International Journal of Social Science and Economic Research

ISSN: 2455-8834

Volume: 04, Issue: 11 "November 2019"

STUDY ON CHARACTERISTICS AND ECONOMIC ATTRIBUTES OF INTERBASIN WATER TRANSFER PROJECT

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ABSTRACT

Interbasin water transfer project plays an important role in social and economic development. It plays a major role in accessing to preferential policies and getting priority approval by scientific defining the characteristics and economic attributes of the project. From the perspective of public management theory and economy theory, it is defined that interbasin water transfer project has many characteristics, such as multi-objectives, basic, natural monopoly, quasi-public product characteristics, external and so on. Based on the defect of the traditional project management coefficient, the calculation model of the project operational coefficient considering the time value of capital is constructed, and the basis for dividing the commonweal project, quasi-public welfare project and operating project is put forward. Based on these, the interbasin water transfer project is defined as quasi-public welfare project.

Keywords: Interbasin water transfer project, Characteristic, Economic Attributes

1. INTRODUCTION

In recent years, along with the continuous development of China's economy and the continuous growth of population, the problem of water resources has become an important barrier restricting human survival and sustainable development. Based on this, since the founding of New China, dozens of interbasin water transfer projects have been built in China, which have played an important role in urban water supply, agricultural irrigation, ecological and environmental protection, and achieved important results.

Because of the significance of interbasin water transfer projects for social and economic development, political stability, environmental protection and other aspects, China has implemented a series of interbasin water transfer projects to achieve the rational allocation of

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water resources through these projects. Moreover, these interbasin water transfer projects have formed the overall layout of "four horizontal and three vertical, north-south allocation, east-west mutual aid" in China. At present, a series of interbasin water transfer projects have been established in Northeast, Northwest, Southeast, Southwest and central areas to ensure the safety of production and domestic water supply and to improve and protect the ecological environment [1].

Judging from the trend of development, China's interbasin water transfer project has gradually changed from a single type of project aim at water supply in that past. The water supply line is also developing from linear type to network type, and the engineering benefit is gradually developing from water supply benefit to water quantity-water quality-water ecology-society comprehensive benefit.

Because of the change of the target, the water supply line and the benefit of the project, the planning and design of the project are required to some extent [2]. It is necessary to take into account such coefficients as the source and scope of water supply, the analysis of adjustable water quantity and the optimal allocation and utilization of water resources, the scale of the project, the overall arrangement and program selection of the water transfer project, and the impact of the inter- basin water transfer on the source areas, so as to ensure the effectiveness of the implementation of the inter-basin water transfer project. It is of great significance to scientifically define the characteristics and economic attributes of interbasin water transfer project for project establishment, project fund raising, and obtaining preferential policies of the project.

2. CONNOTATION AND CHARACTERISTICS OF INTERBASIN WATER TRANSFER PROJECT

2.1 Connotation of interbasin water transfer project

Because of the uneven distribution of water resources in time and space, in order to ensure the rational allocation of water resources, it is necessary to achieve through the allocation of water resources [3]. In this context, the water transfer project came into being. In a broad sense, the purpose of water transfer project is to transfer the surplus water from a certain water source or compensate for a certain water shortage, so as to make more effective use of water resources. Considering that there will be great differences in transmission mode, water transfer scale and control area involved in the water transfer project, the water transfer project can be divided into different types [4]. According to the standard system of water transfer put forward by H.A. Sicklomanov and others in his Monograph on *Water Security and Water Transfer in the World*, it can be divided into three categories according to the redistribution nature of water flow among

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river systems: (1) Regional water transfer projects. The remarkable characteristic of this kind of project is that the water transfer work is mainly carried out on the same river and does not involve the water system allocation between rivers.

Generally speaking, the regional water transfer project is mainly to transfer the water in the river to the irrigated land or the urban water supply system through the water intake settings. (2) Endorheic Drainage water transfer project. The projects involve the redistribution of runoff across local watershed divides within river basins with independent access to lakes, bays or oceans, or between any sections of their hydrographic networks. The biggest characteristic of this kind of water transfer project is that all the water intake works are carried out within the same hydrographic scope. (3) Interbasin water transfer project. Such water transfer projects are water redistribution projects between river basins with distances to and from oceans and lakes [5]. In general, the length of interbasin water transfer varies widely, ranging from tens to thousands of kilometers.

More intuitively, if water is diverted from the main stream or tributaries of a certain water system for agricultural irrigation or urban water supply, the project is a regional water transfer project [6]. For example, the water transfer project that takes water from the main stream of the Yangtze River or one of its tributaries is a regional water transfer project; If the water transfer project is established between the main stream and the tributaries or between the tributaries of a certain water system, the water transfer project is within the basin. For example, the water transfer project established between the Jialing River and the Minjiang River of the Yangtze River is an intra-basin water transfer project; If it is a water transfer project established between water systems, it is a trans-basin water transfer project. For example, if a water transfer project is established between the Yangtze River and the Yellow River, it is a trans-basin water transfer project.

2.2. Characteristics of interbasin water transfer

The implementation of the interbasin water transfer project is the inevitable result of solving the uneven spatial distribution of water resources. From the perspective of our country, as early as the Spring and Autumn Period and the Warring States period, there was the interbasin water transfer project, more than 2500 years ago.

However, in different stages, the status and role of the interbasin water transfer project are different. The early water transfer projects were mainly for military, shipping and irrigation purposes. With the continuous development of social economy, especially the development of cities and towns, the implementation of the interbasin water transfer project has gradually changed to meet the needs of urban residents and industrial water consumption, taking into

ISSN: 2455-8834

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account the needs of agricultural irrigation. In recent years, dozens of trans-basin water transfer projects have been built in China, which play an important role in safeguarding regional economic development and social stability.

From the current situation, the interbasin water transfer project is no longer a simple water conservancy project, it involves economic, social, environmental and other aspects, is a complex system engineering. Different from the general water transfer project, the interbasin water transfer project involves more areas and faces more uncertainties in the process of implementation.

Therefore, the interbasin water transfer project inevitably shows some unique characteristics of its own. Specifically, the characteristics of the interbasin water transfer project are mainly reflected in the following aspects:

(1). Multi-objective of interbasin water transfer project

From the development trend of interbasin water transfer project in recent years, most of the interbasin water transfer projects are comprehensive utilization of water resources development projects. For this kind of project, the goal of its construction is not limited to one, but involves a variety of goals. Generally speaking, the goal of interbasin water transfer project is mainly to solve the problem of regional water shortage, while taking into account the objectives of ecological protection, flood control, shipping, tourism, power generation and so on. For example, the East Route of the South-to-North Water transfer Project aims to provide water for urban and industrial use in the eastern region, while taking into account the objectives of agricultural irrigation and shipping.

(2). The interbasin water transfer project plays a fundamental role in regional water supply security.

Generally speaking, the establishment of cross- basin water transfer projects in the region are related to the problem of resource-based water scarcity, therefore, water security for the healthy development of regional economic and social and social stability is of vital importance. Therefore, the guarantee rate of water supply should be considered not only from the technical and economic perspectives, but also from the strategic perspective of political and social harmony and stability [7]. It is necessary to establish a high- standard multi-source water supply safety guarantee system among cities in the region, including local water, outward diverted water, reclaimed water and emergency standby water. The implementation of the interbasin water transfer project can meet the above requirements and play a fundamental role in regional water supply security.

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(3). Natural monopoly of interbasin water transfer project

As a rapidly developing part of modern industrial economics theory, natural monopoly theory has been well developed. It is generally believed that there are two main reasons for the emergence of natural monopoly: economies of scale and economies of scope [4]. Later, modern law, based on the combination of economics and modern competition law, explains the natural monopoly as follows: refers to the monopoly arising from the natural conditions of the market, which may lead to the waste of social resources or the disorder of the market order if there is competition among the departments operating these resources.

As for the interbasin water transfer project, because it is a project of water redistribution between river basins, the project usually involves more benefits, higher cost and greater difficulty. Moreover, the fixed assets investment cost accounts for a large proportion of the costs of the interbasin water transfer project, and most of them are sunk costs. If repeated investment, it will cause a great waste of resources [8]. For the interbasin water transfer project, the large-scale operation by one water supply unit is more efficient than the simultaneous operation of several small-scale water supply enterprises in a specific industrial scope, that is, the interbasin water transfer project has the characteristics of economies of scale and weak growth of cost function [9]. All these indicate that the project of interbasin water transfer has natural monopoly.

(4). The interbasin water transfer project has the characteristics of quasi-public products.

Public goods are non-exclusive and non- competitive goods. Public goods can be divided into two categories: Pure public goods and quasi- public goods. Pure public goods generally have the characteristics of economies of scale, there is no "crowding effect" in consumption, it cannot be used exclusively through specific technical means in the process of use. Quasi-public goods are between private goods and purely public goods, which can be divided into two categories: one is that the use and consumption of quasi-public goods are limited in a certain region, and the scope of their benefits is limited; Another kind of quasi-public goods is public or can be shared, the use of one person cannot exclude the use of others.[6] That is to say, quasi-public goods are between pure public goods and private goods and can be exclusive or competitive.

Because of the multi-objective nature of the interbasin water transfer project, its water supply benefit, power generation benefit and tourism benefit can bring direct economic benefits to the investors, and it is exclusive and competitive, while its flood control benefit and ecological benefit are significantly non-exclusive and non- competitive. Therefore, it is precisely because of these characteristics of the interbasin water transfer project that it has the characteristics of quasi-public goods. Because of the quasi-public product characteristics of the interbasin water transfer project and the monopoly of water resources, the interbasin water transfer project cannot be fully

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market-oriented operation, and it is necessary to adhere to the operation mode of government administrative means as the main and market mechanism as the auxiliary.

(5). Externality of interbasin water transfer project

The concept of externality was put forward by the famous economists Marshall and Pigou in the early 20th century. Essentially, an economic entity exerts an influence on the welfare of the spectators in its own business activities. Its influence may be positive or negative. Moreover, the influence of externality is not obtained or produced by the economic subjects themselves, but a kind of "non-market" collateral influence.

As a quasi-public product, the interbasin water transfer project has certain non-exclusiveness. It is because of the existence of non-exclusivity that the "Free Riders" of the interbasin water transfer project can enjoy certain public services without paying for them. For example, the flood control benefit and ecological benefit of the interbasin water transfer project can be enjoyed by the public and local governments along the line without payment. Because of the externality of the interbasin water transfer project, the market economy system cannot achieve its basic function of optimizing the allocation of resources.

Considering that the externality of interbasin water transfer project is mainly positive externality, the externality can be internalized in a certain way to avoid "government failure" and realize the role of market mechanism in interbasin water transfer project.

3. DEFINITION OF ECONOMIC ATTRIBUTES OF INTERBASIN WATER TRANSFER PROJECT

According to the theory of project differentiation, projects can be distinguished from different angles, among which, projects can be divided into public welfare projects, business projects, quasi- public welfare projects and so on according to the attributes of project products or services.

Moreover, the division of the project can not only be analyzed from a qualitative perspective, but also be divided quantitatively through quantitative indicators.

The theory of project differentiation provides an effective support for defining the economic attributes of interbasin water transfer projects.

However, it is necessary to establish an effective model to support the quantitative analysis of the economic attributes of the interbasin water transfer project. The operability coefficient of the defined project is given in the theory of project differentiation, and the concrete calculation

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model is given. Considering that the calculation model does not fully consider the program of project construction and related requirements, based on this, it is necessary to reconstruct the calculation model of project operability coefficient.

3.1 Construction of the calculation model of the operable coefficient of the project

The project manageable coefficient is defined as follows: the project manageable coefficient refers to the feasibility of the project through market operation to achieve the project objectives.

In order to better define the project operability coefficient, the following assumptions are made:

Assumption 1: Assuming that the implementation of the project is divided into three stages: the preparation period, the construction period and the operation period, with the end of the preparation period, that is, the beginning of the construction period, as the starting point of the analysis.

Assumption 2: Assuming the annual return on the project investment is i .

Assumption 3: Assuming the construction period of the project is t_b and the operation period of the project is t_c .

Assumption 4: Assuming that the investment in each year of the construction period of the project is $h = 1, 2,...,t_b$; Assuming that the operating income of each year of the project operation period is D_j （$j = 1, 2,...,t_c$） and the operating cost of each year is E_j （$j = 1, 2,...,t_c$, the net operating income of each year of the project operation period is K_j （$j = 1, 2,...,t_c$, and $K_j = D_j - E_j$ （$j = 1, 2,...,t_c$).

The operable coefficient of the project is α , annual average operating income of the project is K, the project total cost is I, the project market value is V, and according to the definition of the project operability coefficient, the calculation equation is given

$$\alpha = V / I$$
$$V = K / i_c \quad (1)$$

According to the Equation (1), it is obtained that

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$$\alpha = \frac{K}{I} \cdot \frac{1}{i_c} \qquad (2)$$

Among them,

$$K = \frac{\sum_{j=1}^{t_c} K_j \cdot \frac{(1+i)^{t_c} - 1}{i} \cdot \frac{1}{(1+i)^{t_b}}}{t_c} \qquad (3)$$

$$I = \sum_{h=1}^{t_b} I_h \cdot \frac{(1+i)^{t_b} - 1}{i} \qquad (4)$$

According to the above equation, the project operation coefficient can be calculated.

It was generally felt that projects could be classified using project operability coefficients α:

(1). When α=0, it means that the project has no operating income and social capital cannot invest in such projects. Therefore, such projects are public welfare projects;

(2). When α<1, it means that the market value of the project is less than the total cost of the project. That is to say, this kind of project has market value, but because of the limited income of this kind of project, it cannot meet the demand of investment. If social capital is involved in such projects, the government should give corresponding policy support or financial support in order to attract social capital. Therefore, such projects are quasi-public welfare projects;

(3) When $\alpha \geq 1$, it means that the market value of the project is greater than or equal to the total cost of the project. This means that such projects can be realized through the investment of social capital, without the need for government investment. Therefore, such projects are business projects.

3.2 Analysis of the operational coefficients of interbasin water transfer projects

In the code for economic calculation of water conservancy, the economic service life of various water conservancy projects is defined and divided into three categories: the first category is flood control, waterlogging control, irrigation, urban water supply and other projects, the economic service life of which is generally 30-50 years (including 20-25 years for electromechanical irrigation and drainage stations); The second type is hydropower station, its economic service life

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is generally 40-50 years; The third type is power transmission and transformation engineering, its economic service life is generally 20-25 years [10]. Interbasin water transfer projects are generally urban water supply projects, which have flood control, irrigation and ecological functions.

Therefore, they belong to the first category of projects, and their economic service life should be 30-50 years.

In addition, according to the provisions of Article 20 of the "Code for Price Accounting of Water Supply for Water Conservancy Projects (Trial Implementation)" (SCJ [2007] No. 470) promulgated in 2007, "the price of non- agricultural water supply shall be calculated and withdrawn according to the net assets of water supply on the basis of compensating the production costs and expenses of water supply and calculating taxes according to law. Net assets profit margin is calculated at the annual interest rate of long-term loans of domestic commercial banks plus 2-3 percentage points. Long-term loans from domestic commercial banks are generally determined at the interest rate of five-year terms". According to the data of the Central Bank, the benchmark interest rate of RMB loans for more than five years in China is 6.15%. Based on this provision, the market acceptable annual return rate of the project is i_C in the range of 8.15%-9.15%. In this study, the median value was i_C =8.65%.

As for the interbasin water transfer project, because the general goal involved is not only to solve the regional water shortage, but also to take into account the ecological protection, flood control, shipping, tourism and other goals.

Therefore, from the perspective of function satisfaction, the investment of interbasin water transfer project can be divided into urban water supply, ecological protection, flood control, shipping, tourism and other investment. Because ecological protection, flood control and other functions cannot produce direct economic benefits, so for the interbasin water transfer project, some of the benefits cannot be directly measured by numerical value, and the direct measurement of operating income, only accounts for a part of the benefits of the interbasin water transfer project; On the other hand, because the investment of water transfer project can be divided into many aspects, and the part that the investment can generate operating income is only one of them.

This can be represented by a legend, as shown in Figure 1.

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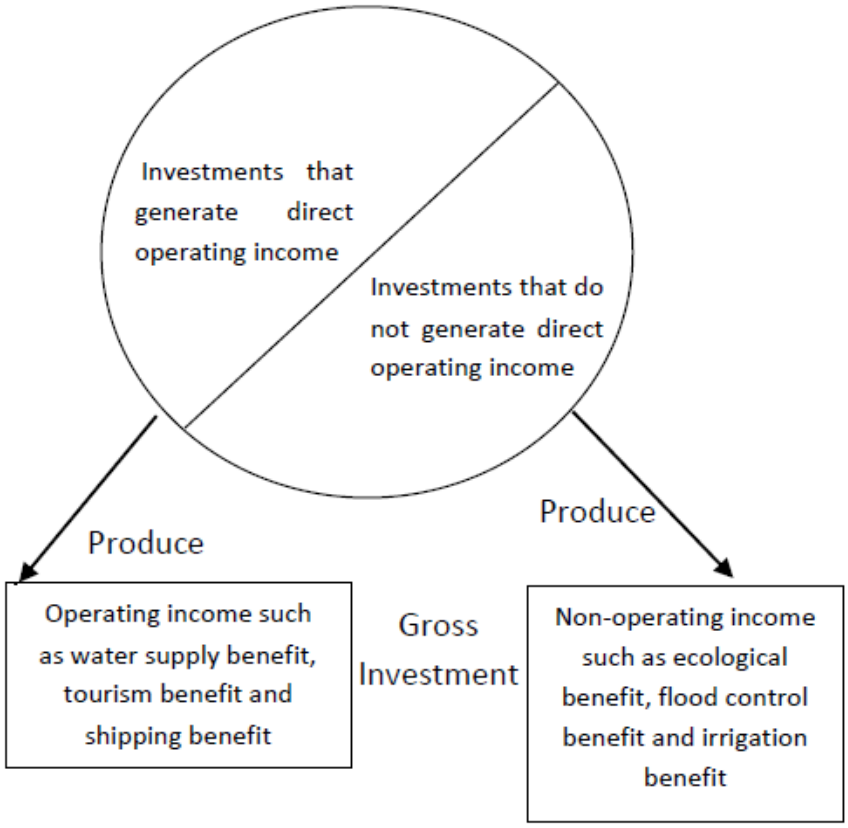

Fig. 1: Decomposition diagram of benefits generated by investment in interbasin water transfer project

As can be seen intuitively from Figure 1, the total investment of interbasin water transfer can be divided into two categories, one is the investment that can generate direct operating income, the other is the investment that cannot generate direct operating income. The investment that can produce direct operating income can produce operating income such as water supply benefit, tourism benefit and shipping benefit, but the investment that cannot produce direct operating income can bring non-operating income such as ecological benefit, flood control benefit and irrigation benefit. That is to say, only a part of the total investment in the interbasin water transfer project can generate direct operating income, and the operating income generated is only a part of the total income. In the calculation model of project manageable coefficient, the ratio between the average annual operating income K of the project and the total cost of the project I should be small. According to the practice of cooperation between the government and the social capital of the interbasin water transfer project in China, the franchise period is basically 30 years. According to this, it can be estimated that the ratio between the annual operating income K of the project and the total cost of the project I is approximately 1/15-1/25.

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Combined with the determined market acceptable annual return rate of the interbasin water transfer project is i_C =8.65%, the project operational coefficient α<1 of the interbasin water transfer project can be estimated roughly. Based on this, it can be considered that, in general, interbasin water transfer projects are quasi-public welfare projects.

4. CONCLUSION

Interbasin water transfer project is of great significance for social and economic development. Scientific definition of the characteristics and economic attributes of this kind of project is of great significance for obtaining preferential policies and approving projects. Based on the defects of traditional project manageable coefficient, this paper constructs a calculation model of project manageable coefficient considering the time value of funds, and puts forward the dividing basis of public welfare project, quasi-public welfare project and operating project, which provides support for defining quasi-public welfare of interbasin water transfer project.

ACKNOWLEDGEMENTS

This work was supported by the National Natural Science Foundation of China (# project No.71801130), Science and Technology project plan Ministry of housing and urban rural development-Soft science research project (# project 2018-R4-003), Jiangsu Social Science Foundation Project (# project 18GLD013).

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