# Game Analysis on Coordinated Development in Beijing and Tianjin and Poverty-stricken Around Beijing and Tianjin

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**Abstract:** The existence of poverty belts around Beijing and Tianjin restricts ecological security and economic development in Jing-Jin-Ji (Beijing-Tianjin-Hebei) regions. This paper defines firstly the scope of poverty belts around Beijing and Tianjin, and regarding on Beijing and Tianjin and the poverty belts around Beijing and Tianjin as the study area, then selects dynamic model and static model in perfect information, applies respectively to the game analysis on relationship of the Central government and local governments, of local governments by using game theory methods, finally draws the appropriate conclusions to promote regional coordinated development.
**Keywords:** Beijing and Tianjin, Poverty Belt around Beijing and Tianjin, Central Government, Local Governments, Game Theory

## 1. Introduction

Due to historical and subjective and objective, and many other reasons, a belt of poverty where poor population is concentrated is formed in northern border areas of Hebei Province, where is connecting Beijing and Tianjin. The poverty belt is the most serious level of poverty in China's eastern coastal areas, while is a typical ecological fragile areas for harsh natural conditions, which not only constrains the ecological safety, urban construction and economic development in Jing-Jin-Ji areas, will also affect regional economic development in North China. Therefore, for the Beijing-Tianjin and around Beijing and Tianjin poverty belt, how to coordinate with the regional development, both to ensure the ecological safety of the Beijing-Tianjin region and promote poverty belt around Beijing and Tianjin's economic development is a serious problem to be solved.

### 1.1 Definition of the study area

In this paper, Beijing-Tianjin and poverty belts around Beijing and Tianjin are the study areas. Beijing-Tianjin refers to Beijing and Tianjin, according to the Asian Development Bank technical assistance project in the “Third Eye Hebei”, the definition of poverty belts is the poor regions in northern Hebei Province, around Beijing and Tianjin, including 32 poor counties, 3798 poor villages, 2.726 million poor people. This 32 poor counties are all located in Hebei Province, an area of 83,000 square kilometers, located in Zhangjiakou and Chengde, Yanshan with the dam, Taihang Mountain area in the west of Beijing-Guangzhou railway , Cangzhou, Heilonggang area.

### 1.2 Summary of other researchers at home and abroad

The Asian Development Bank Technical Assistance Unit in the "Third Eye HeBei" (2004), put forward firstly the concept and define the scope of poverty belts around Beijing and Tianjin, then analysis the causes and effects of poverty belt around Beijing and Tianjin , put forward that establishing a special district for eco-economic model is effective solution to eliminate poverty belt in the end , but which does not analyze their interests and behavior choices in greater depth of the Beijing-Tianjin and around Beijing and Tianjin areas. Mu Aiying, Wu Jianqi (2007) from the perspective of game theory, arrives at the best game strategic choice all levels of government through the establishment of the corresponding analysis model, but which regarding Jing-Jin-Ji metropolitan area as study scope, aiming at regional cooperation among cities. To sum up, the research that regards the Beijing-Tianjin and poverty belts around Beijing and Tianjin as research scope, and analyze in-depth the interests of the governments by using game theory, and promotes coordination mechanism of regional cooperation, is very rare in the previous study. This is the focus of my study.

## 2. Game analysis on Beijing and Tianjin and poverty-stricken around Beijing and Tianjin

Game theory is to study on choosing their own strategy in order to maximize their own interests in the situation of mutual influence. The coordinated development of Jing-Jin-Ji is the interaction of strategy of governments in order to maximize their own interests in cases interdependence, involving the social benefit, ecological benefits and economic benefits. The central government, local governments of research field have each put forward their own interest demands that can be integrated with each other side, but may lead to conflict: the central government wishes to promote regional integration and narrow regional development gap to maintain social stability; the governments of Beijing and Tianjin region request to gain more natural and economic resources form the region around Jing-Jin to improve the ecological environment and realize economic modernization; the government around Beijing and Tianjin aims to accept the economic radiation from Beijing-Tianjin , and speed up their own economic development. This will eventually form a multi-party game relationship between the central government and local governments, and of the local governments.

## 3. Game analysis between the central and local governments

### 3.1 Game Model Selection

The central government and local governments are the players. The game strategy of central government is Whether and how to implement the preferential policies, and specific policies can be divided into two kinds: policy inclination and policy-neutral strategy; The local government's strategy is to strive hard for the pilot area to take advantage of favorable policies for the development of regional economy if preferential policies can bring enough benefit. According to the policy of the central government, local governments can choose the positive and negative implementation. Because in this game, the players choose their own strategies with the order, that is, the central government makes policy firstly, and then local governments choose how to implement policies. Therefore, this dynamic model of perfect information that is used to the analysis, as game-tree (Figure 1 to represent)

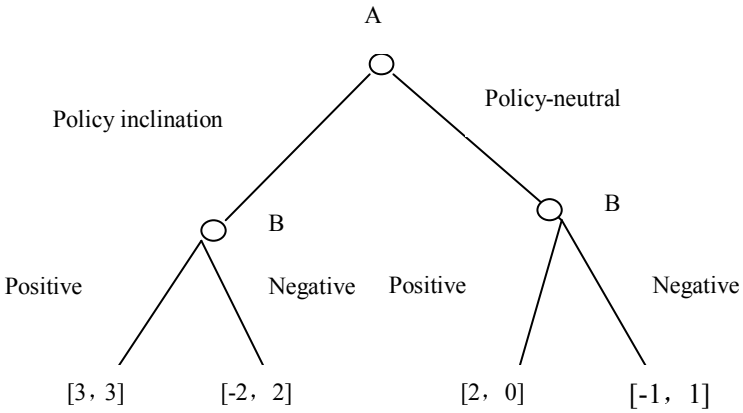


**Figure 1 game tree between central and local governments**

“A” represents the central government, their choice of strategy is to provides policy inclination or policy-neutral. “B” is on behalf of local governments of jing-jin-ji region, their choice of strategy is a active use or passive treatment, and represent respectively to “positive” and “negative” in Figure1. The actions sequence of game is: A operates Firstly, Then “B” choose their own strategy after observing the selection of A. (3, 3), (-2, 2), (2, 0), (-1, 1) is the payments central and local governments gaining from

the game.

### 3. 2 Sub-game perfect Nash equilibrium

Nash equilibrium of Sub-game request that equilibrium strategies are the best response in each given information set for the opponent, thus avoiding that the player implements an empty threat by using not the best response strategy. Figure 2 shows that the game can be decomposed into two sub-games, shown in Figure 2.

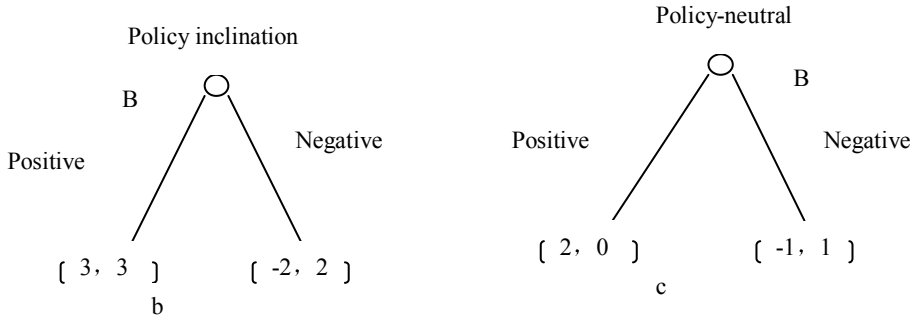


**Figure 2 two sub-games "b" and "c"**

Policy tilt, (active use, passive treatment) as the only sub-game perfect Nash equilibrium can be obtained by backward induction method.

### 3. 3 Conclusion

3.3.1 To strengthen the incentive and restraint mechanisms

The Central Government inclines to implement the policy tilt and vigorously support to promote the development of jing-jin-ji economic cooperation and the process of regional integration. However, there are two balanced strategies for local government: the active use and passive treatment, which means that if there is not enough attractiveness of preferential policies and a strong supervisory system, local governments are likely to choose negative implementation, and thus can not achieve the policy is expected to effect. In this situation, the incentive and restraint mechanisms should be strengthened. On the one hand, financial, taxation, credit and other support efforts should be increased. Finance and taxation policy as a powerful tool of government regulation can play an effective incentive role in cooperation. Key projects should be more supported, so that Jing-jin-ji cooperative behavior is sufficiently stimulated. On the other hand, it is necessary to enter into a binding agreement, and Binding agreement on co-operation must be able to give severe punishment to the party breaching contract.

3.3.2 Repeated games to make cooperation possible

The central government realizes the game with local governments through continuous adjustment policies in policy implementation period. The local government will adopt strategic options under the direction of preferential policies in the future. the optimal response of local governments was negative from the perspective of game analysis, That is the inclined policy given by the central government has not been get in the first phase. However, the process of the game between the central and local governments is a long-term process with mutual selection and mutual influence, local governments would respond positively to the policy, and strive to preferential policies in the next stages.

3.3.3 To improve eco-compensation mechanism of combination of "transfusion" and "hematopoiesis"

To Speed up the economic development and ecological environment construction in poverty belt around Beijing and Tianjin, the key is to eliminate the institutional obstacles and establish long-term and stable eco-compensation mechanism. The compensation mechanism should not be a simple financial transfer payments, but should be combination of "transfusion" compensation and "hematopoiesis" support, so that the external compensation transformed into a self-accumulation and self-development ability to achieve win-win situation in both economic development and environmental protection .

## 4. Game analysis on the relationship of local governments in research area

### 4.1 Model selection

In this game model, there are two players: the governments of Beijing and Tianjin, the governments of poverty belt around Beijing and Tianjin. Their strategies express “cooperation” and “Non-cooperation”. The governments are the simultaneous action, assuming the information is complete, so the game static model in complete information is selected in analysis.

| Government around jing-jin \ Government of Beijing and Tianjin | cooperation（λ）λ λ） | Non-cooperation（1-λ） |
|---|---|---|
| cooperation（θ） | 8，8 | 1，4 |
| Non-cooperation（1-θ） | 4，1 | 3，3 |

**Figure 3 the game of local governments**

### 4.2 Pure strategy Nash equilibrium

According to Figure 3, we can find two pure strategies Nash equilibrium solution: (collaboration, collaboration), and (non-cooperation, non-cooperation), that is, assuming one party chooses cooperation, the other party will choose cooperation; one party chooses non-cooperation, the other party will also choose non-cooperation. Obviously, if the two regional governments choose to cooperate, it will be the best result, and the two sides will achieve a win-win: (5, 5). However, the both parties in this game are rational "economic man", In this case, a rational strategy for the regional parties will be built on the basis assuming that their opponents will act in accordance with their best strategy. If one side chooses cooperation, will face risks of losing two units of interest when the other party choose to conflict; If one side choose to non-cooperation, the worst results will be to maintain the existing benefits. For these considerations, the Non-cooperation in terms of regional parties are the dominant strategy, and thus the two sides will fall into a game of “Prisoner's Dilemma”, that is both parties will choose non-cooperation to achieve (non-cooperation, non-cooperative) Nash equilibrium point. And also, the two sides do not have the enthusiasm to deviate from this choice in current situation.

### 4.3 The mixed strategy Nash equilibrium

This game also has a mixed strategy Nash equilibrium. It is assumed that the mixed strategy of the government around Beijing and Tianjin is $\sigma 1 = (\theta, 1-\theta)$, namely, the governments around Beijing and Tianjin select cooperation on the probability of “θ” and selects non-cooperation on probability of “1-θ” , the same token, the Beijing-Tianjin Government's mixed-strategy is $\sigma 2 = (\lambda, 1-\lambda)$.

The expected utility functions of government around Beijing and Tianjin as follows:

$$\mu_1(\sigma 1, \sigma 2) = 8\theta\lambda + \theta(1-\lambda) + 4(1-\theta)\lambda + 3(1-\theta)(1-\lambda)$$
$$= \theta(6\lambda-2) + \lambda + 3$$

Similarly, the expected utility functions of government in Beijing and Tianjin as follows:

$$\mu_2(\sigma 1, \sigma 2) = 8\theta\lambda + 4\theta(1-\lambda) + (1-\theta)\lambda + 3(1-\theta)(1-\lambda)$$
$$= \lambda(6\theta-2) + \theta + 3$$

Differentiate these two utility functions and get one-step condition of optimization, namely:

$$d\mu_1/d\theta = 6\lambda - 2 = 0, \quad d\mu_2/d\lambda = 6\theta - 2 = 0$$

Solution: $\lambda = 0.33$, $\theta = 0.33$, [(0.33, 0.67), (0.33, 0.67)] is the mixed strategy Nash equilibrium. Namely, Government around Beijing and Tianjin selects cooperation on 0.33 probabilities and selects non-cooperation on 0.67 probabilities. Government of Beijing and Tianjin selects cooperation on 0.33 probabilities and selects non-cooperation on 0.67 probabilities.

**4.4 Conclusion**

4.4.1 To Establish an equal, open, and win-win development concept

In the game shown Figure 3, the determination of payments (8, 8), (1,4), (4,1), (3,3) is based on certain assumptions: the regional cooperation between Jing-Jin and around Jing-Jin are equal, meaning that the influence is same for the both parties whether cooperation or non-cooperation. However, in reality, Tianjin is municipality; Beijing is the capital of China, which makes them in a position of unparalleled competitive advantage. There is inequality between the three places. Beijing and Tianjin, as the heart and lungs of a large area, has been supported by Hebei province under long-term planned economy. Pay attention to the role of the economic hinterland of Hebei and establishing the relationship of equality and mutual benefit between Jing-Jin and around Jing-Jin regions is far-reaching meaning.

4.4.2 Establishment efficient agencies for regional coordination

Based on the above analysis, we can see that the probability that local governments choose cooperation is higher than non-cooperation. The main reason is: at present, China's current regional cooperation is basically built on the basis of administrative divisions. Regional cooperation emphases on economic integration, while different competition subjects in administrative divisions have different styles of management. Local governments often interfere with economy unreasonably to maximize their own interests, so administrative divisions naturally become an “invisible wall” Barreling the process of economic integration. This requires the establishment of efficient regional coordination agencies behalf of Jing-Jin-Ji tripartite interests. the inter-administrative coordinating body responsible for coordinating the major issues of economic activity in the entire region has the following functions: sets up rules, defines functions, identifies sources of funding to make provisions, and formulates the general outline of long-term regional economic development according to division of the regional economic based on characteristics of various regions .

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