree for the ten years from 2007 to 2016 is shown in Figure 2 below.

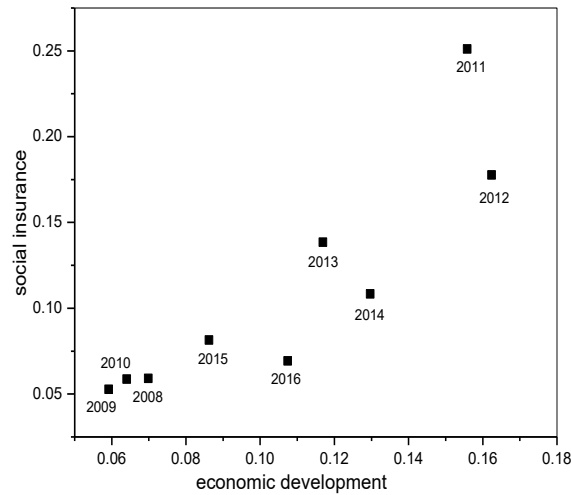


**Figure 2** Gray Coupling Degree of Economic and Social Insurance from 2007 to 2016

The coordinated dispatch of the development speed of the two systems has no obvious regularity and trend in the 10 years from 2007 to 2016, but the momentum in the past two years is more optimistic, showing an increasing trend and reaching the highest level in 2016.

### 3.3. Analysis of Entropy Variable Equation Method

Based on the above scoring results of the two systems from 2007 to 2016, and according to the above formulas (9) and (10), the entropy equation model of economic development and economic two systems is obtained as shown in Figure 3.



**Figure 3** The Coordination Level between Social Insurance and Economic System in 2007-2016 under the Entropy Variable Equation Method

The data of all years from 2008 to 2016 fall in the first quadrant. The two subsystems of economic development and social insurance are developing in a coordinated way, and they are in a relatively coordinated development state.

#### 4. CONCLUSION

This paper establishes the comprehensive evaluation index of economic development and economic system, and carries on the analysis of the indexes of economic development and economic subsystem by the method of entropy value. General coupling coordination model, Grey coupling coordination model and Entropy equation method are used to calculate the coordination degree of economic development and economic two systems in the 10 years from 2007 to 2016. The results show that there is no discrepancy in the description of the coordinated development of China's economic development and economic system calculated by the three methods. Over the past decade, the degree of coordination between China's economic development and economic system has been in the stage of development. Whether the score of coordination degree of general coupling coordination degree model is increased, or the result of coordination degree of development speed of two systems reflected by Grey coupling coordination degree model, or the result of entropy equation method model is in each year along the way. The quadrant position. From 2007 to 2016, the coordinated development between China's economic development and economy has gone through the following stages. From 2007 to 2011, China's economic development and economy are in the stage of continuous development. During this stage, the coordination degree between the development speed of 2007 and 2009 is relatively high, while 2011. The coordination of development speed in the past 10 years is at the lowest level, and China's economic system score catches up with and surpasses the economic development score for the first time in 2011; 2012 and 2013 are transitional areas of coordination degree between the two systems, and the coordination of development speed of the two systems has not changed much; 2013-2016 is the coordination area, and the economic development and economic system are in harmony.

Dispatching has been developing continuously, and reached the highest coordinated development speed of the two systems in 2016. In a word, the degree of coordination between the two systems has been increasing in the past decade, and the degree of coordination of development speed has changed complex, but both of them are positive. Generally speaking, the coupling and coordination degree between social insurance and economic development is constantly improving, but the development speed of social insurance is lower than that of economic development, which is related to the problem of social insurance premium evasion that China has been trying to solve but has not completely eliminated. The problem of fee evasion directly affects the normal operation and development of social insurance. Local governments should pay close attention to the living conditions of local enterprises, especially small and medium-sized enterprises, reduce unnecessary tax burden, provide strong conditions for the development and growth of enterprises, and make room for enterprises to pay social insurance premiums honestly. In the aspect of improving the enthusiasm of workers to pay fees, we should pay special attention to the non-participation of informal employment workers in social insurance. In order to encourage them to increase their willingness to participate in social insurance, we should pay more attention to the protection of their labor remuneration, strengthen training and customize flexible methods of participating in social insurance.

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