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Article

Spatial Variation of Regional Sustainable Development and its Relationship to the Allocation of Science and Technology Resources

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Abstract: With the increasing of labor salaries, the RMB exchange rate, resource product prices and requirements of environmental protection, inexpensive labor and land are no longer the decisive factor of regional competitiveness. From this perspective, China needs to shift from the extensive development mode to the sustainable development mode. Science and technology resources rational allocation is one of the key issues in sustainable development. Based on the counties (districts) data of Zhejiang Province in China, this paper portrays the spatial variation of regional sustainable development level of this area. This paper finds that counties tend to cluster in groups with the same sustainable development level, and this agglomeration trend has been enforced during the past several years. It then testifies to the relationship between the allocation of science and technology resources and local sustainable development, identifies science and technology human resources, financial resources and environmental resource are positively related to local sustainable development, except government financial support. The economic level has a negative relationship with regional sustainable development. This is because the development of the Zhejiang economy grown at the expense of the environment and ecosystem. Some advice is given according to the empirical analysis result.

Keywords: regional sustainable development; science and technology resource; human resources; financial resources; environmental resource

1. Introduction

The global economy has developed greatly in the past century. However, unreasonable utilization of natural resources produced a series of negative consequences. Facing serious economic, societal, resource and environmental problems, such as environmental pollution, ecological imbalance, and resource depletion, humans have to reconsider production and living behavior. From this perspective, sustainable development is proposed as a new kind of development view.

The Chinese government put the sustainable development strategy for the first time into the long-term planning of Chinese economic and social development in 1992. After more than 20 years' development, there are still many prominent problems in the sustainable development of Chinese cities. First of all, extensive features of local economic development are still obviously resource-and investment-driven. Traditional industry, low technology content and low value-added industries still dominate the economy. Competitive advantage mainly comes from a large amount consumption of natural resources and low cost labor. Second, a large number of technical bottleneck problems are still, and have been for a long time, restricting the sustainable development of the city. Most technology resources come from technology licensing, foreign direct investment, joint ventures, and imitation. Many technological problems remain to be solved, such as the living environment, urban planning system, circulating water system, energy saving, traffic, rational land use, and disaster prevention and mitigation. Traffic systems of big cities are vulnerable, there is widespread traffic congestion, increased pollution, serious traffic problems and accidents. Third, industrial technologies related to the sustainable development of urban areas are very poor. The scale and technical level of high-tech industry with difficulty meet the needs of the urban sustainable development.

The ability of science and technology to produce is the engine of sustainable development. The implementation of the strategy of sustainable development must rely on science and technology. Science and technology resources rational allocation is one of the key problems of sustainable development. Sustainable development as a new economic development model and concept, when reflected in the development strategy of countries all over the world, has raised new questions about the allocation of science and technology resources. The solution of these questions also puts forward new standard to examine and evaluate the efficacy and efficiency of the science and technology resource allocation. The main problems of science and technology resources in China at present can be summarized as follows: resources allocation efficiency is not high, waste is serious and there is an imbalance in the structure of configuration.

To a certain extent, China's economy has a regional segmentation structure. In different areas, such as coastal and inland, or the eastern and western areas, there are great differences in formulation, implementation and the affection of science and technology resource allocation policy. The same problem also exists in the provincial developed regions and underdeveloped regions in the domain. Provincial governments often issue special scientific and technological policy to promote the development of the underdeveloped areas of science and technology. However, in actual operation, because of the influence of the objective and subjective factors, some science and technology policies do not achieve the expected effect, and are even invalid. It is important to identify which kinds of science and technology policy are helpful to enhance the regional sustainable development and which are useless. Therefore, the objective of this paper is to find the relationship between the allocation of science and technology resources and local sustainable development, based on the county data of Zhejiang Province in China. Based on this data, we will identify which kinds of science and technology resource have a positive relationship with the promotion of the sustainable development of counties, and which kinds have a negative relationship. The research result of this paper might be valuable for Zhejiang government in making decision on science and technology policy.

After China's reform and opening up in 1978, the national economy has achieved rapid development, especially in the southeast coastal provinces, and Zhejiang province is one representative province. Zhejiang is one of the most balanced and developed provinces in mainland China; a striking feature is the privately operated economy and private economy accounts, which proportionally dominates the economy among all provinces in China. Known as the "Zhejiang model", "Zhejiang experience" and "Zhejiang phenomenon", Zhejiang's achievements and experience gets the attention of and imitation from many provinces. However, the research in science and technology resources' spatial distribution and sustainable development of Zhejiang province are still non-existent. It is against the optimal allocation of science and technology resources and improvement of sustainable development of regions in Zhejiang province. This paper chooses Zhejiang province as the research object, analyzes science and technology resources allocation of counties in Zhejiang province and its impact on regional sustainable development and discusses the key factors influencing the sustainable development of the counties. Furthermore, according to the results of the discussion, this paper puts forward promotion countermeasures and suggestions to improve the science and technology resources spatial allocation effect and the sustainable development of counties. The geographical analysis method of micro spatial unit of counties in this paper can also be used for reference to other provinces in China.

2. Literature Review

2.1. Resource Allocation and Sustainable Development

Resource scarcity requires people to make choices, allocate resources according to certain rules or mechanisms. This process is referred to as the allocation of resources. Traditional economics pursues a kind of economic efficiency, that is when the allocation of resources is conducive to economic growth, it is considered optimized. No matter what kind of resources are being used, adopting what kind of resources combination, so long as it can improve the speed of economic growth, it should be encouraged. However, simply improving the speed of economic growth directly results in serious resource waste. At the expense of the resource, economic growth can only be temporary prosperity.

Many scholars are devoted to resource allocation research in view of sustainable development. Schilling and Chiang proposes criteria under which the depletion of non-renewable resources would create excess costs for future generations, and try to answer what will be the impact of the depletion of non-renewable resources on sustainable economic development [1]. Lu and Hu point out that as China's urbanization process, rural resources are not coordinated with rural sustainable development [2]. To realize the sustainable development, it need to take a variety of policies and measures for the reconfiguration of rural resources. Higgins explores the prevailing urban transformations of Hong Kong and London in the light of a policy shift from sustainable development preoccupation to carbon control management [3]. Fürsta and Helming *et al.* discuss and present major challenges and demands on integrated land use and regional resource management and come up with an analytical framework how to correspond these demands [4]. Wan systematically expounds the basic theory and methods of the dynamic assessment of mineral resources on the basis of the sustainable development theory [5]. Chen discussed the necessity and importance of developing the theory of variable fuzzy sets to the variable fuzzy clear hybrid sets [6]. Wei and Liu adopt the relative carrying capacity theory and research method; taking nationwide and Shanxi Province as reference areas, they calculate the carrying capacity of natural resources and economic resources and synthetic carrying capacity of Taiyuan City respectively, and analyze its dynamic evolution rule from 2000 to 2010 [7].

2.2. Science and Technology Resource Allocation and Sustainable Development

A study of science and technology resources in China can be divided into three stages. In the first stage, from the 1970s to 1980s, along with the formation of resource economics theory, Chinese scholars began theoretical research of the principle of resource allocation and patterns. Second stage, from the 1980s to 1990s, researchers focused on the evaluation of science and technology resources, the efficiency of research, including the use of various scientific research methods. In the third stage, the United Nations Conference on Environment and Development in 1992 has played a huge role in promoting the formation of the concept and strategy of sustainable development.

More and more scholars in China not only pay attention to resources scarcity, but also realize it is more important that the sustainable reasonable effective utilization of limited resources, especially pay attention to national, regional sustainable ability construction problems. They realized that science and technology resources are the most important resources, the foundation of national sustainable development construction and the national competitiveness. Sun and Li discuss the development process of the concept of science and technology resources, the science and technology resource allocation target of sustainable development, and the elements system of the sustainable development of science and technology resources allocation [8]. Jiang and Liu established the objective function of sustainable development, built the industrial structure dynamic optimization model of sustainable development from the input - output analysis, and gives the model of computer technology [9]. Cheng thinks that in order to make scientific and technological innovation to strengthen the positive effect and reduce the negative effects, a new suitable "sustainable" science and technology innovation system must be established to promote the sustainable development [10]. Wu figured out that science and technology provides an important source for the urban sustainable development [11]. Szymanska and Miszczuk point out that an important rural endogenous resource is the human factor. On the basis of the obtained results it has been concluded that young people are more creative; they are leaders in innovation implementation [12]. Sedlacek focuses on universities and how they function to foster sustainable development. It identifies their actual and potential roles in fulfilling educational, research, governance, and economic development functions, as well as facilitative and mediating functions [13]. Tripon creates and develops an innovative technology for sustainable development of human resources using non-formal and informal education—for student practice [14].

2.3. Evaluation Index of Sustainable Development

Many researchers have established various types of evaluation indexes or index systems after unremitting efforts. International representative indexes include the Human Activity Intensity (HAI) index established by Israeli Hebrew University, the Human Development Index (HDI) established by The United Nations Development Program (UNDP), sustainable development indicators by Eurostat, and the International Competitiveness Index by International Institute for Management Development, Lausanne, *etc*.

Zhang and Cheng *et al.* introduced in detail the latest research progress of index system of sustainable development established by the United Nations Commission on Sustainable Development (UNCSD), Organization for Economic Cooperation and Development (OECD), International Union for Conservation of Nature and Natural Resources (IUCN) and World Bank [15]. They analyze the advantages and disadvantages of these systemic index system and the research, development and evaluation of actual applications of the typical international social development, economic development and ecological environment sustainable development index. Chen and Li *et al.* established the sustainability assessment framework based on the ecological footprint and human development index (HDI), made a comprehensive evaluation of the social development of our country and its influence on the Marine fishery resources by using the evaluation framework [16]. By studying the change of the ecological footprint of Beijing in 1990 to 2003, Zhang finds per capita ecological deficit showed significant correlation with the population, GDP [17]. Since 1990, the per capita ecological deficit intensity is in a state of unsustainability. Zhang and Chen make the time series measure and analysis of ecological footprint of supply and demand of Chizhou based on an ecological footprint model, they use the grey model forecast the per capita ecological footprint, and policy recommendations are put forward from reducing energy consumption, change the way of consumption, increase crop yield, *etc.* in order to reduce the ecological footprint [18]. Chansarn aims to assess the sustainable development of Thailand from 1971 to 2008 by looking at its efficiency in utilizing natural resources and environment, as measured by energy use and CO2 emission, to create the economic growth and promote the well-being of Thai people, as measured by real GDP per capita. The findings reveal that the growth of CO_2 emission and energy use was higher than that of real GDP per capita, implying that Thailand employed too many natural resources in creating the economic growth and promoting the well-being of its people [19]. Cairns and Martinet investigates the relationship among current consumption, sacrifice and sustainability improvement in a general context and in two canonical, stylized economies and argue that the maximum value of utility measures what is sustainable and provides the limit to growth. Maximum value is interpreted as a dynamic environmental-economic carrying capacity and current utility as an environmental-economic footprint [20]. Pires and Fidélis *et al.* aimed to discuss the constraints and achievements of standardizing these sustainable development indicators [21]. They first explore and analyze the efforts of European institutions and research projects supported by them towards the harmonization of local sustainable development indicators. Then they analyze a Portuguese initiative that uses common indicators to benchmark sustainable development across cities and municipalities. Bravo considers that the Human Sustainable Development Index (HSDI) has been proposed as a way to amend the United Nations' Human Development Index (HDI) by adding an environmental dimension. In addition, it was found that, while the HSDI represents a step ahead from the HDI, it remains insufficient in its representation of environmental sustainability [22]. A better equilibrium between social, economic and environmental goals is needed to reach a true index of sustainable development.

2.4. Research Comment

Existing literature makes a lot of empirical studies in the topic of science and technology resources allocation, including spatial distribution present situation, allocation model, allocation efficiency, relations with innovation and economy development. At the macroeconomic level, some scholars study the guidance function of science and technology policy on the resources allocation, adopting the combination of qualitative and quantitative evaluation method, carry on the comparative analysis of science and technology, national science and technology resource allocation situation and policy implementation effect, and put forward useful suggestions. Most existing literature studies from the perspective of economics, only a few discuss spatial difference in the perspective of geography. Furthermore, most geographical studies focus on spatial units of province and interstate, with quite few on the county and district. Obviously, analysis on smaller spatial units can reflect more regularity and difference of the internal space of the region. Therefore, this paper analyzes science and technology resources allocation of counties in Zhejiang province and its impact on regional sustainable development.

From the existing research literature, scholars generally realized that science and technology is the key to promoting sustainable development. The allocation of science and technology resources has a close relationship with the motivation and direction of regional economic development. Unreasonable allocation of science and technology resources is one of the important factors that hinders regional sustainable ascension. Therefore, the research of science and technology resources allocation has important theoretical and practical significance in narrowing the difference between regional economies and promoting regional sustainable development. However, in current research of the relationship between the allocation of science and technology resources and the sustainable development is relatively lacking. Normal scholars pay attention to relationship between natural resource allocation and the sustainable development. Therefore, this paper focus on the relationship between science and technology resources spatial allocation and regional sustainable development, and studies the way to promote the regional sustainable development by a rational allocation of science and technology resources.

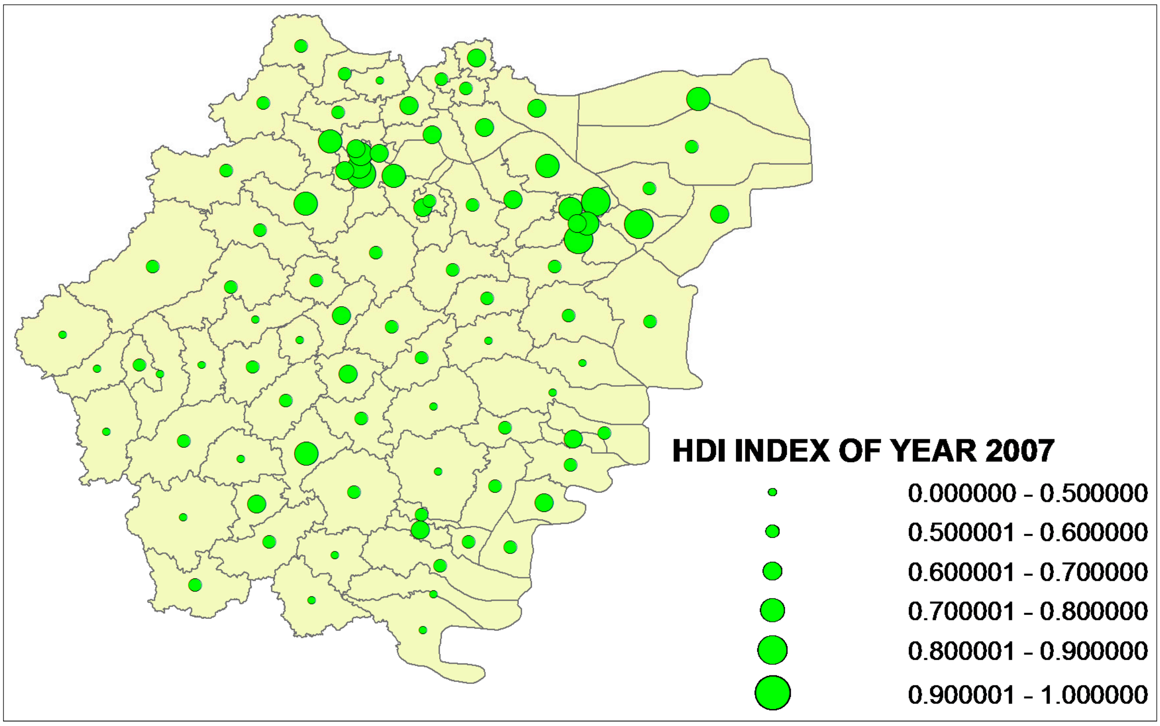
3. Spatial Variation of Regional Sustainable Development

In this paper, according to former studies, regional sustainable development is measured with the human development index (HDI). The HDI is an index system used to evaluate development based on the theory of sustainable development, and was firstly published by the United Nations Development Program (UNDP) in a human development report in 1990. The HDI states that the most important connotation of human development includes three aspects: we can choose to live a long and healthy life, we can choose gain a higher education, and we can obtain a high level of life resources. The HDI is the comprehensive index to measure the average achievement of these three aspects. First, health and longevity of life, which is denoted by life expectancy at birth. Second, knowledge, which is denoted by the adult literacy rate and comprehensive enrollment rate of primary and secondary schools and university. Third, decent standard of living, using purchasing power parity to calculate the per capita gross domestic product (GDP). Then using weighted average method respectively to calculate the index of the three aspects, average the three aspects of index. HDI is valued from zero to one, the larger the number is, and the development is more sustainable.

The data of living a long and healthy life, a higher education, a high level of life resources can be measured by the current life expectancy for region, regional education level and per capita consumption expenditure, which can be obtained from Zhejiang Statistical Yearbook and regional Statistical Yearbook in Zhejiang province and the statistic data of Science and Technology Department of Zhejiang Province between year 2007 to 2011.

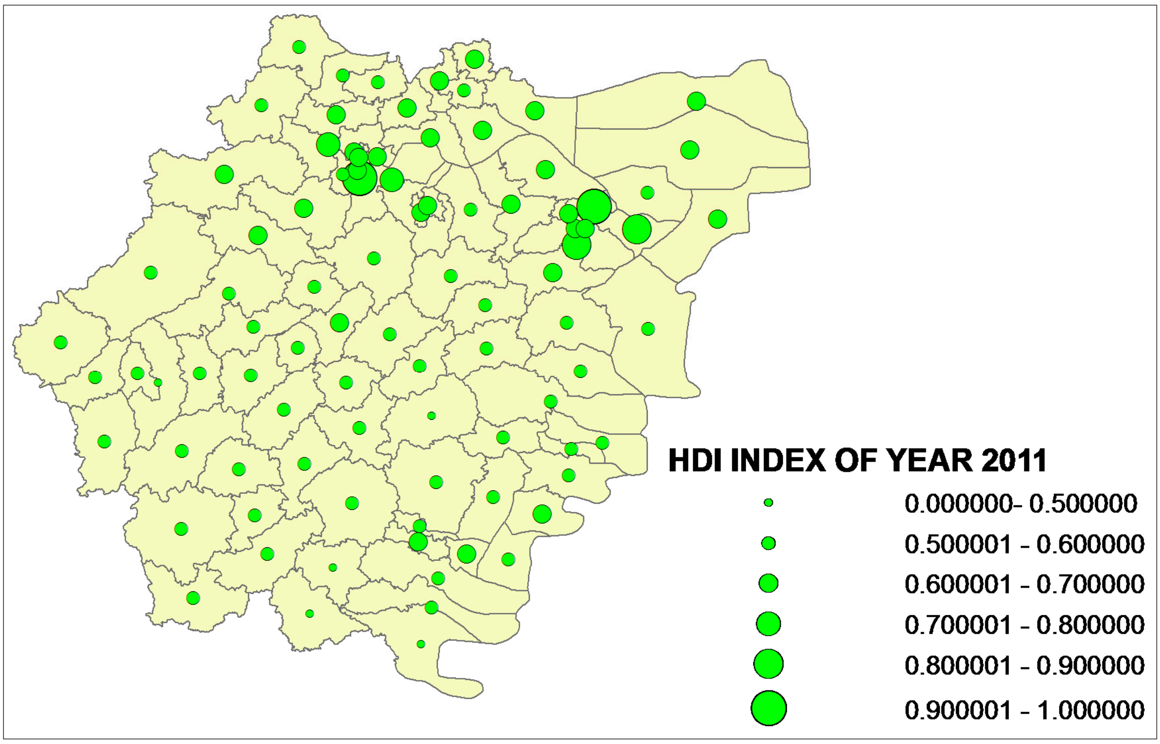
According to the statistics of the HDI, in the year 2007, the top five districts (counties) with the highest sustainable development level are Beilun district, Zhenhai district, Yinzhou district which belongs to Ningbo city, Binjiang district which belongs to Hangzhou cities, Liandu district and Lishui city, as shown in Figure 1.

Figure 1. Regional sustainable development level in year 2007.



In year 2011, the top five districts (counties) are Beilun district, Zhenhai district, Yinzhou district which belong to Ningbo city, Binjiang district and Yuhang district which belongs to Hangzhou cities, as shown in Figure 2.

Figure 2. Regional sustainable development level in year 2011.



Spatial autocorrelation refers to the correlation of the same variable in different locations. It is a concentration measurement of the spatial agglomeration degree of unit attribute value. There are two spatial autocorrelation indicators: global and local. The global autocorrelation indicator detects the spatial pattern of the whole region, the value reflect the degree of autocorrelation. The local autocorrelation indicators calculates the relevance of each space unit to its adjacent ones in a particular attribute. The main global spatial autocorrelation indexes include Global Moran's I, Geary's C, Getis'G, during which Global Moran's I is used frequently. Its formula is as follows:

$$I = \frac{N}{\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}} \times \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n}(x_i - \bar{x})^2} \quad (1)$$

In the formula, n is the number of spatial units. x_i is observed value. $\bar{x}$ is the mean value of x_i. w_{ij} is the space connection matrix of unit *i* and *j*. There are many ways to construct space connection matrix in principle according to different research purposes. In this paper, it use the adjacency matrix, 1 and 0 indicate the adjacent relation of unit *i* and *j*, 1 means adjacent whereas 0 means non-adjacent. Define $w_{ij} = 0$, and get a N dimension matrix $w(n,n)$. Global Moran's I need to test of significance as follows:

$$z(I) = \frac{I - E(I)}{S(I)}, S(I) = \sqrt{\text{var}(I)} \quad (2)$$

Calculated in accordance with the above steps of Global Moran's I, values range between −1 to 1. A positive value stands for positive correlation, a negative for negative correlation. The greater absolute value is, the larger spatial correlation is, and there is a strong clustering or strong difference. In contrast, the smaller the absolute value representation space distribution correlation is small, and the value tends to zero stands for the distribution of the space is random.

It uses the Global Moran's I to analyze the regional sustainable development level of counties (districts) in Zhejiang province. The Global Moran's I varied from 2007 to 2011 as shown in Table 1. When it is positive, it means counties (districts) tend to cluster to the counties (districts) with roughly same sustainable development level. It increases from 2007 to 2011, means this agglomeration has been enforced during the past several years.

Table 1. Global Moran's I of regional sustainable development.

Year	Global Moran's I	Z Score
2007	0.568804	9.998164
2008	0.568804	9.998164
2009	0.590226	10.399656
2010	0.603443	10.705256
2011	0.605040	10.766186

4. Modeling

4.1. Hypothesis

Science and technology resources allocation elements includes the capital, talent, knowledge, patents, information and so on in a narrow sense. The broad sense also includes laboratory equipment, research facilities such as libraries, databases, information networks, *etc*. Science and technology capital provide funding for science and technology activities, is the precondition of science and technology activities to conduct. Talent is the source of science and technology innovation of science and technology, also is the main body of science and technology activities. Information, infrastructure and equipment is the supporting condition of science and technology activities [23]. According to related researches, regional comparative advantage of scientific and technological human resources, financial resources and environmental resources are the direct cause of regional scientific and technological resources allocation efficiency [24]. Developed areas keep the sustainable development of high growth speed and economic prosperity by configuring scientific and technological resources and strengthening innovation ability and obtaining economic benefits; less developed areas can also achieve technological leapfrogging and even become creative areas through the development of regional science and technology, or by breeding the technology absorption capacity [25]. In this paper, we discuss the relationship between science and technology resources allocation and the regional sustainable development from three aspects: science and technology human resources, financial resources and environmental resources.

Human resources are a motive force to promote sustainable economic development and determines modern economic growth and development. In given conditions of natural resources, physical capital, labor and other inputs, the improvement of human capital will lead to outward expansion of social production possibilities frontier. Or under a given output, the improvement of human capital will lead to reduction of natural resources, physical capital investment, save the resources and guarantee sustainable development. Facing problems such as pollution and resource depletion, accumulation of human capital can improve the efficiency of the use of natural resources, and prompt people to seek out alternatives and provide a warranty on knowledge and skills when non-renewable resources run out. In the economic development of developed countries the national income created by the natural resources assets contribution decrease from 45% to about 25%. The contribution of human labor (knowledge and skills) share increase from 55% to 75%. That is to say, in the process of economic modernization, human capital becomes more and more important, contribution to economic growth is becoming bigger and bigger. A lot of history suggests, Human capital investment and value-added is the key factor for country's economy breaking its natural resources bottleneck to enter the high quality economy. Due to lack of the accumulation of human capital, human capital returns is very low in China. However, the human capital investment will no doubt play a more important role in the future, the importance to the coordination of economy and society, the comprehensive and sustainable development is self-evident. Under the trend of economic globalization, whether a country is rich in natural resources is not very important. As long as have a high quality human capital team, one country can achieve economic take-off. Only the priority to the development of human capital makes the development of country enter the sustainable development based on human capital, overcome the disadvantages social and economic development right now and make the development of one country into the track of benign cycle development. General studies use pure science and technology personnel number or received higher education personnel to measure a region science and technology human resource. This paper argues that science and technology human resource include not only explicit human capital, but also the invisible human capital of education, science, *etc*. So it divides science and technology human resource into science and technology personnel quantity, popularization of science and technology and labor education. So three hypothesis are brought forward:

H1: Regional scientific and technological personnel positively relate to local sustainable development. The more regional scientific and technological personnel is, the more sustainable local economy is.

H2: Regional popularization of science and technology positively relate to local sustainable development. The more regional popularization of science and technology is, the more sustainable local economy is.

H3: Regional labor education positively relate to local sustainable development. The more education labor got, the more sustainable local economy is.

In the process of the development of science and technology, capital investment plays an important role. Any scientific and technological innovation, no matter original innovation, integrated innovation, or the introduction of digestion-absorption-innovation, there must be a large number support of research and development of science and technology. This requests that when making long-term science and technology development strategic plan, increase the science and technology research and development funding must be the important content of the policy. In knowledge economy era, scientific research in essence is a process of knowledge innovation and production, scientific research funding is the basic condition of knowledge production and the most important guarantee. In order to get rid of poverty and achieve long-term development, many developing countries are trying to increase investment in science and technology, give special attention to talents and science and technology capacity building. It is worth noting that on the investment in science and technology there is still a huge gap in developed world and developing world. High-tech industry has the characteristics of high investment, high risk and high return. Science and technology capital investment discovers and cultivates potential small and medium-sized enterprises, and help the outstanding ones with capital. At the same time, capital investment will also be fully mobilize the enthusiasm of scientific and technological personnel, short the distance of the science, technology and industry. Capital input of science and technology not only provides the needed capital, but also offers the development of innovative enterprise a variety of other social resources, make its competitive advantage format rapidly. Science and technology funds investment for the development of high and new technology, which includes not only government behavior in the investment, but also independent enterprise or scientific research institutes' research and development behavior. Therefore, a science and technology investment can be divided into total funding of science and technology, government financial support, enterprise research and development enthusiasm. So three hypothesis can be made as follows:

H4: Regional total funding of science and technology positively relate to local sustainable development. The more total funding of science and technology there is, the more sustainable the local economy is.

H5: Regional government financial support positively relate to local sustainable development. The more government financial support there is, the more sustainable the local economy is.

H6: Regional enterprise research and development enthusiasm positively relate to local sustainable development. The more enterprise research and development enthusiasm there is, the more sustainable the local economy is.

Obviously, the science and technology environment in one area includes a region's economic level, infrastructure construction and industrial structure. Products and services provide by urban infrastructures can be used as an intermediate input directly involved in the city production process. Therefore, the development level of the urban infrastructure directly or indirectly affects the cost and efficiency of the production department, thus affects urban economic growth. For example, a developed city's traffic and communication systems create production elements space transfer and market trading convenience for specialized division of labor, and this enables mass production based on specialization, promotes economic activities geographically concentrated, results in the decrease of the average cost, and achieves economies of scale and agglomerate economy. At the same time, economic growth stimulates the demand for infrastructure and other services, forming a virtuous cycle. Infrastructure development level and service quality directly decides the investor's risk, uncertainty and transaction costs. The World Bank's research shows that infrastructure shortage and high costs do not form a complete set, and these are the main problems in the business environment. This is especially important for small and medium enterprises. World economic development processes indicate that industrial structure changes and gradually evolves as the change of demand structure of and technical progress. In order to realize sustainable development and the prosperity of a city, the industry is a basic and fundamental support. Only after a city's industry has developed, will a large number of employment opportunities be created. Then, they absorb a large number of the population and explore and develop both at home and abroad. Industrial structure, especially the proportion of high technology industry demonstrates the development level of high-tech industry. Therefore, the following hypotheses can be made:

H7: Regional economic level positively relate to local sustainable development. The higher the economic level, the more sustainable the local economy.

H8: Regional infrastructure construction positively relate to local sustainable development. The higher the infrastructure construction level, the more sustainable the local economy.

H9: Regional proportion of high technology industry relate positively to local sustainable development. The higher the proportion of high technology industry, the more sustainable the local economy.

4.2. Variables and Evaluation Index

Regional sustainable development is an explained variable, measured with the human development index (HDI), shown in Table 2. Explanatory variables can be divided into three aspects: science and technology human resource, science and technology financial resource and science and technology environment resource. Evaluation index are shown in Table 1.

Table 2. Variables measurement index.

Variable	Measurement Index
sustainable development	human development index(HDI)
scientific and technological personnel	technical personnel number per ten thousand people
popularization of science and technology	Popularization of science and technology funding per capita
labor education	proportion of education funding in local fiscal expenditure budget
regional total funding of science and technology	proportion of science and technology investment in GDP
government financial support	proportion of science and technology funding in fiscal expenditure
enterprise research and development enthusiasm	proportion of enterprise technology research and development fee in main business income
economic level	per capita GDP
infrastructure construction	informationalized level
industrial structure	proportion of high-tech industry

From the perspective of human resources, general studies use science and technology personnel numbers or received higher education personnel to measure a region's science and technology human input. This paper argues that the human input include not only explicitly consider human capital investment, but also the invisible education popularization of science to the human capital, *etc*., so that it uses technical personnel number per ten thousand people, popularization of science and technology funding per capita, proportion of education funding in local fiscal expenditure budget as the measurement index of scientific and technological personnel, popularization of science and technology and labor education, respectively.

From the perspective of financial resources, this paper argues that funded investment of science and technology includes not only government investment, but also independent research and development of enterprise, and research activities of scientific research institutes. A proportion of science and technology investment in the GDP, a proportion of science and technology funding in fiscal expenditure and a proportion of enterprise technology research and development fee in main business income are used as measurement index of the regional total funding of science and technology, government financial support and enterprise research and development enthusiasm.

Obviously, the science and technology environment firstly relates to the region's economic level and infrastructure construction. Per capita l GDP, informationalized level are used as measurement index of environment resource, including economic level, infrastructure construction. Secondly, the regional science and technology environment should also include the region's industrial structure, especially for scientific and technological innovation, the proportion of high technology industry in the area is especially important. Therefore, a proportion of high-tech industry is used as measurement index of industrial structure.

4.3. Econometric Model

The panel data model mainly includes the pool OLS model, the fixed effect model and the random effect model. Due to the time of sample data, the section unit is short, changes of parameters are mainly focused on cross section, and the first decision is to choose variable intercept model. Specific to the selection of the fixed effect model or the random effect model, it tests by Lagrange Multipliers and test results shows that the fixed effects model should be adopted. Therefore, this paper selected the fixed effect model to carry out empirical analysis, and the concrete form of the model are as follows:

$$\begin{aligned} \lg SD_{it} &= \alpha_i + \beta_1 \lg PER_{it} + \beta_2 \lg POR_{it} + \beta_3 \lg LE_{it} + \beta_4 \lg FUN_{it} \\ &+ \beta_5 \lg FIN_{it} + \beta_6 \lg ERD_{it} + \beta_7 \lg ECO_{it} + \beta_8 \lg INF_{it} + \beta_9 \lg IND_{it} + \mu_{it} \end{aligned} \tag{3}$$

α_i is the variable Intercept, reflects the individual differences between the regions. β_i reflects the corresponding impact on sustainable development. μ_{it} is the random error term. $SD_{it}, PER_{it}, POR_{it}, LE_{it}, FUN_{it}, FIN_{it}, ERD_{it}, ECO_{it}, INF_{it}, IND_{it}$ are sustainable development, scientific and technological personnel, popularization of science and technology, labor education, regional total funding of science and technology, government financial support, enterprise research and development enthusiasm, economic level, infrastructure construction, industrial structure respectively. To reduce the heteroscedasticity and serial correlation, we use Feasible Generalized Least Squares (FGLS) estimation model.

4.4. Data

The data of the technical personnel number per ten thousand people, popularization of science and technology funding per capita, proportion of education funding in local fiscal expenditure budget, proportion of science and technology investment in GDP, proportion of science and technology funding in fiscal expenditure, proportion of enterprise technology research and development fee in main business income and proportion of high-tech industry can be obtained from the statistic data of Science and Technology Department of Zhejiang Province from 2007 to 2011 and Zhejiang Science and Technology Statistical Yearbook. The data of per capita GDP and informationalized level are coming from the Zhejiang Statistical Yearbook and Zhejiang Regional Informationalized Development Index Report. The data of living a long and healthy life, a higher education, a high level of life resources can be measured by the current life expectancy for region, regional education level and per capita consumption expenditure, which can be obtained from Zhejiang Statistical Yearbook and regional Statistical Yearbook in Zhejiang province.

5. Results and Discussion

5.1. Results of Empirical Analysis

It uses STATA 11.0 to analyze the data. The result is as Table 3.

Table 3. Regression result.

	Variable	Coefficient	*p*-value
human resource	PER	0.1909008	0.000
	POR	0.0648423	0.000
	LE	0.0202836	0.000
financial resource	FUN	0.0616795	0.000
	FIN	0.1886012	0.888
	ERD	0.1653552	0.000
environment resource	ECO	−0.0001678	0.004
	INF	0.0884934	0.000
	IND	0.4235742	0.000
	con	−34.08153	0.000
	obs	450	
	Durbin-Watson	2.5367	

Notes: PER is scientific and technological personnel; POR is popularization of science and technology; LE is labor education; FUN is regional total funding of science and technology; FIN is government financial support; ERD is enterprise research and development enthusiasm; ECO is economic level; INF is infrastructure construction; IND is industrial structure; con is constant; obs is observation.

According to the result, scientific and technological personnel, popularization of science and technology, labor education, regional total funding of science and technology, enterprise research and development enthusiasm, infrastructure construction, proportion of high technology significant and positively correlate to regional sustainable development. The economic level significantly but negatively correlates to regional sustainable development, government financial support has no relationship with regional sustainable development.

As concerns human resources, hypotheses 1, 2 and 3 are valid. Scientific and technological personnel, popularization of science and technology and labor education are positively related to regional sustainable development. According to the situation in Zhejiang province human resources in less developed areas is limited, to accelerate the development of less developed areas, narrow the gap between regions, Zhejiang provincial government and local government introduce a series of science and technology policy, make more efforts to support underdeveloped areas, encourage entrepreneurial and innovative talent to make contribution in the less developed areas. In addition, these policies and efforts did work. The economy of less developed areas made a lot progress, but still has a long way to go in order to catch up with the developed area.

As concerns financial resources, hypotheses 4 and 6 are valid and hypothesis 5 is invalid. It means that regional total funding of science and technology, enterprise research and development enthusiasm are positive related to regional sustainable development but government financial support is not. It is can be known that there are a lot of limits for governments to distribute the resources, including low efficiency, blindness, and disobedience of the market rules. Therefore, the better way for financial resource distribution is to let market to dominate. The government plays the role of offering services, including public services, making policy and guidelines, and keeping the market free, impartial and transparent.

As concerns environmental resources, hypotheses 8 and 6 are valid and hypothesis 7 is invalid. It finds that regional sustainable development is negatively related to economic level, and positively related to infrastructure construction and proportion of high technology. In the past several decades, the development of Zhejiang economy has sacrificed the environment and ecosystem. Heavy water and air pollution surrounds the developed areas. The more developed the area, the more pollution there is. Therefore, quality of life in developed areas is actually lower than less developed areas. That us why the relationship between economic level and sustainable development is negative. Sustainable development depends on the base of better infrastructure and a higher proportion of high technology.

5.2. Discussion

This paper portrays the spatial variation of regional sustainable development level of counties (districts) in Zhejiang provinces in China. It finds that counties tend to cluster with the ones with the same sustainable development level, and this agglomeration trend has been enforced during the past several years. This paper analyzes the relationship between science and technology resources and regional sustainable development theoretically based on related literature, and brings forward several hypotheses for human resources, financial resources and environmental resources. Using data from Zhejiang province in China, it examines the hypotheses and finds that in human resources, scientific and technological personnel, popularization of science and technology and labor education are positively related to regional sustainable development; in financial resources, regional total funding of science and technology, enterprise research and development enthusiasm are positively related to regional sustainable development but government financial support is not; in environmental resources, regional sustainable development is negatively related to economic level, and positively related to infrastructure construction and proportion of high technology. Based on the results of the empirical study, some advice can be given as follows:

Improve the quality of the average labor force. From the empirical analysis and the investigation, the influence of rising labor costs price, raw material prices, exchange rate changes undoubtedly bring an end to the low cost strategy of Zhejiang. Currently, the developed region of Zhejiang province is seeking a transformation from labor-intensive to technology-intensive. Therefore, for a long period in the future, the average labor quality will directly affect the sustainable development in the region.

Eliminate the power of government in allocating science and technology resources. Let the market dominate the distribution of science and technology resource. There are a lot of limits for the government to distribute the resource, including low efficiency, blindness and disobedience of the market rules. Therefore, the best way for the financial resource distribution is to let the market dominate. The government plays the role of offering services, including public services, making policy and guideline, and keeping the market free, impartial and transparent.

Create a good environment for sustainable development. Construction of a good environment is very important to the improvement of sustainable development, especially innovative and entrepreneurial talents pay more attention to the social environment, cultural environment, living environment, education and health environment, and thus, creating a favorable environment can better attract talents of science and technology.

6. Conclusions

China needs to shift from the extensive development mode to the sustainable development mode because of the limit of resources and environment. Science and technology resources rational allocation is one of the key issues in sustainable development. Based on the counties (districts) data of Zhejiang Province in China, it portrays the spatial variation of regional sustainable development level and finds that counties tend to cluster in groups with the same sustainable development level. This agglomeration trend has been enforced during the past several years.

It then testifies to the relationship between the allocation of science and technology resources and local sustainable development, identifies science and technology human resources, financial resources and environmental resource are positively related to local sustainable development, except government financial support. Economic level has a negative relationship to regional sustainable development, because the development of the Zhejiang economy grown at the expense of the environment and ecosystem. Some advice is given according to the empirical analysis result.

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Author Contributions

Jian Wu conceived and designed the study, completed the papers in English, Guangdong Wu participates in drafting the article and revises it critically for important intellectual content, Qing Zhou gave many good research advices and helped to collect and analyze the data. Mi Li makes a comprehensive English revision.

Conflicts of Interest

The authors declare no conflict of interest.

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