

Spillover Effect of Water Conservancy Technology Popularization

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Abstract. Water conservancy sci-tech (scientific and technological) popularization achievements is an important part of water conservancy sci-tech for government and the key to the transformation of sci-tech achievements into real productive forces. Otherwise, it is an important link in promoting the combination of economy and sci-tech. The performance of water conservancy sci-tech popularization determines the economic value and social function of government sci-tech innovation activities. This paper analyzed water conservancy sci-tech popularization performance from the perspective of spillover effect, measured spillover effects in view of different project categories and different river basins. The results showed that between different project categories and different river basins, there existed spillover effect at different level. According to the result, this paper put forward related suggestions from the perspective of overflow subject, overflow way, overflow receiver.

Keywords: Achievements of water conservancy technology; Performance; Spillover effects.

1. Introduction

At present, a new round of technological revolution and industrial revolution is rising and interacting, innovation is a key support to realize the "double high" in our country. As an important link in sci-tech innovation, transformation of sci-tech achievements plays a significant role in many industries. Improving the quality and efficiency of transformation of sci-tech achievements has become the important measure of the "start-ups and innovation by the public". At present, the average conversion rate was 20%, the scientific and technological achievements to realize industrialization is less than 5%, the patent technology of the exchange rate is only 5%, they were far lower than developed countries. What's worse, quite a number of scientific researches has not transformed into actual productivity.

Scientific and reasonable water conservancy science and technology achievements appraisal system, is helpful to guide the implementation of sci-tech achieve reasonable output, and increase emphasis on the sci-tech popularization achievements, so as to increase the effective supply results, maximize the use of its potential indirect practical value. Due to the extermination of the results of the water conservancy sci-tech, the promotion will result in the corresponding spillover effect, which will improve the overall technical level of the industry and greater economic benefits [1]. Therefore, it is needful to measure the spillover effect of transformation of sci-tech achievements and actively advocate to establish a scientific and reasonable promotion mode, give full play to the positive externalization of public results, solve the "obstruction" in the processes of sci-tech achievements transforming into economic benefits. In this paper, we used the data of the water conservancy technology promotion plan from 2003 to 2013 to study the technological spillover effect of water conservancy technologies between different project categories and different watersheds.

2. Literature Review

At present, the domestic scholars mainly concentrated the study of water conservancy sci-tech achievements promotion performance on the following several aspects: such as Wang Zhiqiang (2015) took public welfare water resources evaluation of sci-tech achievements for example, discussed public welfare oriented evaluation index system of water conservancy sci-tech achievements from the effectiveness, efficiency and externality, which was based on the externalities of public welfare standard index, embodied in the areas of science and technology progress, solve the intersection problem of the development of industry and area, including the knowledge and technology spillover

[2]. Zhang Huawei (2014) studied the performance of the knowledge transfer network of agro-technical extension and the knowledge spillover effect of agro-technical extension in China [3]. Wang xiaoyong et al. (2014) proposed to carry out evaluation on non-competitiveness and non-exclusivity of water conservancy scientific and technological achievements, promoted third-party evaluation and strengthen pre-evaluation and post-evaluation of public welfare projects by classifying evaluation of water conservancy scientific and technological achievements and defining the connotation of transformation of scientific and technological achievements [4]. Xu bin et al. (2011) selected an agricultural science and technology enterprise in Chengdu region as the evaluation object on the basis of the survey on agricultural enterprises and farmers in Sichuan region, and conducted fuzzy comprehensive evaluation from three aspects of input, management and effect of result promotion [5]. Wu ling et al. (2008) constructed a performance evaluation index system for the promotion of scientific and technological achievements of ecological environmental protection from the aspects of promotion ability, promotion level, promotion efficiency, promotion effect, innovation ability and the sustainability of promotion as the criterion layer [6]. In the existing literature, the performance evaluation of water conservancy science and technology achievements promotion is still mostly in the construction stage of the index system. Although some scholars have proposed the externalities of public welfare science and technology achievements promotion, they have not clearly proposed how to measure such positive externalities. The benefits of water conservancy science and technology achievements are far greater than the economic benefits obtained by the transferor, and spillover effect is a manifestation of positive externalities.

In view of the above shortcomings, this paper takes the extension of water conservancy sci-tech as an example from the perspective of spillover, evaluates the performance of the extension of water conservancy sci-tech achievements, and comprehensively recognizes the value of the government's sci-tech innovation activities. Water conservancy is the national public welfare undertakings, water conservancy science and technology have obvious social nature of public welfare, the basic characteristics of the water conservancy industry has determined that the water in the transformation of production and the promotion of scientific and technological achievements with very strong positive externalities. So, by studying the water conservancy technology spillover effect from the promotion of scientific and technological achievements, and based on this, the paper studies from the perspective of spillover, spillover effect, spillover receiver, and put forward relevant suggestions, have a certain degree of reference for general water conservancy in China to promote sci-tech achievements.

3. Materials and Methods

According to the theory of industry association, all parties involved may have other parties' products, technology or "free rides" during the process of multiple contact, thus resulting in technology spillover. Due to job training, cooperative research and published literature, the existence of various academic conferences and seminars, there exists imitation or copy of products in the water conservancy sci-tech promotion process, especially in different application areas and different river basins. So, taking the river basin and the project category for research units, this paper studies technology spillover in order to play a dominant role to the construction of promotion model.

3.1 Basic Model

The most used application on the study of inter-industry technology spillover effect measurement is Feder model (1982) of the two departments. Feder divides the economy section into the export sector and the export sector, export sector output is used to explain the export sector output, and it is also called cross explanation. If the coefficient of cross-interpretation is positive, there is a positive spillover effect [7]. This paper used the idea of C-D production function to construct the technology overflow model and simplified the two departments of Feder, finally, constructed the technology overflow model between the two departments.

$$Y_i = Y_i(L_i, K_i, P_j), i \neq j \quad (1)$$

Among them, Y_i , L_i and K_i respectively represent the output, labor input and capital input of department i , and P_j expresses the relevant factors of influence of the department j , which has technical spillover effects on department i . To differentiate the above, for example:

$$dY_i = \lambda_L \cdot dL_i + \lambda_K dK_i + \lambda_Z dP_j \quad (2)$$

Here, λ_L , λ_K and λ_Z respectively represent the marginal productivity of L_i , K_i , P_j in the department i , and the transformation of this equation is:

$$\frac{dY_i}{Y_i} = \frac{\lambda_L \cdot L_i}{Y_i} \cdot \frac{dL_i}{L_i} + \frac{\lambda_K \cdot K_i}{Y_i} \cdot \frac{dK_i}{K_i} + \frac{\lambda_Z \cdot Z_j}{Y_i} \cdot \frac{dP_j}{P_j} \quad (3)$$

Here, suppose that L_i , K_i , P_j satisfies the constant output elasticity, then the above formula can be written as:

$$\frac{dY_i}{Y_i} = \alpha_1 \cdot \frac{dL_i}{L_i} + \alpha_2 \cdot \frac{dK_i}{K_i} + \alpha_3 \cdot \frac{dP_j}{P_j} \quad (4)$$

Considering the availability of data and the convenience of calculation, the form of equation after arrangement, that is, when regression analysis is carried out, this paper selects the equation form of the above logarithmic processing, namely:

$$\ln Y_i = \alpha_1 \ln L_i + \alpha_2 \ln K_i + \alpha_3 \ln P_j + \mu \quad (5)$$

Here, α_1 , α_2 and α_3 represent the output elasticity of L_i , K_i , P_j , and μ means random error, which is the technical overflow model of water conservancy technology promoted by this paper.

3.2 Water Sci-tech Promotion Spillover Effect Evaluation Model

For the selection of technology spillover index mainly consider two aspects. First, due to the diversity of the plan, the study can undertake research in project categories, respectively is rural water conservancy, construction, hydrology and informatization, soil and water conservation, water resources, water environment, flood control and drought relief, publicity and training; Furthermore, China is a vast country, in the field of water conservancy research often takes river basin as the research unit, and the basin analysis is helpful to understand the status of water conservancy technology spillovers basin level, they are the Yangtze river basin, Yellow River, Pearl River basin, Haihe basin, Huaihe basin, the Songhuajiang basin and the Taihu basin.

3.2.1 Technology Spillover Model between Different Items

In the model, certainty of variable P_j is the key step to the model application. Above, variable P_j represents the elements that effect on the technology spillover effect project. In order to make the model have more practical application value, the variable P_j in the model can be represented by the innovation index of the projects. Based on the interpretation, the basic quantitative model of technology spillover between different project categories is constructed:

$$\ln Y_i = \alpha_1 \ln L_i + \alpha_2 \ln K_i + \alpha_3 \ln P_j + \mu \quad (6)$$

Among them, Y_i , L_i and K_i respectively represent the output, labor input and capital input of project i , and P_j represents the innovation index of project j . α_1 , α_2 and α_3 represent the output elasticity of L_i , K_i , P_j , and μ represents the random error of the regression equation.

3.2.2 Technology Spillover Model between Different Basins

Based on the actual situation of the project, the variable P_j in this model can be represented by the innovation index of different basins. Based on the above interpretation, the basic quantitative model of technology spillover between different basins is constructed:

$$\ln Y_i = \alpha_1 \ln L_i + \alpha_2 \ln K_i + \alpha_3 \ln P_j + \mu \quad (7)$$

Among them, Y_i , L_i and K_i respectively represent the output, labor input and capital input of basin i , and P_j represents the innovation index of basin j . α_1 , α_2 and α_3 represent the output elasticity of L_i , K_i , P_j , and μ represents the random error of the regression equation.

4. Results

This article adopted the SPSS20 regression analysis according to the capital investment, human capital investment and calculated innovation index of water conservancy sci-tech promotion plan in 2003-2013. The result is as follows:

Table 1. Technical spillover coefficient between project categories

Project i \ Project j							
	Rural Water Conservancy	Project Construction	Hydrology Information	Soil and Water Conservation	Water Resources Environment	Flood Control and Drought Relief	Publicity and Training
Rural Water Conservancy	-	-	0.049	0.226	-	0.271	0.231
Project Construction	-	-	0.705	0.733	0.33	0.176	-
Hydrology Information	0.153	0.244	-	0.567	0.077	0.553	0.406
Soil and Water Conservation	-	-	-	-	-	0.366	0.318
Water Resources Environment	-	-	0.043	-	-	0.109	0.295
Flood Control and Drought Relief	-	0.729	0.895	-	-	-	0.309
Publicity and Training	-	-	0.252	-	-	0.41	-

Note: “-” represent that there is no overflow effect, and the coefficients on the table represent the overflow effect of project category i on project category j .

According to the results in Table 1, spillover effects of flood control and drought relief, hydrology informatization, publicity training project are the most obvious. They have a different degree of overflow almost every type of project. Every province held flood control and drought relief and hydrology informatization knowledge lecture and related training every year. Publicity and training programs have been promoted in various forms to promote the achievements of advanced technologies. These reasons greatly increase the spillover effect.

Table 2. Technical spillover coefficient between water basins

basin j basin j	Yangtze River	Yellow River	Pearl River	Haihe	Huaihe	Songhuajiang	Taihu
Yangtze River	-	0.554	0.209	-	0.367	-	-
Yellow River	0.446	-	-	0.169	0.275	0.287	0.264
Pearl River	0.602	0.617	-	-	-	-	-
Haihe	0.643	0.675	-	-	-	-	-
Huaihe	0.858	0.166	-	0.097	-	-	-
Songhuajiang	0.12	0.287	-	0.019	0.065	-	0.063
Taihu	0.183	0.19	-	0.083	0.115	0.092	-

Note: “-” represent that there is no overflow effect, and the coefficients on the table represent the overflow effect of basin i on basin j.

According to the results in Table 2, spillover effects of Yangtze river and Yellow River basin are the most obvious. The Yangtze river, the Yellow River are the two largest basins, supporting water and energy resources in the China's most densely populated region, what's more, water conservancy project construction, rural drinking water safety work of them are brought to the attention of the departments at all levels. Sci-tech achievements popularized and applied in the two big basins have a strong representation. And the exchanges and cooperation between the two basins of learning also greatly promote the Yangtze river and Yellow River basin water conservancy spillover effect from the promotion of sci-tech-achievements. Several other major basins also have a certain degree of spillover, which indicates that the positive externalization of the hydraulic sci-tech- achievements promotion work is obvious.

5. Conclusion

Water conservancy sci-tech promotion does exist a certain degree of technology spillover effect between different project categories and river basins, and it also shows that the technology overflow has played a larger role in water conservancy sci-tech progress. Reasonable use of water conservancy technology "externalization" can save economic resources. Technology spillovers level depends on the overflow owns degree of the achievements, diversity of overflow way and the digestion and absorption ability of the receiver. This article puts forward the following suggestions from the perspective of overflow subject, the overflow path, overflow receiver:

5.1 Step up the Construction of Demonstration Parks and Speed up the Sharing of Technologies

In view of the existence of spillover effects, the water conservancy administrative department should speed up the demonstration application of scientific, technological achievements and strengthen the existing sci-tech demonstration park transformation of the achievements and technology diffusion of demonstration effect, improve the campus facilities, rich zone display content

and means. What's more, we should establish and improve the assessment supervision and incentive mechanism and make full use of the water special technology demonstration and all kinds of promotion plan.

5.2 Encourage the Establishment of Intermediary Service Agencies and Expand the Overflow Path

Establishing science and technology intermediary service agencies can provide trading places, technology trading information platform and information retrieval, processing and analysis, evaluation, brokerage services. According to the requirements of users design different procedures, expand the approaches of technology spillovers and build different technology platform, provide different retrieval relevance. Build public research platform according to industry and regional development, provide the transformation of sci-tech achievements, technical integration and common technology research, etc.

5.3 Cultivate High-quality Talents and Improve the Ability of Absorbing Technology

Strengthen science popularization and propaganda, promote the building of water conservancy science education base, further intensify propaganda of scientific and technological achievements, actively create advanced practical water conservancy technology promotion platform, widely propagandize water state policy and major water scientific and technological achievements through a variety of forms, spread scientific knowledge of water conservancy, strengthen technology promotion and training. Through regular training and learning for technology popularization person, formulate reasonable incentive system to improve work enthusiasm of technology extension workers, continuously improve the scientific literacy of the technology spillovers receiver, and strengthen water saving consciousness.

Acknowledgments

Our research is supported by China Scholarship Council (201506710041).

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