

Study on the Mathematical Model of Technology Diffusion in Technical Economic System

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Abstract

In the technical and economic system, there is a certain interaction between various technologies, mainly in the form of technology diffusion. By constructing the mathematical model of technology diffusion, the trend of technology diffusion can be predicted, the reasonable distribution of science and technology productivity can be realized, and the policy optimization measures can be formulated on the basis of evaluating the existing policies. This paper first points out the basic idea of digital model of technology diffusion, and then focuses on the analysis of various parameters of mathematical model of technology diffusion, and puts forward the application conclusion of mathematical model of technology diffusion, in order to provide reference for relevant industry personnel.

Keywords: *Technology and Economic System; Technology Diffusion; Digital Model*

1 INTRODUCTION

The research contents of technical economics include technological development, economic development, technological policy, technical scheme, technical measures, etc., which together constitute the technological economic system. Different technologies existing in the technological economic system often bring different degrees of promotion to economic growth. However, there are certain interactions between different technologies, mainly in the form of technology promotion and technology penetration, which is essentially technology diffusion.

2 BASIC IDEA OF DIGITAL MODEL OF TECHNOLOGY DIFFUSION

For human beings, science and technology belong to common wealth, not restricted by regions, countries and nations, and there is no class nature. After science and technology research and development, often from the research and development gradually to the surrounding. Therefore, the place of technology research and development can be called the source of technology diffusion, and the place where the technology is accepted after the technology diffusion is the place of technology absorption. Technical diffusion source usually has a certain objective influence on the surrounding, and the concept of field can be described as technical diffusion field. If there is a technology absorber within the scope of the technology diffusion field, the absorption technology is applied in the presence of the technology transfer between the diffusion source and the absorber. The diffusion field of this technology is similar to the properties of the electric field and the magnetic field.

First of all, the technical diffusion field is just like the electric field and magnetic field. The form of matter and information in the field presents special characteristics. Some technologies are bodies internally, while different technologies will have a certain role between them.

Secondly, the charged bodies or belt magnets will not lose the charge or electromagnetic force when they act on the surrounding technology. Similarly, the technology diffusion source will not lose the technology when it spreads to the surrounding technology.

Thirdly, the field strength of the electric field and the magnetic field presents a dissipation phenomenon. Similarly, the technical diffusion field will also change with the spatial distance, and the greater the distance, the weaker the influence is.

Finally, the size of the action between two charged bodies or belt magnets is affected by the size of the charge or electromagnetic force. Similarly, the amount of technical diffusion in the technical diffusion field is affected by the overall capacity of the technical diffusion source and the overall capacity of the technical absorber.

Therefore, the phenomenon of technical diffusion can also be described by using Coulomb's law:

1. Technical diffusion field $E = K_1 \text{Technical diffusion source diffusion capacity } Q_{\text{expand}} / \text{Quatic } R \text{ of the distance between the diffusion source and the absorber}^2$

2. Technology transfer amount of technology diffusion source $F = K_2 \text{Technical diffusion field } E \text{ The absorption capacity of the technical absorber } Q_{\text{inhale}}$

3. Technology transfer quantity of technology diffusion source $F = K \text{ the diffusion capacity of technology diffusion source } Q_{\text{expand}} \text{The absorption capacity of the technical absorber, } Q_{\text{inhale}} / \text{Quatic } R \text{ of the distance between the diffusion source and the absorber}^2$

among, K , K_1 And K_2 It belongs to the proportional coefficient, and the size is determined by each unit of measure, and $K = K_1 \times K_2$.

Although the technical diffusion field is similar to the electric field and the magnetic field, there are also obvious differences. The specific laws of the technical diffusion are analyzed below^[1].

3 PARAMETER ANALYSIS OF THE TECHNICAL DIFFUSION MATHEMATICAL MODEL

3.1 Equivalent Distance

Technology is usually circulated under the support of the technology carrier, such as the flow of people will bring about the technology circulation. The circulation of technology will change with the distance, the larger the distance, the smaller the circulation. The technical diffusion field is often inversely proportional to the distance between the diffusion sources. Theoretically speaking, the field strength of the technical diffusion field should be centered on the technical diffusion source to form a circle. However, in fact, the diffusion intensity of the technical diffusion source to the same distance position is not consistent, and the field strength equivalent line of the technical diffusion field belongs to a closed curve with irregularities, with high potential in convenient transportation and low potential in inconvenient transportation. The extensive application of modern transportation tools effectively shortens the transportation distance between different regions, so the concept of equivalent distance can be cited. The so-called equivalent distance mainly uses the geographical distance with the same transportation distance for equivalent replacement. In the current developed transportation industry, the distant technology absorption experience is mapping to the source of technology diffusion.

Equivalent distance is the reflection of the technology carrier, that is, the reflection of the technology circulation situation, and its influencing factors are affected by the traffic time and the transportation passenger flow. First of all, the equivalent distance changes with the change of traffic time, and the two are directly proportional, that is, the shorter the time required for the journey between the technology diffusion source and the technology absorber, the smaller the equivalent distance. Secondly, although the equivalent distance changes in the transport passenger flow, the two are inverse proportional, that is, the larger the transport passenger flow, the smaller the equivalent distance. In the case of choosing a single transportation, equivalent distance $R = \text{traffic time } T / \text{transportation traffic } S$, in the selection of diversified transportation, whether sea, land, air, or walking, will produce certain effect, so should combine a variety of transportation mode, constitute parallel form, calculate the equivalent distance. If diversified transportation vehicles are adopted in the sections, the series form is formed, and the passenger flow of the technology diffusion source and the technology absorption body is determined by the bottleneck mouth passenger

flow. In view of the traffic trunk, especially the far but direct transportation, there are main modes of transportation between the two places.

For example, there are three kinds of transportation from ground A to ground B, one is the train, the required transportation time is 1 day, the average daily passenger flow of 2000 people; the second, the required transportation time is 3 days, the average passenger flow of 40 people per day; the third is the plane, the required transportation time of 6 hours, two flights a week, 100 passengers per flight. Then, the calculation results of single train transportation, single passenger car transportation and single aircraft transportation are 0.5, 75 and 8.75 respectively, while the calculation results of three transportation modes are 0.47, which is similar to 0.5. Therefore, it can be seen that the main transportation mode from ground A to ground B is train^[2].

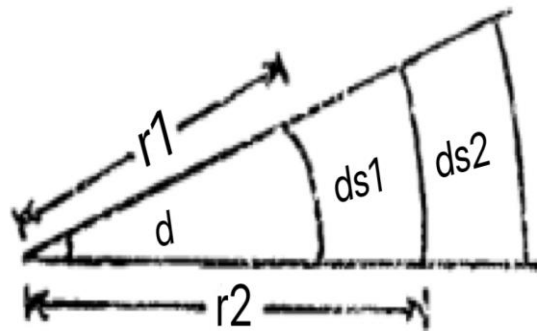


FIGURE 1 FLOW VOLUME AND FLOW ARE INVERSELY RELATED TO DISTANCE

3.2 Technology Diffusion Capability

The diffusion capacity of technology diffusion sources is affected by scientific and technological capabilities and technology diffusion policies. First of all, technology diffusion ability is proportional to scientific and technological ability, mainly with the enhancement of scientific and technological ability. Secondly, the ability of technology diffusion is directly proportional to the technology diffusion policy. The introduction of favorable policies can promote the technology diffusion, and the introduction of adverse policies will lead to the phenomenon of technology blockade. So, the technology diffusion ability $Q_{\text{expand}} = H_1 \text{Technology diffusion source local technology capability } A_{\text{expand}} \text{Technology diffusion policy, } P_{\text{expand}}$. Where, H_1 belongs to the proportional coefficient. In calculating scientific and technological ability, the main mark can be used as the calculation parameter, and the weighted method can be used to evaluate scientific and technological ability.

3.3 Technical Diffusion Field

The technical diffusion field is often formed around the technical diffusion source. Combined, the above formula shows that:

Technical diffusion field $E = K_a \text{Technology diffusion source local technology capability } A_{\text{expand}} \text{Technology diffusion policy, } P_{\text{expand}} \text{quadratic S of passenger flow}^2 / \text{quadratic T of the journey time required by the main vehicle}^2$

among, K_a belongs to the proportional coefficient, $K_a = K_1 \times H_1$. The diffusion phenomenon is widespread. For the technology absorption ground concerned, the absorbed technology is the result of the superposition of multiple field strengths in the technical diffusion field. Usually, the technical diffusion field in a certain place $= E_1 + E_2 + E_3 + \dots + E_n$. When a strong diffusion source exists around the absorber, the field strength felt by the absorber is mainly caused by this strong diffusion source.

3.4 Technical Absorption Capacity

The technical absorption capacity of different technical absorbers is often different, so in the technical diffusion field, the same technical absorbers with the same field strength can get different amounts of technical transfer. Technology absorption capacity is mainly affected by scientific and technological capacity, technology absorption policies and resources. First of all, technological absorption ability is proportional to scientific and technological ability, mainly enhanced with the enhancement of scientific and technological ability. Secondly, the technology absorption capacity

is directly proportional to the technology absorption policy, and the introduction of favorable policies can strengthen the effect of technology absorption. Thirdly, the absorption capacity of technology is directly proportional to the richness of resources, mainly including economic, demographic and natural resources. The more abundant the resources, the stronger the absorption capacity of technology is.

Usually, technology transfer and technology exchange have an interaction, and the input amount is lower compared with the output of scientific and technological capabilities. The effect of technology transfer mainly depends on the ratio of the scientific and technological ability of the technology diffusion source and the technology absorber. By analyzing the factors affecting the absorption capacity of the technology, the following equation:

Technical absorption capacity $Q_{inhale} = H_2 \text{ Absorber local technology capability } A_{inhale} \text{ Technology absorption policy } P_{inhale} \text{ Retriactyl resource condition } M_{inhale} (A_{expand} / \text{ Absorbent local technology capacity } A_{inhale}) = H_2 \text{ Diffusion source local technology capability } A_{expand} \text{ Technology absorption policy } P_{inhale} \text{ Retriactyl resource condition } M_{inhale}$

among, H_2 Belongs to the proportional coefficient.

3.5 Technology Transfer Quantity

The technology transfer amount between the technology diffusion source and technology absorber available from the above equation is:

Amount of technical transfer, $F = K_b \text{ Technology diffusion field } E \text{ technology absorption capacity } Q_{inhale} = K_2 \times K_a \text{ Diffusion source local technology capability } A_{expand} \text{ Technology diffusion policy, } P_{expand} - H_2 \text{ Diffusion source local technology capability } A_{expand} \text{ Technology absorption policy } P_{inhale} \text{ Retriactyl resource condition } M_{inhale} = K_b \text{ technology diffusion policy } P_{expand} \text{ Technology absorption policy } P_{inhale} \text{ Retriactyl resource condition } M_{inhale} A \text{ quadratic of the local technology capability } A_{expand}^2 / \text{ Quatic R of equivalent distance}^2$

among, K_b Belongs to the proportional coefficient, $K_b = K_2 \times K_a \times H_2$. Since the proportional coefficient is usually constant, mainly determined by the unit of measurement, so the proportional coefficient is directly taken as K , so the technology transfer amount of the technology diffusion source and the technology absorber $F = K \text{ technology diffusion policy } P_{expand} \text{ Technology absorption policy } P_{inhale} \text{ Retriactyl resource condition } M_{inhale} A \text{ quadratic of the local technology capability } A_{expand}^2 / \text{ Quatic R of equivalent distance}^2$

This is also a mathematical model of technology diffusion.

However, in general, the local amount of technology transfer of the technology diffusion source is different from the local amount of technology transfer of the technology absorber, and the technology absorber often absorbs the technology through various aspects. According to the technical diffusion source with different technical characteristics, the technical absorber has different amount of resources in the absorption process, which depends on the correlation of the technology and resources. For example, if the technology absorber is rich in local metal mineral resources, the technology absorber will have a large amount of resources for metallurgical technology and less resources for other technologies^[3].

4 APPLICATION OF THE MATHEMATICAL MODEL OF TECHNICAL DIFFUSION

In the application of the mathematical model of technology diffusion, a certain place can be selected as the reference point to study the technology policies and scientific and technological capabilities in various places.

First of all, the local technology absorber is selected as the base point. In the background of policy stability, it can be considered that the level of technology diffusion policy in different regions is equivalent, so that the local scientific and technological capabilities can be calculated:

$$A_1: A_2: A_3: \dots: A_n = R_1 \sqrt{F_1} / M_1: R_2 \sqrt{F_2} / M_2: R_3 \sqrt{F_3} / M_3: \dots: R_n \sqrt{F_n} / M_n$$

According to the same technical characteristics and resources of technology diffusion sources:

$$A_1: A_2: A_3: \dots: A_n = R_1 \sqrt{F_1}: R_2 \sqrt{F_2}: R_3 \sqrt{F_3}: \dots: R_n \sqrt{F_n}$$

An assessment of local technology diffusion policies for technology diffusion sources provides that:

$$P_{\text{Expand 1}}: P_{\text{Expand 2}}: \dots: P_{\text{expand n}} = R_1/A_1 \times \sqrt{F_1/M_1}: R_2/A_2 \times \sqrt{F_2/M_2}: \dots: R_n/A_n \times \sqrt{F_n/M_n}$$

Similarly, in view of the situation that the technical characteristics and resources of technology diffusion sources are the same:

$$P_{\text{Expand 1}}: P_{\text{Expand 2}}: \dots: P_{\text{expand n}} = R_1/A_1 \times \sqrt{F_1}: R_2/A_2 \times \sqrt{F_2}: \dots: R_n/A_n \times \sqrt{F_n}$$

Secondly, select the local technology diffusion source as the base point to evaluate the local technology absorption policy of the technology absorber:

$$P_{\text{Suction 1}}: P_{\text{Suction 2}}: \dots: P_{\text{inhale n}} = F_1 \times R_1^2/M_1: F_2 \times R_2^2/M_2: \dots: F_n \times R_n^2/M_n$$

According to the technology diffusion model, technology absorption in absorbing technology, technology transfer, and technology diffusion policy, technology absorption policy, technology absorption local resources and technology diffusion source local technology ability is proportional relationship, and technology absorption and technology diffusion source of the equivalent distance into inverse relationship, so can infer the conclusion:

Firstly, in order to give full play to the role of the central city, accelerate the progress of technology transfer, and realize the integrated development of urban and rural economy and technology in various regions, we should strengthen the diffusion ability of science and technology in the central city from three aspects: first, introduce favorable policies to promote the diffusion of technology; secondly, improve the scientific and technological ability of the central city itself; and finally, promote the development of transportation industry in the central city and improve the transportation conditions. The first two aspects, especially to improve the scientific and technological capacity of the central city, often need to go through a long process, so we can focus on the third aspect, and increase the investment in the transportation industry by improving the traffic conditions in the urban center, and then get compensation^[4].

Second, the amount of technology transfer generated by the technology absorber when absorbing the technology has nothing to do with the local scientific and technological capability of the technology absorber, but also with the resource factors affecting the local scientific and technological capacity of the technology absorber. Although this conclusion is somewhat surprising, the in-depth analysis is reasonable. In recent years, enterprises in township areas lacking technical ability and professional farmers in rural areas are widely citing advanced technology, sparsely populated and backward economic development areas are promoting the construction of modern industrial facilities, and the key to these phenomena depends on the strength of people. Therefore, the areas with low technical ability level should eliminate the inferiority complex, actively cite advanced technology, and boldly try to innovate.

Third, the local technology absorption status of the technology absorber depends on the local technology absorption policies and resources. Among the two influencing factors, the decisive factor is the technology absorption policy, which shows that each regions should introduce powerful policies that can promote technology absorption to speed up the speed of technology absorption.

5 CONCLUSION

In the technological economic system, the mutual diffusion between different technologies will effectively promote the development of technological economy. Relevant industry personnel should conduct in-depth research on the mathematical model of technology diffusion, analyze the quantitative relationship of technology diffusion, and then comprehensively predict and evaluate the prospect of technological and economic development.

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