

# The Game Model Research on the Industry Conversion in Oil and Gas Resource-Based Cities

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**Abstract:** The industry conversion in resource-based cities is the key to balance the regional economic development in China. In order to study this issue, the paper illustrates the related concept and the necessity of the industry conversion in Oil and gas resource-based cities. Then, this paper analyzes the game model of the industry conversion in Oil and gas resource-based cities in the condition of high market concentration degree. Based on the above, the paper concludes that enterprises usually like to minimize their input on the industry conversion and the task is left to the government. Finally, the paper proposes the according tactics that the government should implement.

Keywords: resource-based city; industry conversion; game analysis

## **1. Introduction**

Oil resource-based city, which is an important part of resource-based cities, is a city based on oil resources and dependent on its development. Over 40% of the work force directly or indirectly engage in the exploitation, production and business operations of the oil resources; over 50% of the city's national revenue depends on the oil resources. According to the report "Study on the economic restructuring of resource-based cities in China" given by the Academy of Macroeconomic Research of our National Commission for inspecting discipline in 2002, the sum assured of China's resource-based cities is 118, among which there are 9 oil resource-based cities, Xilinhaote, including Daqing, Dongying, Panjin, Huayang, Qianjiang, Yumen, Kelamayi and Kuerle, accounting for 8% of the resource- based cities<sup>[1]</sup>.

Oil resource-based city refers to the oil and gas industry as the pillar industry of the city, it is the country's resources an important part of cities. In order to maintain economic development and social stability, to avoid the former Soviet Union Baku "city of empty oil to make" ending, the early 90s from the 20th century, state and local governments pay attention to oil resource-based city 's industrial restructuring problem, academic circles have carried out some study. Abroad as for the resource-based industrial transformation of the city mainly from Canada, Australia and the United States, particularly the resourcebased Canadian scholar Cities research's results and theoretical achievements is the most dramatic in this field. Although domestic the research of oil resource-based city is relatively less, made some research achievements, among them, for the country's largest oil city, the adjustment of industrial structure is the most active research. However, the problem of oil resource-based city industrial transformation remains unresolved so far. Therefore, the need for oil and gas industry transformation of resources city related problem is studied, in order to promote the smooth implementation of the oil resourcebased city's industrial transformation problem.

# 2. The transformation of oil resource-based city game analysis of causes

1) Resource-efficient, beneficial to the transformation of the oil Cities

China is a country, whose oil and gas resources are scarce, and it is the primary goals of China's oil development that how to improve oil recovery economy effectively after an oilfield is threw into exploitation. China's oil and gas industry in highly concentrated market structure is conducive to government objectives in the pursuit of oil and gas recovery and effective monitoring and implementation of large-scale oil and gas companies also contribute to the development and adoption of new technologies. This makes the utilization of oil and gas resources in China is the world's leading level and oil and gas development cycle was significantly longer, which is very favorable to the city's the implementation of the oil industry in transition.

2) Perpendicularity integration system restricts the transformation of oil resource-based city

China Petrochemical Corporation and China National Petroleum Corporation achieved the formation of the upstream and downstream integration, and it is beneficial

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to enhance the overall strength of the two companies. It can help companies get higher returns large vertically integrated oil and gas mining company system and the high entry barriers. Since 1999, three major oil companies of CNPC, Sinopec and CNOOC oil company has conducted internal restructuring, made the separation of the core part and non-core businesses and concentrate quality assets, and took advantages of the core business such as the separation of oil and gas exploration and development to form shares of the company together with coming into the domestic and foreign market, and the rest of the formation of a surviving corporation.

3) Restructuring increases the difficulty of the city' s transition

The overall group restructuring, the surviving corporation is left to the existence of a large number of non-operating assets, unclear property rights and some foreign investment, increased the difficulty of the surviving corporation making up deficits. The surviving company will directly face fierce competition from domestic and foreign markets, and it will require substantial investments in technology development, equipment modification infrastructure construction and so on, and the Group focus on supporting the development of listed companies, weaken the company's efforts to support the surviving corporation, be lack of clear investment policy, and it will be unable to maintain simple reproduction if depending on depreciation only, and the extended reproduction has no way to mention, this brought huge pressures to the survival and development of space of the surviving corporation.

### 3. The game model of oil resource-based city's transformation

#### 3.1. Game Model

Government and the oil and gas companies play a leading role in the industrial restructuring of the oil city, because our country land oil and gas exploration was monopolized by CNPC and Sinopec, and the oil and gas exploration in a city was controlled by a company, the subject was single, so it is convenient to establish game model, and this model is established based on the basis of below hypothesis. Firstly, the government and the enterprise is rational, utility maximization; Secondly, the government and the enterprise implementation of industry transformation efforts can be expressed by their input; thirdly, the government and the enterprises invested in industrial transformation, the function of its utility is in accordance with the function of Le Corbusier- douglas

Governme: 
$$U_G = (C_G + C_E)^\gamma (F_G + F_E)^\rho$$
(1)

Enterprise: 
$$U_E = (C_G + C_E)^{\alpha} (F_G + F_E)^{\rho}$$
(2)

Wherein:  $U_{a}$  — The government's utility;

 $U_E$  — Enterprise's utility;



 $C_{G}$  —The investment of the government used for industry transformation;

 $C_{E}$  —The investment of enterprise used for industry transformation;

 $F_{G}$ —The investment of the government used for other purposes;

 $F_{E}$ —The investment of the enterprise used for the original industry;

$$0 < \alpha, \beta, \gamma < 1, \alpha + \beta \le 1, \gamma + \beta \le 1$$

Industrial restructuring will not only bring the growth of GDP and fiscal revenue, but also be conducive to employment and improve the urban environment, has obvious external economy. Therefore, the Government pays more attention than oil and gas companies, so .

#### **3.2. Measurement and Analysis**

Government and business decision-making goal is to maximize their utility function under the precondition of satisfying the budget constraint, This can be expressed as follow:

Government:

$$\max U_G = (C_G + C_E)^{\gamma} (F_G + F_E)^{\beta}$$
  

$$s.t.C_G + F_G \le B_G, C_G \ge 0, F_G \ge 0$$
  

$$\max U_E = (C_G + C_E)^{\alpha} (F_G + F_E)^{\beta}$$
  

$$s.t.C_E + F_E \le B_E, C_E \ge 0, F_E \ge 0$$
(4)

Enterprise:  $s.t.C_E + F_E \le B_E, C_E \ge 0, F_E \ge 0$ 

Wherein:  $B_G$  —Government funds can be invested;

 $B_E$  — The enterprise funds can be invested.

Figure out the government to compose in reply the enterprise reaction function, the result is:

Government:

 $C_{G}^{*} = \max\left\{\frac{\gamma}{\gamma + \beta}(B_{G} + B_{E}) - C_{E}, 0\right\}$  $C_{E}^{*} = \max\left\{\frac{\alpha}{\alpha + \beta}(B_{G} + B_{E}) - C_{G}, 0\right\}$ (5)

(6)

Enterprise: From this may result in:

$$C_G^* + C_E = \frac{\gamma}{\gamma + \beta} (B_G + B_E)$$
(7)

$$C_E^* + C_G = \frac{\alpha}{\alpha + \beta} (B_G + B_E)$$
(8)

Because of  $\gamma > \alpha$ , so  $C_{g}^{*} + C_{E} > C_{E}^{*} + C_{g}$ .

When the capital that the government can invest changes, will have the following three conditions:

1)When  $B_G \ge \frac{\gamma}{\gamma + \beta} (B_G + B_E)$ , the government budget is greater than the optimal scale of inputs, now the Nash equilibrium is:

$$C_{E}^{*} = 0, F_{E}^{*} = B_{E}; C_{G}^{*} = \frac{\gamma}{\gamma + \beta} (B_{G} + B_{E}), F_{G}^{*} = B_{G} - \frac{\gamma}{\gamma + \beta} (B_{G} + B_{E})$$
(9)

Under these conditions, the government invested more than the best investment demand for industrial transformation. Therefore, this can meet the inputs that the industrial transformation required; while the company is very



stingy on the industrial transformation, all the funds still participated in the original industry.

2) When 
$$\frac{\alpha}{\alpha+\beta}(B_G+B_E) \le B_G < \frac{\gamma}{\gamma+\beta}(B_G+B_E)$$
.

, the available investment funds of the government invested is less than its optimal size, but greater than the optimal investment scale enterprises, now the Nash equilibrium is:

$$C_E^* = 0, F_E^* = B_E; C_G^* = B_G, F_G^* = 0$$
(10)

Under conditions, although the available investment funds of the government have been less than optimal investment demand; however, the optimal strategy is the enterprise funds are invested in the original company, not to and the Industrial Investment.

3) When 
$$B_G < \frac{\alpha}{\alpha + \beta} (B_G + B_E)$$
, the available investment funds of the government invested is less than its optimal size, now the Nash equilibrium is:

$$C_E^* = \frac{\alpha}{\alpha + \beta} (B_G + B_E) - B_G, F_E^* = \frac{\beta}{\alpha + \beta} (B_G + B_E); C_G^* = B_G, F_G^* = 0$$
(11)

Under this condition, the enterprise cannot but participate in industrial restructuring to make up for the lack of the government's input<sup>[2]</sup>.

The above analysis indicated that in oil and gas city's industrial reforming, the government and enterprise's behavior is the mutual influence. Because industrial reforming has the obvious external economy, the government more takes seriously regarding this, so has the enthusiasm effect in the reforming process; But the enterprise always favors in the reduction uses in industrial reforming the investment, pushes the industrial reforming duty to the government. The oil city is not willing to invest in the urban industrial reforming, but is glad to the existing industrial investment, this means that when an area's oil and gas resources dry up gradually, these enterprises will be inclined to shift the production to other areas whose production cost is low, but will not invest the original urban industrial reforming. This requests government must take enterprise this response into consideration when the implementation industry reforming process is carried out, and draws up the corresponding countermeasure.

#### 4. Countermeasure suggest

#### 1) Clear about government's core status in reforming

Through above analysis based on the game model, may know the government has the enthusiasm effect in petroleum city industrial reforming. These companies are transnational in the stockholder's rights assignment and the management operation, and the business objectives are to realize the shareholder benefit maximization. In these company's decision-making, the importance of the petroleum city's sustainable development has yielded in the operator to owner's responsibility, when an area's oil gas resources dry up gradually, these enterprises will be inclined to shift the production to other areas whose cost is low, but not invest in the original city's industrial reforming<sup>[3]</sup>. This requests government must take enterprise's this response into consideration when the implementation industry reforming process is carried out, which requests the overall mentality of industry reforming should trans from formerly mainly relying on the Oil companies to invest under the diversified management to implement industrial reforming under government's support, the coordination and the management.

#### 2) The reform of the current resource tax system

China is a country whose oil and gas resources are scarce, industrial reforming of the oil city also requests extending the oil gas development cycle at the same time, and how cost-effective enhanced oil recovery is still the primary objective of oil development in China. With regards to this, the government need to continue to required oil companies to improve oil recovery by administrative measures on one hand; On the other hand, the government should actively explore how to encourage listed companies that have been restructuring to improve oil recovery by market means in the market economy<sup>[4]</sup>. At present, more feasible measures are reducing the resources tax of the old oil region, and resource tax will be linked with the recovery, and establishing tax systems over diminishing resources, to encourage enterprises to increase investment in the old oil region, extend oil and gas development cycle in order to buy time for the oil Cities.

3) Improve services to oil companies

Currently, petroleum city have paid great attention to attract outside investment, should regard two big oil companies whose headquarters is located in Beijing as the biggest investors in order to realize industry transformation, try to win two big oil companies increases in the exploration and development of local, or arrange some processing projects. To treat the same as for the foreign oil companies to provide services in the whole process, but also focus on improving the quality of service.

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