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ARTICLE

Calculation and Measurement of China's Human Capital after Comparing Human Capital with Technological Innovation

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Abstract: Human capital, as a synthesis of wisdom and physical fitness condensed in workers, is sometimes confused with technological innovation by existing literature. This paper makes comparisons between these two terminologies. Technological innovation is a short-term activity that attaches importance to economic benefits while human capital accumulation is a long-term strategic process with lifelong benefits, and human capital is the foundation of technological innovation. In empirical part, this paper adopts Solow Residual Method to calculate stock, elasticity and growth rate of human capital of 10 countries after eliminating physical capital, labor force and technological innovation. It is found that human capital stock in the United States is the largest and human capital growth in China is the fastest. Calculation is followed by measurement. We construct a comprehensive index of human capital by using Index Weight Assignment Method and Two-level & Three-factor CES Function to measure and predict human capital level in China. Both calculating and measuring results show that growth rate of China's human capital is around 5%. In the future, for high-quality economic development, China should give priority to human capital development and comprehensively improve human capital competitiveness.

Keywords: Solow residual method, Index weight assignment method, Two-level & Three-factor CES Function, Comprehensive index of human capital, High-quality economic development

1. Introduction

The study of human capital in economics began in the 17th century, but it was not until the late 1950s and early 1960s that the theory of human capital was gradually formed. In 1960, Schultz [1], the initiator of human capital theory, first put forward and discussed complete concept of human capital. Human capital refers to a synthesis of

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knowledge, ability and health condensed in workers that can realize value proliferation. Education is the main way to accumulate human capital. Subsequently, Becker [2] completed development process of human capital theory from concrete to abstract and established the human capital investment theory, marking the formal formation of modern human capital theory. In the late 1980s and early 1990s, New Growth Theory, founded by Romer and Lucas, pushed human capital research to another high spot. In Lucas' economic growth model [3], human capital and technological innovation (or knowledge) exist at the same time. Accumulation of human capital only depends on existing level of human capital and has nothing to do with technological innovation – that is, human capital and technological innovation are two independent elements.

In many existing papers, however, there is no clear boundary between human capital and technological innovation. These two notions are sometimes regarded as the same thing without being distinguished in form or content. Some researchers distinguish them in form, but human capital includes technological innovation in content, which is another common confusion – that is, form is separated but content is not really separated. Moreover, some papers distinguish them both in form and content, but in empirical study, human capital is presented by education and technological innovation is presented by R&D. Technically, that is education and R&D are distinguished rather human capital and technological innovation in this kind of literature. The questions, whether human capital and technological innovation are independent conceptually or practically, what are the differences and connections between them, and what is the definition and scope of human capital, need to be further studied, which is the starting point and innovative contribution of this paper. Human capital is a critical indicator reflecting a country's comprehensive national strength, and competition of national comprehensive strength is essentially competition of human capital. Therefore, it is crucial to correctly calculate human capital, scientifically measure human capital and understand its contribution to economic growth.

This paper, at first, makes comparisons between human capital and technological innovation in three angles – that are definition, essence and quantitative difficulty. Technological innovation is a short-term activity centered on economic benefits while human capital refers to a synthesis of wisdom and physical fitness condensed in workers. Human capital is cumulative, and human capital accumulation is a long-term strategic process with lifelong benefits. Secondly, on the basis of distinguishing two terminologies, physical capital, labor force and technological innovation are eliminated by Solow Residual Method in order to calculate stock, growth rate and elasticity of human capital of 10 representative countries, including China, the United States and Japan from 1996 to 2019. The results show that stock of human capital in the United States is the largest and growth of human capital in China is the fastest. This paper then adopts Index Weight Assignment Method and Two-level & Three-factor CES Function to construct a comprehensive index of human capital to measure human capital level in China from 1978 to 2019. It is found that the growth rate of human capital in China is around 5%. The calculating and measuring results are consistent, indicating scientific effectiveness of the comprehensive index of human capital. Subsequently, we predict China's human capital level in 10 years and point out the direction and destination of human capital development in the future.

The remaining sections are arranged as follows. The second section is literature review that discusses existing papers' confusion on human capital and technological innovation in three aspects. The third section analyzes differences and relationship between human capital and technological innovation. The fourth section uses Solow Residual Method to calculate stock, growth rate and elasticity of human capital. The fifth section adopts Index Weight Assignment Method and Two-level & Three-factor CES Function to construct a comprehensive index of human capital, and then calculates and predicts human capital level in China. The final section is conclusion.

2. Literature Review

The confusion between human capital and technological innovation in existing studies can be divided into three main categories. First of all, human capital and technological innovation are directly regarded as the same notion without being distinguished either in form or content. The feature of this kind of research is that only physical capital, labor force and technological innovation appear in growth model but human capital is ignored or contained in technological innovation. For example, based on the assumptions that physical capital and labor force bring about total output and remaining contribution factors belong to total factor productivity, Wu [4] and Tu and Xiao [5] used Stochastic Frontier Production Function Method to decompose total factor productivity into technological progress and technological efficiency. They found that since reform and opening-up, the main source of China's total factor productivity growth was technological progress. Similarly, Zheng and Hu [6], Yan and Wang [7] and Yu et al. [8] adopted Malmqusit Index Method to decompose total factor productivity into technological progress and technological efficiency, thus gained the same conclusion as Wu's [4]. Xu

et al. [9] constructed an accounting framework of Aggregate Production Possibility Frontier (APPF) to explore driving force of China's economic growth. The empirical results showed that physical capital investment was the main driving force, and contribution of total factor productivity was also obvious. In these papers, total factor productivity is seen as a technological factor, which means except physical capital and labor force, human capital has no place. This may inevitably lead to overestimation of technological innovation's contribution, meanwhile, underestimation of human capital's contribution to economic growth. Some scholars, such as Chen and Li [10], pointed out that the impact of human capital on economic growth should not be ignored. Notwithstanding, only technological innovation appeared in their economic growth model instead of human capital. Zhao and Yang [11] argued that technological progress was not the only factor leading to total output other than capital and labor input. Therefore, total factor productivity was divided into technological progress and institutional change in their study and the latter had a significant impact on economic growth through capital and labor channels. However, Zhao and Yang did not further explore root cause of institutional change, which was actually the role of human capital. Mentioning the importance of human capital in economic growth, Fleisher, Li and Zhao [12] believed that except physical capital and labor force, if remaining economy-driving forces were all classified as total factor productivity without considering human capital, the contribution of technological innovation to economic growth would be overestimated. On the contrary, introduction of human capital into economic growth accounting would rationalize contribution of technological innovation.

Secondly, some researchers distinguish the two notions in form, but in content, human capital includes technological innovation. To be specific, technological innovation is regarded as a part of human capital, which is a kind of confusion that form is separated but content is not really separated. In the paper of Wang and Fan [13], for instance, the indicators measuring human capital stock included not only workers' education level but also R&D expenditure and technological achievement represented by the number of patent applications. Besides, many other scholars regard R&D expenditure as a part of human capital investment. Xu and Gong [14] defined human capital investment as the amount of financial expenditure on culture, education, science and health. Hou et al. [15] pointed out that the use of scientific research expenditure was actually a process of continuous improvement of scientific researcher's ability, hence scientific research expenditure belonged to human capital investment. Xu [16] also stated that R&D was a process of creating and applying knowledge, which consumed individual intelligence and physical strength and produced innovative outcomes. As a result, both education expenditure and scientific research expenditure should belong to human capital investment. In addition to scientific research expenditure, Song et al. [17] treated the number of scientific and technological personnel per 10000 urban employees as human capital. Sun and Yi [18] regarded the proportion of scientific researchers in total population as educational human capital. Lu and Zhou [19] considered the acceptance of patent applications and turnover of technology market as a part of human capital. Nevertheless, Qian [20] argued that the target of human capital investment was human while the target of R&D investment was object. If R&D expenditure can be seen as a part of human capital investment simply because it can improve ability of scientific researchers, then almost all productive expenditures will belong to human capital investment, which is obviously inconsistent with the reality. In summary, whether R&D expenditure belongs to human capital investment is controversial and the reason is that boundary between human capital and technological innovation is unclear.

Finally, some papers have distinguished human capital and technological innovation both in form and content, yet there are still problems of incompletion. To be specific, human capital is represented only by education-related indicators. As mentioned above, human capital, a combination of wisdom and physical fitness, is accumulated through education, basic research, on-the-job training and medical care. In other words, the distinction is made between technological innovation and education rather than human capital. In earlier studies, Romer [21] expressed human capital in terms of literacy rate in UNESCO database. Mankiw, Romer and Weil [22] adopted the proportion of workers with secondary education in total population as human capital. Romer [23] and Barro and Lee [24] took primary and secondary school enrollment rate in the initial year as the initial level of human capital. Wang and Yao [25] used average years of education of the population aged 14 to 65 to represent human capital stock, and then calculated total factor productivity in Solow Residual Method. It was revealed that physical capital was the main source of China's economic growth, and the contribution of total factor productivity was greater than that of human capital. Different from average years of education, Wang et al. [26] multiplied the total amount of labor force with a certain degree of education by years of education to measure human capital stock. They then measured technological innovation with scientific and technological capital stock

accumulated by R&D expenditure. It was found that human capital and technological innovation contributed increasingly to China's economic growth. Bai and Zhang [27] adopted years of education to calculate simultaneously the stock and intensity of human capital. In their empirical study, human capital stock was estimated by total years of education, human capital intensity was approximated by average years of education, and R&D intensity was measured by the proportion of R&D expenditure in GDP. They claimed that human capital was a labor-quality other than labor-quantity input. Thus it must be taken into consideration when estimating total factor productivity. In addition to human capital stock, Whalley and Zhao [28] saw the number of graduates with different education levels as estimated value of human capital and then calculated the residual in growth accounting to obtain total factor productivity. The empirical results showed that the value of total factor productivity was very small and negative, indicating that China's economic growth was mainly driven by joint accumulation of physical capital and human capital. The conclusions of Whalley and Zhao are different from those of Wang et al. and Wang and Yao due to various measurement indicators of human capital.

By reviewing literature, we can find that human capital and technological innovation have not been well distinguished. Two opinions that technological innovation includes human capital and human capital includes technological innovation exist at the same time. In addition, the academic world has not reached an agreement on measurement indicators of human capital. Different measurement indicators may lead to different conclusions and contributions of human capital to economic growth. This paper subsequently will discuss differences and relationship between human capital and technological innovation, which is also helpful to calculation and measurement of human capital.

3. Differences and Relationship between Human Capital and Technological Innovation

Before defining the concept and scope of human capital, we need to clarify differences and relationship between human capital and technological innovation. The differences are mainly reflected in the following three aspects.

In the first aspect, technological innovation emphasizes behavior while human capital emphasizes connotation. Technological innovation, on the one hand, is generation of new ideas and invention of new technologies; on the other hand, it refers to transforming potential productivity into real productivity as well as transforming new knowledge or technology into specific innovation achievements (such as products or services), which then enter market and finally realize market value. To sum up, technological innovation is an innovative behavior of scientific researchers and emphasizes commercial application of new technology. Human capital, however, is a combination of wisdom and physical fitness condensed in workers. Wisdom includes quality, ability and experience, and physical fitness includes health, physical strength and action. The accumulation channels of human capital include education, "learning by doing", health care and sports activities. Human is the carrier of human capital – in other words, human capital cannot exist independently without the carrier. Intangible human capital is attached to individual and takes individual's physical ability as the premise. It is reflected through a certain labor and production process playing the role of value proliferation.

The second point is that technological innovation is a short-term business activity with real-time benefits while human capital accumulation is a long-term strategic process with lifelong benefits. Technological innovation is a discontinuous event whose beginning is generation of new knowledge or technology, and ending is successful realization of innovative achievements' commercial value. Moreover, technological innovation has periodicity, and each cycle includes four stages – formation, development, maturity and recession. If innovation achievement is no longer required by market, creating profits will become difficult. Then market will initiate elimination function and technology will initiate self-renewal function. In the end, existing technology will be replaced by another new technology. Third, market demand is the starting point and profit is the core driving force of technological innovation. To ensure market position and economic benefits, innovation subject needs to adapt to changeable market demand and carry out technological innovation activities quickly and frequently. The standard to test success of technological innovation activity is not completion of technology but realization of commercial value. Therefore, technological innovation is an economic activity pursuing short-term benefits. Contrary to short-term technological innovation, human capital means long-term accumulation, which is a process of continuous improvement of wisdom and physical fitness. The total amount of wisdom and physical fitness stored in individuals at a certain time is the result of human capital accumulation, whose main channel is education. Generally, the purpose of a country's education development is not to pursue profits but to improve national quality and provide potential sources for both social and economic development. Furthermore, the accumulating process of human capital is phased over

several steps. Before taking part in work, individuals accumulate human capital in forms of quality and ability through education, aiming to be capable of thinking and understanding. During work, workers accumulate human capital in forms of skills and experience through practice and on-the-job training, aiming to have creativity and productivity. An old Chinese saying goes, "It takes ten years to grow a tree but one hundred years to cultivate a person". Human capital is of great strategic significance because it is real embodiment of a country's power and determines economic growth potential. If compared technological innovation to the sudden impulse of economic growth, then human capital is the sustainable driving force of economic growth.

Last but not least, technological innovation is easy to quantify while human capital is difficult to quantify. The indicators measuring technological innovation include the number of international patent applications of PCT (Patent Cooperation Treaty), intellectual property income, top 500 world-famous brands, etc. In addition, there are other indicators such as R&D expenditure, R&D personnel, scientific and technological papers and works, technological invention awards, etc. These indicators all have specific values, so technological innovation is much easier to quantify. On the contrary, human capital quantification is doomed to be difficult. As mentioned above, human capital refers to wisdom and physical ability which is not independent of individual, so it is impossible to observe it directly. Moreover, human capital accumulation is a continuous dynamic process that is much more complicated to measure than static activities. However, this does not mean that human capital cannot be measured. In next section, Solow Residual Method will be used in an effort to measure human capital.

Although there are several differences between human capital and technological innovation, there are still connections between them. On the one hand, technological innovation is an activity of applying new knowledge and technology and then transforming them into innovative achievement. New knowledge and technology come from human wisdom and quality, which means technological innovation is essentially a kind of human activity. On the other hand, perceiving changes of market demand, realizing commercial values of innovative achievement, imitating and surpassing new technology all need individual's ability, experience and physical fitness as the backing. Accordingly, technological innovation is inseparable from the role of human capital. The relationship between human capital and technological innovation is also reflected in that human capital can promote technological innovation, absorption and imitation. Benhabib and Spiegel [29], based on cross-section panel data of 78 countries from 1960 to 1985, found that level of human capital stock determined level of technological innovation, and technologically weak countries with more human capital stock could quickly catch up with technologically leading countries. Vandenbussche, Aghion and Meghir [30], based on panel data of 19 OECD countries from 1960 to 2000, claimed that skilled human capital contributed to technological innovation and unskilled human capital contributed to technological imitation. Fleisher, Li and Zhao [12] used provincial data of China from 1985 to 2003 to investigate impacts of human capital on total output and total factor productivity. Their study showed that human capital directly promoted economic growth by itself and indirectly promoted through technological innovation channel. Furthermore, impacts of human capital on total factor productivity can also be divided into direct impact and indirect impact. The direct impact is reflected in improvement of technological innovation and the indirect impact is reflected in improvement of technological absorption capacity.

These are the main differences and connections between human capital and technological innovation. In a word, technological innovation is a short-term activity that attaches importance to economic benefits while human capital accumulation is a long-term process that attaches importance to social benefits. Human capital is the foundation of technological innovation. Clarifying the differences between them will help to measure stock and growth rate of human capital and objectively understand the contribution of human capital to economic growth.

4. Calculating Stock and Growth Rate of Human Capital

4.1 Model Setting

We assume a Cobb-Douglas production function, and input factors include physical capital, human capital, labor force and technological innovation. Bai and Zhang [27] pointed out that when accounting for technological innovation or total factor productivity, physical capital, labor force and human capital are necessary elements. Thus, when we calculate human capital, production function should also include physical capital, labor force and technological innovation. Based on the assumption of Cobb-Douglas production function, to calculate stock and growth rate of human capital, this paper uses Solow Residual Method, which is proposed by American economist Robert M. Solow based on Cobb-Douglas production function to calculate the residual

value after regression. As discussed in the third section, there are obvious differences between human capital and technological innovation. Therefore, when using Solow Residual Method to calculate human capital stock, we will further eliminate technological innovation after eliminating physical capital and labor force. Assuming Cobb-Douglas production function is constant returns to scale and technological progress is Harold neutral, the production function is:

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In this function, Y_t is total output, K_t is physical capital, H_t is human capital, A_t is technological innovation, L_t is labor force, and $(AL)_t$ is effective labor force., α, β and 1-α-β are output elasticity, i.e. share of factor income of physical capital, human capital and effective labor force respectively.

Take natural logarithm on both sides of Function 1 and obtain:

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Take derivation of t on both sides of Equation 2 and move items to get Solow residual value:

after Comparing Human Capital with Technol (3)

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Accordingly, growth rate of human capital is:

[Abstract] Human capital, as a synthesis of wisd (4)

In Equation 4, g_H is growth rate of human capital, g_Y is growth rate of total output, i.e. economic growth rate, g_K is growth rate of physical capital, g_A is growth rate of technological innovation, and g_L is growth rate of labor force.

4.2 Variable Choices and Data Sources

This paper collects the time series data of 10 representative countries from 1996 to 2019 to calculate and compare human capital country by country. First, GDP growth rate is selected to represent economic growth. Economic growth refers to the continuous and stable increase of an economy's production over a period of time due to the increase of input factors [18]. And GDP refers to the final result of production activities of all permanent residents in a country (or region) within a certain period of time. Thus, GDP growth rate can be used to measure economic growth. Data are from Penn World Table 10.0 database [31], which provides two types of GDP – output-side real GDP and expenditure-side real GDP. The former one aims to measure living standard of people and the latter one aims to measure actual production capacity of an economy [32]. Since the input factors we select are all from production field, output-side real GDP is more suitable for our empirical study. Second, physical capital stock is calculated by using buildings and equipment inputs. As mentioned by Sun and Ren [33], in theory of growth accounting, when measuring physical capital, it is necessary to classify input factors, which are generally divided into buildings and equipment. Penn World Table 10.0 database provides the actual value of physical capital stock that is calculated by using constant prices of buildings and equipment. Next, referring to the practice of Zhao and Yang [11], the number of persons engaged is used to measure labor force, and data is also from Penn World Table 10.0 database. Finally, the proportion of R&D expenditure in GDP and the number of patent applications are selected to measure technological innovation. It is believed that intangible technological capital stock is accumulated by R&D investment. Therefore, when investigating the contribution of technological capital, Wang et al. used the proportion of R&D expenditure in GDP [26]. Deng [34] further claimed that patents and R&D activities were closely linked, and combination of the two could better measure technological innovation. Besides, we obtain data from WDI (World Development Indicators) database of the world bank, and then integrate labor force and technological innovation to obtain effective labor force.

4.3 Calculation and Comparison of Human Capital

Combining indicators and data, the econometric regression equation corresponding to equation 2 is:

innovation is a short-term activity that attaches ir (5)

In this equation, residual term includes human capital in logarithmic form. Ordinary Least Square is used to estimate country by country, and basic regression results are shown in the odd columns of Table 1 and Table 2. It should be noted that there is a certain connection between human capital, physical capital and effective labor force, which implies that regression will inevitably have endogeneity problem. In the absence of instrumental variables, this paper solves endogeneity by using lagged values of physical capital and effective labor and Two-stage Least Square method. The regression results are shown in the even columns of Table 1 and Table 2.

In the above tables, the coefficient of ln(capstock) is output elasticity of physical capital, i.e. . The coefficient of ln(efflabor) is output elasticity of effective labor, i.e. . Subsequently, output elasticity of human capital, i.e. can be obtained, which is shown in the antepenultimate row of Table 1 and Table 2. After calculating growth rate of total

Table 1. Regression results of China, the United States, Japan, Germany, and the United Kingdom

	China		United States		Japan		Germany		United Kingdom	
Variables	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
ln(capstock)	0.472***		0.533***		0.209**		0.206**		0.491***	
	(-0.0768)		(-0.171)		(-0.0884)		(-0.0784)		(-0.055)	
ln(efflabor)	0.102***		0.203***		0.352***		0.583***		0.390*	
	(-0.0238)		(-0.0619)		(-0.0952)		(-0.101)		(-0.197)	
L.ln(capstock)		0.477***		0.524***		0.205**		0.208**		0.497***
		(-0.0776)		(-0.168)		(-0.0868)		(-0.0792)		(-0.0557)
L.ln(efflabor)		0.099***		0.200***		0.363***		0.557***		0.479*
		(-0.0231)		(-0.0609)		(-0.0983)		(-0.0968)		(-0.242)
Output Elasticity of Human Capital	0.426	0.424	0.264	0.276	0.439	0.432	0.211	0.235	0.119	0.024
Observations	24	24	24	24	24	24	24	24	24	24
R-squared	0.998	0.998	0.987	0.987	0.778	0.778	0.925	0.925	0.847	0.847

Table 2. Regression results of Australia, Canada, India, Brazil and Republic of Korea

	Australia		Canada		India		Brazil		Republic of Korea	
Variables	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
ln(capstock)	0.468***		0.470***		0.508***		0.335***		0.452***	
	(-0.105)		(-0.0318)		(-0.048)		(-0.0607)		(-0.039)	
ln(efflabor)	0.168***		0.316***		0.208***		0.193***		0.330***	
	(-0.031)		(-0.0318)		(-0.0403)		(-0.0348)		(-0.0657)	
L.ln(capstock)		0.464***		0.466***		0.518***		0.330***		0.440***
		(-0.105)		(-0.0315)		(-0.0489)		(-0.0598)		(-0.038)
L.ln(efflabor)		0.167***		0.255***		0.212***		0.197***		0.363***
		(-0.0309)		(-0.0257)		(-0.0411)		(-0.0356)		(-0.0721)
Output Elasticity of Human Capital	0.364	0.369	0.214	0.279	0.284	0.270	0.472	0.473	0.218	0.197
Observations	24	24	24	24	24	24	24	24	24	24
R-squared	0.948	0.948	0.952	0.952	0.998	0.998	0.990	0.990	0.967	0.967

output, physical capital stock, and effective labor force of each country, we then calculate growth rate of human capital by using factor output elasticity of 2-SLS and equation 4, and the results are shown in Table 3. Finally, the residual value of regression is derived – that is, human capital stock of each country from 1997 to 2019, as depicted in Figure 1 below.

As can be seen in Table 3 and Figure 1, the growth rate of human capital in developing countries is generally higher than that in developed countries. From 1996 to 2019, China has the highest growth rate of human capital (4.92%) and is more than twice as much as that of the United States. In terms of human capital growth rate, China is followed by India, whose GDP is close to Germany's GDP. Similarly, India's human capital growth rate is twice as much as that of Germany. The reason may be that India, as a developing country, has high growth rate of population and effective labor input, hence growth of human capital has an advantage of population scale.

A more noteworthy country is Japan. As shown in Table

Table 3. The growth rate of total output, physical capital, effective labor force and human capital of each country from 1996 to 2019

	Growth rate of total output	Growth rate of physical capital	Growth rate of effective labor force	Growth rate of human capital
China	6.60%	8.71%	3.57%	4.92%
The United States	2.46%	1.98%	3.59%	2.57%
Japan	0.36%	0.35%	0.95%	-0.12%
Germany	2.21%	2.11%	2.32%	2.05%
The United Kingdom	2.50%	3.92%	1.08%	1.53%
Australia	3.56%	2.84%	5.13%	3.77%
Canada	2.83%	2.81%	3.72%	2.05%
India	7.30%	9.77%	5.24%	4.17%
Brazil	3.65%	4.86%	2.15%	3.43%
Republic of Korea	3.06%	3.86%	2.27%	2.72%

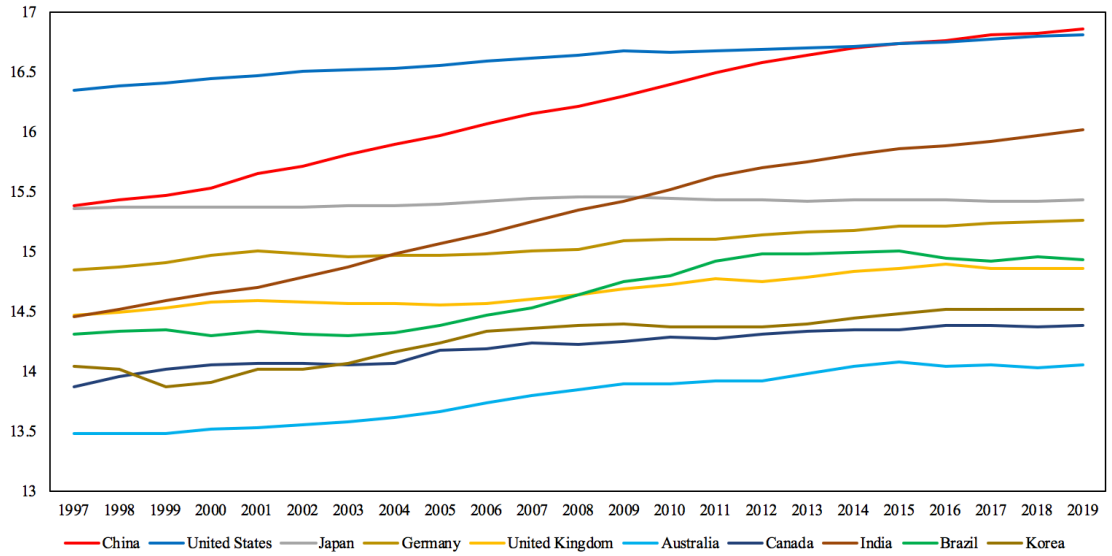

Figure 1. Human capital stock based on regression residual values of each country from 1996 to 2019

1, Japan has a large elasticity of human capital, which is credited with government's successive attention to education and two successful education reforms in history. The first education reform took place in Meiji Restoration period (1868-1912). Reform contents included learning actively from western advanced countries, forming a unified education network throughout the country and taking primary compulsory education as the central link of education reform [35]. In the early stage after World War II, Japan, as a defeated country, was devastated and depressed and its total output fell sharply. In 1947, Japan's government published the basic law on education, which proposed to establish a democratic and cultural country. To achieve this goal, Japan mainly depended on the power of education, thus second comprehensive education reform commenced. First step was increasing investment in education to ensure adequacy of education funds. From 1960 to 1970, growth rate of Japan's education expenditure firstly exceeded its GDP. At the same time, the proportion of government education expenditure in GDP continued to increase, which surpassed 4% (4.01%) in 1972, further surpassed 5% (5.06%) in 1979 and finally reached 5.60% in 1987, higher than other developed countries' in the same period. Second policy was reforming compulsory education and strengthening its popularization. In 1947, Japan's government changed the compulsory education from six-year to nine-year and continued to popularize it nationwide. In 1953, the popularization rate of compulsory education reached 99.9%, and in 1971, the enrollment rate of primary and secondary schools was over 100% (100.85%), ranking in the forefront among developed countries. The third point

was attaching importance to senior high school and higher education to cultivate professional talents. Japan's senior high school enrollment rate was about 40% in 1950, running up to 93% in 1976. Higher education enrollment rate was about 20% in 1960, amounting to over 50% in 1976 [36], marking the beginning of higher education popularization. The popularization of senior high school education and higher education had further promoted accumulation of human capital and provided abundant professional talents for transformation of industrial structure, technology introduction and absorption in Japan. In addition, Japan strengthened science and engineering education of university to cultivate scientific and technological talents for R&D. Meanwhile, it revitalized vocational education to provide skilled talents for industrial development. Only after two or three decades, Japan's education had advanced tremendously and education level of the whole population had been greatly improved, which accumulated a large amount of human capital for economic growth. In 1972, Japan overtook Germany and became the world's second largest economy. In the meantime, Japan's technological innovation level gradually surpassed that of Germany, Britain and France. Takeo Fukuda, the 67th Prime Minister of Japan (served from 1976 to 1978), once pointed out that, "It is human capital that revitalizes the country, shoulders the national missions and realizes the national prosperity. Japan is not a well-resourced country, and the reason why it is able to become strong and powerful in a short time is popularization of education and improvement of national education level". However, after the 1990s, because of capital market collapse and real estate bubble, Japan's economy suddenly slowed down and growth rate of human capital, at the same time, had not improved for a while. According to the calculation results in Table 3, average growth rate of human capital in Japan from 1996 to 2019 is -0.12%, ranking poorly among many countries. Japan has a high elasticity of human capital, so as long as the human capital development strategy is properly changed, growth effect of human capital can be brought into play again.

In China, human capital stock had been continuously rising from 1996 to 2019, and even surpassed that of United States in 2015. Since the 1990s, with rapid economic growth, fast urbanization process, prominent demographic dividend and attention of the whole society and families to education, China had a great advantage of accumulating human capital. Demographic dividend was gradually changing into human capital dividend, and China was gradually moving from a country with large population to a country with powerful human capital. Education is the main way of human capital accumulation, and China holds the biggest educational work all over the world. After years of development and reform, China's education had made great achievements and overall education level of people had been greatly improved. As can be seen first from education investment, the total investment in education increased at an average annual rate of 16.30% from 1991 to 2019, from 73.150 billion yuan to 501.7812 billion yuan, and the proportion in GDP increased from 3.32% to 5.09% [37]. Secondly, from the perspective of education, the number of people without being educated of the total population in China had been decreasing from 39.00% to 7.33% from 1982 to 2019. Among the population aged 15 and over, people with junior high school education or above increased from 251 million to 932 million, and the proportion increased from 37.15% to 82.52%. The average schooling years of working-age population increased from 6.24 years in 1985 to 10.5 years in 2019 [38], higher than world average level 8.5 years [39]. Thirdly, from the perspective of education enrollment rate, the population coverage rate of nine-year compulsory education reached 85% in 2000, and the goal of "basically popularizing nine-year compulsory education and basically eliminating illiteracy among young and middle-aged people" was initially achieved. In 2002, the gross enrollment rate of higher education reached 15%, marking the beginning of higher education popularization. In 2010, the population coverage rate of "two basically" reached 100%, which meant that China had fully realized the goal of "two basically" and taken the lead in realizing education for all people among nine large-population developing countries (which are China, India, Indonesia, Bangladesh, Pakistan, Egypt, Nigeria, Mexico and Brazil). In 2015, the gross enrollment rate of senior high school education reached 87%, marking the realization of "basically popularizing senior high school education". By the end of 2018, the gross enrollment rate of pre-school education was 81.7%, the net enrollment rate of primary school-age children was 99.95%, the gross enrollment rate of junior middle school was 100.9%, the consolidation rate of nine-year compulsory education was 94.2%, the gross enrollment rate of senior high school was 88.8%, and the gross enrollment rate of higher education was 48.1% [40].

Since human capital stock is going up, the contribution of human capital to China's economic growth is also becoming increasingly prominent. Column 2 of Table 1 shows that elasticity of human capital is 0.424, close to that of physical capital 0.477, which means that China's economic growth is driven by accumulation of both physical capital and human capital. Large-scale physical

capital investment can promote rapid improvement of economic growth in the short term. However, it is impossible for an economy to achieve sustainable growth only by physical capital investment without human capital accumulation. When there is too much physical capital and little human capital, advanced machinery and equipment cannot be fully utilized by workers, and production efficiency is greatly reduced, resulting in the decline of marginal income of physical capital, which will finally hinder economic development. On the contrary, when there is too much human capital and little physical capital, resources such as production materials and jobs will become tight because high-level human capital has to engage in simple work so that low-level human capital becomes unemployed. In brief, economic growth needs both physical capital and human capital. The coordination and matching of these two kinds of capital can ensure a rapid and sustainable economic growth. The matching of human capital and physical capital, in addition, is a sufficient and necessary condition for technological innovation. Technological innovation is a process of transforming new ideas and technologies into innovative achievements and then realizing commercial value. This process is inseparable from machinery, equipment, and wisdom and physical strength of technicians. Therefore, without either human capital or physical capital, technological innovation cannot take place.

Since the stock, output elasticity and growth rate of human capital are all calculated by using Solow Residual Method, this paper will next adopt Index Weight Assignment Method and Two-level & Three-factor CES Function to construct a comprehensive index so as to measure human capital stock of China from 1978 to 2019. We then compare the measuring results with the calculating results to test rationality of this comprehensive index, and finally predict China's human capital level in 10 years.

5. Measuring China's Human Capital Stock

5.1 Measuring Indicators

Referring to the concept of human capital and the differences between human capital and technological innovation in section 3, we define that human capital includes three factors – knowledge, quality and health. Knowledge comes from basic research, quality comes from education, and health comes from medical care and sports. Therefore, the comprehensive index of human capital is composed of three sub-indicators – basic research, education (academic and physical education) and health care. General research and experimental development (R&D) are divided into three types – basic research, applied research and experimental development. Basic research refers to experimental or theoretical research aiming to reveal essence of objective things and obtain new discoveries, theories and basic principles. It takes scientific theories and works as the main form, reflecting original innovation ability of knowledge. Unlike applied research and experimental development, the objective of basic research is not specific application or economic benefit. That's why we classify the basic research into human capital as the source of knowledge.

To unify dimension, we use the number of personnel in relevant fields for three sub-indicators. As mentioned above, human capital refers to knowledge, quality and physical ability attached to individuals. Therefore, it is reasonable using the number of personnel to represent human capital. First, basic research is presented by the number of researchers in basic research and experimental development, involving scientific R&D institutions, colleges and universities and industrial enterprises above designated scale. Second, mainly accumulated by education, human capital is embodied in quality and ability of school students, which will determine employment rate of graduates [41]. Thus, education index is seen as the number of graduates of all kinds of education at all levels, including general education, vocational education and adult education. Thirdly, employees in health and sports industries are necessary for people to obtain medical resources and participate sports activities, which can objectively reflect a part of human capital [18]. That's why we use the number of personnel in various health institutions and sports system to represent health care index. The personnel of health institutions include health technicians such as doctors, nurses and pharmacists, as well as non-health technicians such as managers and skilled workers, involving hospitals, grass-roots medical and health institutions, professional public health institutions, etc. The personnel of sports system include athletes, full-time coaches, full-time cultural teachers, involving sports administrative organs, training bases and stadiums, sports vocational colleges, sports middle schools and primary schools. The classification standard and data sources stem from China Statistical Yearbook and China Education Statistical Yearbook of the National Bureau of Statistics.

5.2 Measuring Equation

Cobb-Douglas function assumes that substitution elasticity between two factors is one, but practically, substitution elasticity between every two indicators of human capital comprehensive index is different. Under

this situation, Two-level & Three-factor CES Function, which allows substitution elasticity varies among factors, is another choice. This paper uses Two-level & Three-factor CES Function to construct a comprehensive index of human capital, which is shown as:

(6)

Citation: Wu KP, Wu MT. Calculation and Measurement of

The first level is:

Science Research, 2022, 5(1), 5796. I

(7)

The second level is:

workers, is sometimes confused with

(8)

This paper makes comparisons be

The first-level elements include the number of basic researchers, i.e. BR_t, and the number of education graduates, i.e. EDU_t. The substitution elasticity between BR_t and EDU_t is ital is the found. At the second level, the combined element of BR_t and EDU_t, i.e. Sc recombines with the number of health and sports personnel, i.e. HS_t to form an integrated CES function. The substitution elasticity between Sc and HS_t is ogical innovation. It is found that l weights, equal to relative ratio of expenses which are respectively R&D expenditure, total investment of national education and total cost of medical care. Calculating equation of substitution elasticity ita is:

Index Weight Assign

measure and predict

(9)

In Equation 9, is marginal rate of substitution between the number of basic researchers and the number of education graduates . And it is calculated as follows:

[Keywords] Solow resi

Three-factor CES Func

(10)

Similarly, calculating equation of substitution elasticity is:

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(11)

In Equation 11, is marginal rate of substitution between the combined element and the number of health and sports personnel . And it is calculated as follows:

(12)

5.3 Measuring Results

By using data of three sub-indicators and equation 7 to 12, substitution elasticities are calculated as and . Bringing them into equation 6, we can obtain the final measuring results of human capital. In line with the year span in section 4, Table 4 shows human capital from 1996 to 2019. Further calculation shows that growth rate of the measuring value of human capital is 5.02%, very close to that of the calculating value of human capital 4.92% in section 4. This indicates that the comprehensive index of human capital constructed above is scientific and effective. Moreover, growth rate of the number of basic researchers is 5.00%, growth rate of the number of school graduates is 0.39%, growth rate of the number of health and sports personnel is 1.22%, and growth rate of combined factor (of the number of basic researchers and school graduates) is 5.01%.

Table 4. Measuring results of China's human capital stock from 1996 to 2019

Year	Number of basic researchers	Number of graduates	Number of health and sports personnel	Human capital H'	Human capital H
1996	6.96	5050.02	688.35	7.10	7.35
1997	7.17	5341.28	698.80	7.30	7.57
1998	7.87	5575.14	701.65	8.02	8.31
1999	7.60	5845.38	704.67	7.74	8.01
2000	7.95	5968.62	706.40	8.09	8.36
2001	7.88	5967.40	702.81	8.02	8.27
2002	8.40	6073.28	667.68	8.55	8.81
2003	8.97	6210.26	636.27	9.12	9.40
2004	11.07	6304.25	647.67	11.25	11.58
2005	11.54	6433.14	658.90	11.72	12.06
2006	13.13	6426.20	682.61	13.33	13.71
2007	13.81	6561.03	711.23	14.02	14.40
2008	15.40	6612.67	740.24	15.63	16.07
2009	16.46	6554.90	793.48	16.69	17.17
2010	17.37	6525.76	836.30	17.61	18.10
2011	19.32	6447.99	877.33	19.59	20.13
2012	21.22	6377.95	927.55	21.51	22.10
2013	22.32	6183.63	994.28	22.61	23.24
2014	23.54	5877.79	1038.24	23.85	24.53
2015	25.32	5749.69	1084.30	25.65	26.41
2016	27.47	5768.17	1132.06	27.83	28.68
2017	29.01	5726.28	1189.60	29.38	30.30
2018	30.50	5710.15	1244.56	30.88	31.87
2019	39.20	5810.69	1307.65	39.69	40.97

Next, based on above five growth rates, we can project human capital and relevant indicators in 10 years. The predicting formulas are ticity and growth rate of human capital of 10 countries after eliminating physical

capital, labor force and technological innovation. It is found that human capital. In addition to three sub-indicators, we also predict the number of ordinary senior high school and college graduates by using growth rate of , and professional (or assistant) doctors per 1000 population by using growth rate of . Prediction results are shown in Table 5. In terms of research and experimental development, the number of people engaged in basic research in 2019 is 392,000, which, according to prediction, will double to 670,800 by 2030. Moreover, the proportion of basic research investment in total R&D investment in 2019 is 6.14%. This number, based on prediction by using growth rate of , will go up to 8.24% in 2025, which is consistent with the goal of China's 14th Five-year Plan. The 14th Five-year Plan proposes that for innovation-driven development, average annual growth rate of R&D investment should remain more than 7%, and proportion of basic research investment in total R&D investment should reach more than 8%. Secondly, when it comes to education, in 2019, China's population aged 15 to 64 is 986 million with ordinary senior high school graduates accounting for 0.80% and ordinary university graduates accounting for 0.77%. Besides, senior high school education gross enrollment rate is 89.5% and higher education gross enrollment rate is 51.6%. It is predicted by using growth rate of that senior high school gross enrollment rate will reach 93.39% in 2030 and that of higher education will reach 53.84%. Accordingly, policy implication is that China must accelerate popularization of senior high school education and higher education. At last, in health care, the 14th Five-year Plan has added the indicator "number of occupational (assistant) doctors per 1000 population" into the category of people's livelihood and well-being, which is the main indicator of economic and social development. In 2019, the number of occupational (assistant) doctors per 1000 population is 2.76 and it will reach 3.16 in 2030, predicted by using growth rate of .

6. Conclusions

Discussing differences between human capital and technological innovation, and defining the concept and scope of human capital are of great significance to correctly understand human capital and its contribution to economic growth. After pointing out confusions between human capital and technological innovation in the existing literature, this paper first distinguishes them in three aspects. First, technological innovation emphasizes human behavior and results, which is an economic activity that transforms new knowledge or new technology into innovative achievement and finally realizes market value. Human capital emphasizes human connotation and quality, which is a synthesis of wisdom and physical fitness condensed in workers. Second, technological innovation is a short-term business activity with real-time benefits while human capital accumulation is a long-term strategic process with lifelong benefits. Third, it is easy to quantify

Table 5. Ten-year prediction of China's human capital

Year	Number of basic researchers	Number of education graduates	Number of health and sports personnel	Human capital	Number of ordinary university graduates	Number of ordinary senior high school graduates	Number of licensed doctors/1000
2020	41.16	5833.20	1323.60	43.03	761.47	792.31	2.80
2021	43.22	5855.79	1339.75	45.19	764.42	795.38	2.83
2022	45.39	5878.48	1356.09	47.45	767.38	798.46	2.86
2023	47.66	5901.25	1372.64	49.83	770.35	801.55	2.90
2024	50.04	5924.11	1389.38	52.33	773.34	804.65	2.93
2025	52.55	5947.05	1406.33	54.96	776.33	807.77	2.97
2026	55.18	5970.09	1423.49	57.72	779.34	810.90	3.01
2027	57.94	5993.22	1440.85	60.61	782.36	814.04	3.04
2028	60.84	6016.43	1458.43	63.65	785.39	817.19	3.08
2029	63.88	6039.74	1476.22	66.85	788.43	820.36	3.12
2030	67.08	6063.13	1494.23	70.20	791.48	823.54	3.16

technological innovation but difficult to quantify human capital, but this does not mean that human capital cannot be calculated or measured. That's what we do in section 4 and 5. In section 4, Solow Residual Method is used to calculate stock, growth rate and output elasticity of human capital in 10 representative countries from 1996 to 2019. The calculation results show that the United States has the largest stock of human capital while China has the fastest growth of human capital (4.92%, more than twice as much as that of the United States). In section 5, we adopt Index Weight Assignment Method and Two-level & Three-factor CES Function to construct a comprehensive index of human capital which includes three sub-indicators – the number of basic researchers, the number of graduates and the number of health and sports personnel. Subsequently, the comprehensive index plays an important role in calculating China's human capital from 1978 to 2019 and predicting human capital level in the next 10 years. Comparing the calculating and measuring results, we find that the comprehensive index of human capital is scientific and effective, and growth rate of human capital in China is around 5%. In line with the final prediction results, China should continue to increase proportion of basic research investment in total R&D investment, accelerate popularization of senior high school education and higher education, and expand supply of medical and health resources. Nowadays, the strategic orientation of China's economic development is paying attention to technological innovation, sustainable development and modern economic system construction. Human capital is the foundation of technological innovation as well as the long-term driving force of economic growth. National rejuvenation and high-quality economic development all depend on it. Therefore, China must give top priority to the development of human capital and comprehensively improve the level of human capital through education, basic research, medical care and sports activities.

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ARTICLE

Industrial Linkage: Dynamic Equilibrium Supply Chain of Foundry Landmark Industrial Chain -- An Analysis Based on Zhejiang

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Abstract: In the face of the impact of the epidemic on the industrial chain and supply chain, it is an inevitable requirement for industrial development to ensure the dynamic balance of the supply chain. Supply chain is the basis for the generation of industrial chain. Industrial linkage can promote the rational layout of industries. The operation mode of supply chain is the main driving force of industrial linkage. To build a dynamic and balanced supply chain, we must focus on symbolic industries and adopt measures of chain protection, chain supplement, chain creation and chain financing.

Keywords: Industrial chain, Supply chain, Dynamic equilibrium, Industry linkage

1. Questions Raised

General secretary Xi Jinping pointed out that "we need to promote the formation of a new development pattern based on domestic circulation as the main body and international and domestic dual cycles promoting each other", pointing out the direction for the transformation of China's economic development priorities. Through technological improvement and innovation, reorganizing the national industrial chain and supply chain, actively participating in international competition, learning foreign advanced experience and technology, and promoting our own products and technology abroad will become the main melody of China's economic development in the future.

1.1 Environmental Change: Calling for the Reorganization of Industrial Chain and Supply Chain

1.1.1 The change of international and national environment promotes the reorganization of industrial chain and supply chain

The outbreak of novel coronavirus pneumonia has a

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great impact on China and the world economy. Despite the effective control of the epidemic situation, the economic downhole has been repaired and narrowed to a certain extent. Many areas'economy has recovered to the level of pre epidemic development, but in many countries, COVID has not been effectively controlled worldwide. The unsynchronized spread and development of the epidemic in the world has blocked the international transportation network and caused a large number of breakpoints in the global supply chain. Due to the escalating regional political and economic frictions, the rise of trade protectionism and unilateralism, the trend of regionalization and localization of global production networks, and the trend of "De Sinicization" of industrial chains and supply chains began to prevail. These deterministic and uncertain factors have exacerbated the downward pressure on the international and domestic economy. In the face of changes in the international and domestic environment, the strategic choice of cooperation and competitive advantage, tap the domestic demand potential and establish a national unified market, the readjustment of the industrial chain and supply chain has become inevitable.

1.1.2 Zhejiang's industrial development needs the innovation of iconic industrial chain and supply chain

In recent years, Zhejiang has paid attention to the innovation of industrial chain and supply chain, implemented the "Chain length system", the development of industrial chain has shifted to both ends of the "Smile curve", and some industries have sprouted the high-end of industrial chain. However, under the influence of experience and development inertia, without external conditional intervention, enterprises engaged in the same or similar economic activities in the industrial chain follow the principle of location optimization in order to maximize profits and form a phenomenon of enterprises clustering in advantageous locations. It shows that enterprises gather around the industrial chain center composed of leading industries and extend along the upstream and downstream of leading industries. With the continuous increase of accumulated enterprises in the industrial chain and the continuous expansion of industrial scale, one or more core enterprises will appear in the industrial chain, and these enterprise centers will also gather many associated enterprises, so as to form industrial sub centers of a certain scale. Due to different resource endowments, the spatial distribution of enterprises in the industrial chain is bound to be unbalanced. The benefit pursuit of regional enterprises for location advantages, the path dependence and inertia of regional specific resource endowments and economic development characteristics have led to the imbalance and irrationality of industrial development, the disconnection of industrial chain and supply chain, chain obstruction and difficult linkage of all links. For example, Shaoxing chemical fiber mainly produces conventional low-grade products, the production of functional fibers is almost blank, and the production capacity of high-grade fabrics is insufficient, which can not form a supporting with the developed famous clothing enterprises in Ningbo and Wenzhou. Building a landmark industrial chain and a dynamically balanced supply chain urgently need to be put on the agenda.

1.2 Building of Sign Industry

It is necessary to reconstruct the theoretical system of modern industrial chain and supply chain. Advantageous industries must be supported by symbolic industrial chain and supply chain. The particularity of development determines that we must build a modern industrial chain and supply chain. Although the academic community has some research on the modernization and significance of industrial chain and supply chain, there is not enough research on the mechanism and path of building a landmark industrial chain and doing a good job in the dynamic balance of supply chain development, the relationship between industrial chain and supply chain, industrial layout and supply chain integration contradictions, which needs to be further clarified theoretically [1]. Therefore, it is necessary to rely on the relationship between industrial chain and supply chain. According to the international situation and the reality of Zhejiang's industrial development, in the process of building a symbolic industrial chain, enhance the applicability of the supply chain, in order to do some research on the path of the same frequency resonance of the supply chain under the goal of casting a symbolic industrial chain.

This paper will focus on the core conclusion of the dynamic equilibrium of industrial linkage, set up the sub problems of the relationship between industrial chain and supply chain, the relationship and methods between industrial chain and industrial layout, and the operation mechanism and measures of supply chain when building a landmark industrial chain, and use the method of inductive reasoning.

2. Literature Review

The research on industrial chain and supply chain mainly focuses on the development and optimization

of industrial chain and supply chain [1]. The research on the development of industrial chain focuses on the development mode and modernization of industrial chain. Taking the development of carbon fiber industry in Beijing as an example, Ma Shu-hui, Li Yi-ming and Liu He, put forward a new model for the development of the whole industrial chain [2]. Chen Wen-hui and WANG Jing-qian defined the development of industrial chain clusters and constructed the evaluation criteria, power and conditions for the development of industrial chain clusters [3]. Li Ye proposed to take strategic guidance and goal guidance in scientific and technological innovation, institutional innovation and other aspects to promote the integration of innovation chain and industrial chain and boost the development of industrial chain [4]. Miao Wei put forward the important symbol of industrial chain and supply chain modernization [5]. Huang Qun-hui put forward the great significance of building modern industrial chain and supply chain [6]. Based on the collaborative driving theory, Wang Jing defines the content boundary and characteristics of the modernization level of industrial chain and supply chain, constructs the model and analysis index system of the modernization level of industrial chain and supply chain, and puts forward the integration path to improve the modernization level of industrial chain and supply chain [7]. The research on the development and optimization of supply chain mainly focuses on a certain perspective, specific regions and industries. Under the environment of creating a new development pattern of "double circulation", Zhang Jian-jun, Sun Da-wei and Zhao Qi-lan proposed cross-border coordination of supply chain[8]. Yang Zhen-hua and Xiao Jun, guided by the market, proposed to strengthen the organic combination of free trade zone construction and industrial supply chain optimization, so as to extend the global industrial chain and supply chain [9]. Zhang Xi-cai took the sales of agricultural products in poor areas as the research object, and Put forward the optimization path of urban assisted agricultural product supply chain [10]. These studies focus more on the development mode and optimization path of industrial chain and supply chain. There are both qualitative and quantitative analysis in the analysis process, but they do not distinguish the two different concepts of industrial chain and supply chain, and even mix the two concepts together. The research on the symbolic industrial chain and the supply chain to adapt to the development of the symbolic industrial chain is almost blank. Therefore, it is necessary to clarify the relationship between the industrial chain and the supply chain and establish a dynamic balanced supply chain to adapt to the development of the symbolic industrial chain.

3. Multidimensional Perspective: Do a Good Job in the Dynamic Balance of the Supply Chain in the Landmark Industrial Chain

3.1 Clear Relationship: The Basis for the Connection between Industrial Chain and Supply Chain

The industrial chain includes the supply chain. The development of the industrial chain can promote the generation of the supply chain. Deconstructing this interactive relationship is the basis for establishing the connection between the two. Industrial chain is an objective internal model organization form formed in the process of balanced docking of value chain, enterprise chain, supply chain and spatial chain based on the supply-demand relationship of technical and economic relationship. It is an economic organization relationship twisted between different regions and industries based on a certain technical and economic relationship chain. Starting from the product production of the whole industry, from raw material supply, circulation to consumption, it forms the network structure of relevant links and organization carriers, which is manifested in the industrial level, correlation degree, depth of resource processing and satisfaction of demand. It has structural and value attributes. Based on the objective regional differences and comparative advantages of regional development, coordinate the contradiction between regional professional division of labor and multi-dimensional demand. Supply chain is the whole process from raw material procurement to products meeting consumers' needs, focusing on core enterprises and based on the supply-demand relationship between each node enterprise, in order to reduce costs, improve efficiency and meet customers' personalized needs to the greatest extent. Through the control of information flow, logistics and capital flow, supply enterprises, manufacturing enterprises, distributors, logistics enterprises and final consumers are connected into an overall functional network structure. It is a virtual organization formed under the background of economic globalization and the development of knowledge economy, which meets the requirements of the times. Around the core enterprise, it can form multiple or multi-level suppliers in the upstream and multiple or multi-level distributors in the downstream.

Industrial chain is an economic concept and supply chain is a management concept. The connotation and extension of supply chain can be understood as a fishbone diagram composed of an arrow on the plane. Industrial chain is a fishbone diagram of three-dimensional spatial concept. The existence of industrial chain does not depend on the integrity and systematicness of supply chain

connection. The connection of the strategic partnership of the supply chain is the basis for the generation of the industrial chain, and multiple supply chains or supply chain segments constitute the industrial chain.

3.2 Industrial Linkage: The Method of Industrial Layout and Supply Chain Integration

Industrial linkage is an industrial cooperation activity between enterprises located in the same link or different links of the industrial chain in the same region or different regions based on technical and economic correlation. It takes the government administrative promotion as the auxiliary, the market mechanism as the leading, the industrial connection as the foundation and the professional division of labor as the main line. Its action mechanism is to take the regional industry as the node and the linkage relationship as the edge to form a collection of industrial coordination systems, that is, the collection of regional industries, the collection of industrial linkage relationships. The reflection of linkage ability - the edge weight topological weighted network structure composed of point weight and linkage strength.Industrial linkage breaks the boundaries of land or industry, industry and enterprise, makes the enterprises in the industrial chain interdependent and restrict each other, exchanges materials, information and funds, and forms a benign interaction. Different industries and within the same industry form a cooperative interest community. Through coordination and beyond the zero sum game, its operation efficiency is improved and the benefit of the whole system is maximized. Industrial linkage is the driving force for the sustainable development of regional economy and regional industrial expansion. It can promote the communication of different links of the industrial chain, speed up the transmission of products, technology and knowledge, and balance the number, scale and product structure of enterprises in different links of the industrial chain. Enable a single enterprise to obtain stable raw materials and markets, reduce business and transaction risks, and increase the added value of products. Industrial linkage follows industrial integration, strategic alliance and short, medium and long-term contractual relations. The development direction can be horizontal linkage, two-way linkage, backward linkage, forward linkage, intra regional linkage and extraregional linkage [11].

Industrial linkage is inseparable from industrial association. Industrial association is the network structure formed by industries, including the association between individual industries, between industries and the whole industrial system and industrial system. An important aspect of industrial association analysis is industrial network association analysis. The study of industrial network association through industrial network self-organization change and empowerment of industrial network can reveal the operation state of industrial linkage.

The driving force of linkage development is the supply chain operation mode, which is the main driving force to promote linkage development [12]. Relying on the construction of symbolic industrial chain and supply chain, we can achieve: First, change the spatial layout of supply chain. Drive an effective supply chain with the industrial chain, and promote the rational layout of the industrial chain with the balance of the supply chain. Second, transform and upgrade the level of traditional manufacturing industry and move towards the high end of the value chain. Although the output value of China's manufacturing industry ranks first in the world, and the manufacturing industry in Zhejiang Province also occupies a very important position in the country, the manufacturing industry lacks leadership and control in the global supply chain, and the key links and core parts are still weak. It is necessary to integrate various resources and form a high-end, intelligent, green and service-oriented manufacturing industry with digital, intelligent and networked technical means. The third is to restore and smooth the supply chain, take the building of a landmark industrial chain as the starting point, protect and intensify the vitality of market subjects, take the construction of the supply chain as the breakthrough, give play to the leading role of leading enterprises in the supply chain, and optimize and lead the development of small and medium-sized enterprises in the chain. Cultivate, expand and form emerging advantageous industrial clusters, and concentrate on overcoming a number of "Neck" technologies. With the help of 5g platform, integrate big data, Internet of things and cloud services, strengthen the connection of supply chain node enterprises, and improve the synergy and operation efficiency of the supply chain [13].

Taking the construction of landmark industrial chain as the guidance, industrial linkage as the means and supply chain construction as the starting point, arranging the quantity of supply chain, balancing the distribution of supply chain in the same region or different regions, and developing the quality and quantity of enterprises in the chain will help to boost the quality, speed and competitiveness of economic development.

3.3 Dynamic Equilibrium: Measures and Mechanisms to Realize Supply Chain

Dynamic equilibrium means that the changes of various economic variables in the economic system

are in a balanced state with the passage of time. The dynamic equilibrium supply chain is the network equilibrium of the supply chain in the running state. It is a linkage, which is reflected in the determination of value orientation and value growth power in the design and operation, and can balance the relationship between enterprises, customers and other stakeholders to achieve the flexibility of organization design, agility and rapid response of manufacturing, and make the operation of the whole supply chain reach the best state. The supply chain presented is an ecological supply chain. The whole process from procurement to waste recycling forms a green closed loop, which reflects the unity of the proliferation of economic indicators, the sense of responsibility of social indicators and the friendliness of environmental indicators, and can provide services for the landmark industrial chain [14].

In this strategic opportunity period of major transformation, Zhejiang Province has put forward the action plan for the implementation of manufacturing industry foundation reengineering and industrial chain upgrading project (2020-2025), which defines ten symbolic industrial chains: digital security industry chain, integrated circuit industry chain, network communication industry chain, intelligent computer industry chain, biomedical industry chain, refining and chemical integration and new materials industry chain, energy saving and new energy automobile industry chain, intelligent equipment industry chain, smart home industry chain and modern textile industry chain. Taking into account the foundation of pillar industries, advantageous industries, emerging industries and key enterprises, under the guidance of "Domestic big cycle as the main body, international and domestic double cycles promote each other", adhere to innovation driven, and "Take digitization, high-end, globalization and marketization as the guidance", make up for weaknesses and forge long plates, which provides favorable policy support for the adjustment and rational layout of industrial chain and supply chain. It also provides a legal basis for the construction of dynamic equilibrium supply chain with industrial linkage.

The symbolic industrial chain is composed of key equipment, core components, logistics, information flow and capital flow of product integrated manufacturing and auxiliary services. These links are connected by competitive core technologies, which determine the formation and development of the whole symbolic industrial chain and have a strong industrial correlation diffusion effect. Start with the industrial linkage subject, core technology and mechanism of industrial linkage, so as to achieve "Government coordination, enterprise initiative and cross regional integration", so as to realize the dynamic balance of the supply chain.

Government coordination means that the government attaches importance to the governance of industrial chain and supply chain, finds its own role orientation, changes managers, decision makers and builders into service providers, coordinators and promoters, and defines the leading role of the government. Follow the law of market economy, comply with the changing environment of market demand and industrial development, give full play to the comparative advantages of various regions, avoid "Dislocation" and "Loss of position", and achieve "Mechanism leading chain, policy encouraging chain and facility ensuring chain".

Mechanism leading chain, that is to establish a coordination mechanism and operation guarantee mechanism according to the operation mode of "Mechanism + industrial chain" and "Mechanism+ supply chain". The coordination mechanism includes the policy coordination of land, capital, taxation and environmental protection in the province, the coordination of realizing intensive development and overall optimization of layout, and the formulation of operation systems in terms of organization, leadership, implementation, reward and punishment suitable for the enterprise and the environment. The "manufacturing high quality leading group" established in our province is a full-time management and discussion and coordination organization sent by the government to coordinate major issues in the construction of manufacturing industry chain and supply chain through contact meetings and formulate relevant policies and systems, that is, to act as the discussion coordinator of industrial chain and supply chain construction, as well as the promoter and manager of industrial chain and supply chain construction. The operation guarantee mechanism includes restraint mechanism, supervision mechanism, incentive mechanism and compensation mechanism. The industrial fund mechanism established in our province is to give play to the guiding force of industrial fund investment, effectively connect with industrial development policies, and play a guiding role in key industrial chain and supply chain enterprises.

Policy incentive chain is to create a policy environment conducive to industrial cooperation and supply chain development. The responsibility of the government role should use the market operation rules, formulate the public fair policy of regional management, and maintain a good market competition order. Make full use of administrative means to implement and improve the development policies of enterprises, industries and supply chains, standardize the behavior of enterprises and regional development subjects, break the segmentation

of industries and regions, reasonably set the regional industrial scale, optimize the allocation of production factor resources. Make clear policy provisions on providing financial support and preferential tax treatment for iconic industrial chains and supply chains, and reducing comprehensive costs of enterprises. The "chain leader system" policy of industrial chain implemented in our province is to provide services for solving problems, eliminating risks, promoting experience and promoting cooperation for the establishment of industrial chain and supply chain with the cooperation of relevant provincial departments.

Facility chain guarantee is to establish and complete various infrastructure to ensure the operation of the supply chain. In addition to soft environment conditions, the construction of dynamic supply chain should also have hard conditions and facilities, establish a wide range of industrial chain and supply chain public service platforms such as property right trading platform, capital market platform, industrial Internet platform and cloud service platform, implement the "5g + industrial Internet Project". Promoting the application of big data, cloud computing and artificial intelligence in the supply chain is a powerful guarantee for the construction and operation of the supply chain [15].

Enterprises take the initiative to determine the leading enterprises by relying on the symbolic industrial chain, so as to make the leading enterprises become the organizers and integrators of the supply chain. According to the principle of self-organization, build and optimize the supply chain, and form a benign linkage within the supply chain, between the supply chain and the supply chain, and between the supply chain and the industry within or across regions. This linkage can be expressed as "chain protection, chain supplement, chain creation and chain financing".

Chain protection is the protection of the existing supply chain and the built supply chain.In the process of CO frequency resonance of integrated supply chain, enterprises in the chain will encounter difficulties and risks more or less, which will hinder the normal operation of the supply chain. Starting the linkage incentive mechanism of the supply chain and following the contract spirit of the supply chain can achieve the purpose of overcoming difficulties and avoiding risks. In the construction of Zhejiang's symbolic industrial chain of network communication, Futong group, headquartered in Hangzhou, implements the "dual industry" strategy of optical fiber communication industry and energy and power cable transmission industry. The group company continues to improve the whole industrial chain of optical communication, from the upstream formulation of national standards for optical communication to the whole industry of optical fiber preform, optical fiber, optical cable, optical device and broadband switch. A whole industry chain factory has been established in Jiashan County, and an intelligent manufacturing system with the core technology of "Manufacturing technology, automation technology and information technology" has been constructed. However, due to the slow recovery of accounts receivable and insufficient production capacity of Hangzhou Yuantong Cable Technology Co., Ltd., one of the upstream raw material suppliers (Primary suppliers), the supply of raw materials to Futong group was affected, resulting in the decline of production capacity and benefit of Futong group. To this end, Futong group uses blockchain technology to promote the integration of blockchain in the supply chain. With the help of Zheshang Bank, it creates a "Accounts receivable chain platform", pulls in upstream raw material supply enterprises, builds its own business circle, establishes a mutual trust mechanism for accounts receivable, releases risks and ensures the smooth capital flow of enterprises in the supply chain. It has opened up the supply interruption of raw materials caused by capital pressure of upstream enterprises, and received excellent chain protection effect [16].

After determining the core supply chain to be built by the landmark industry, take the key enterprises of the core supply chain as the origin of the supply chain, find the breakpoints in the supply chain, search for strategic cooperative enterprises in the region or across regions, and optimize the integrated supply chain. Taking the landmark industrial chain of Intelligent Computing manufacturing as an example, it mainly complements the supply chain around domestic intelligent computing machine enterprises. At present, the design and manufacturing of core components and high-end chips required by the whole machine factory depend on foreign imports. In view of the lack of design and manufacturing of upstream high-end accessories, we can cooperate with R & D institutions such as aridamo Institute, Huawei Hangzhou Research Institute, Zhijiang laboratory and Pujiang National Laboratory Intelligent Computing Research Institute to supplement the short board of accessories with the design and development of related core technologies, and parts manufacturing can be combined with the existing enterprises of Zhejiang Kunpeng industrial base, Huawei Ningbo Kunpeng Ecological Industrial Park and China Great Wall (Wenzhou) independent innovation base.

Chain creation aims at the lack of key technology design and manufacturing neck enterprises in the iconic industrial chain, establishes core enterprises through

introduction or independent innovation, and integrates new supply chains centered on core enterprises. For example, CNC machine tool manufacturing in the landmark intelligent equipment manufacturing industrial chain, in order to overcome the short board of low-end products, create a high-end CNC machine tool manufacturing center centered on Taizhou, and form an integrated supply chain supported by enterprises in Hangzhou, Jiaxing and Shaoxing.

Financial chain is to integrate the enterprises that are not effectively integrated into the supply chain or the supply chain whose end is abroad, and a few single enterprises or supply chains with weak competitiveness interrupted by the epidemic into the core supply chain, so as to achieve the purpose of expanding the core supply chain.

It is worth noting that in the process of "Chain protection, chain supplement, chain creation and chain fusion", the principle of structural optimization allocation should be reflected. On the one hand, the design of core supply chain should reflect agility, flexibility and personalization. The supply-demand relationship in the chain can be designed as multi-level suppliers and multi-level agents, single-level suppliers and agents or other forms of combination. Its quantity must achieve the goal of timely production, timely supply, rapid response and decreasing cost formed by the maximum satisfaction of customer needs. The constructed supply chain has value-added value that a single enterprise does not have to create profit value. The other party should first analyze the symbolic industrial chain and determine the supply chain. According to the operation characteristics of the industrial chain, the industrial chain is divided into pre production link, in production link, circulation link and post production link, such as the new energy vehicle industrial chain. The pre production link includes machinery, iron and steel, petrochemical, rubber, textile, electronics and other industries. The production link involves R & D, vehicle equipment manufacturing, education, training and consultation, the circulation link involves transportation, storage, packaging and other types of enterprises, and the post production link involves logistics, sales, insurance, maintenance, leasing, refueling and charging, consumer finance, catering, hotels and other types of enterprises. In the process of building the core supply chain of the industrial chain, we should focus on the equipment manufacturing core enterprises of the whole vehicle, set up two new energy vehicle equipment manufacturing centers in Hangzhou and Taizhou according to the development plan and the geographical distribution of industrial advantages, and build two core supply chains from raw material procurement → production → sales → customers and transportation logistics and information sharing throughout the period. Machinery, steel, petrochemical, rubber, electronics, etc., which provide raw materials for auto parts at a higher level, design and logistics support in production, procurement, transportation, storage, packaging in circulation and logistics, sales, maintenance, etc. in post natal links should be linked to form a strategic cooperative partnership to meet both supply and demand and an integrated supply chain. In the two core supply chains, many sub chains can be integrated, such as the transportation enterprises in the supply chain. Taking the transportation enterprises as the core, the sub chain of providing transportation tools → transportation enterprises → maintenance → recycling can be constructed. In this way, two new energy vehicle industry clusters will be formed in Hangzhou and Taizhou. The scale and benefits of the cluster should be based on the principle of the best combination of parent and child supply chains. Avoid the waste of input resources caused by the aggregation and expansion of industrial enterprises.

Cross regional integration means that the construction of supply chain is not limited to the province, but actively integrated into the Yangtze River Delta and the whole country according to needs. Due to the difference between resource endowment and traditional foundation, some enterprises in our province are lack of supply chain links, so we need to borrow ships to go to sea and get married across provinces. For example, the equipment components of robot manufacturing enterprises, such as encoders, high-performance bearings and other modules, are the short board of the province. To overcome the short board, we should increase the strategic cooperation with supporting enterprises in the Yangtze River Delta. For another example, ethylene enterprises in the advantageous ethylene industry chain of our province should go international and establish an international supply chain.

4. Conclusions and Prospect

To build a symbolic industrial chain, we need to forge a symbolic supply chain, pay attention to dealing with the relationship between supply chain and industrial chain, and do a good job in the regional distribution of supply chain, the balance between supply chain and supply chain, and the internal balance of supply chain. In addition to government behavior and self-organization behavior, we must establish a supply chain ecological governance system with the participation of government, industry, enterprises, financial institutions, universities and scientific research institutes. Standardize the regional distribution of the spatial scale of the governance scope, and determine the core enterprises, closed chain supply

chains, auxiliary enterprises and industries. Pay attention to the vertical and horizontal competition and cooperation relationship among enterprises, within the supply chain and between supply chains. The vertical competition and cooperation transaction relationship determines the length of the supply chain, the horizontal competition and cooperation relationship determines the width of the supply chain, and the length and width of the supply chain ultimately determine the scale of industrial agglomeration and the standardization, rationality and economy of regional layout. Although the research conclusions can be used as a reference for the development and optimization of China's industrial chain and supply chain, because the research model mainly takes Zhejiang as an example, there are differences in regional development between the East and the West in China's provinces, and the universality of the research conclusions must be adjusted according to the actual situation of various regions. The definition and standard of symbolic industrial chain, the treatment of the relationship between symbolic and non symbolic industrial chain, and the quantitative analysis of the coupling of industrial chain and supply chain need to be further studied. With the deepening of theoretical research and the development of practice, these problems will be solved one by one.

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ARTICLE

Research on the Leading Value Drive of Rural Homestead Transfer under Rural Revitalization——Based on the Evidences of China

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Abstract: With the development of urban-rural integration in China, the functional value of homestead bases has evolved from a single residential security value to a multiple composite values, and the property income of homestead bases has gradually become the value driver of transfer and the intrinsic demand of farm households. This paper takes Baitafan of Jinzhai County, Chongqing City, and Xiaofang Yu Village of Ji County as examples for in-depth discussion, and finds that the dominant value drivers of home base transfer mainly include three kinds: capitalization income, commercialization income, and non-farm employment income. The study concludes that it is important to give full play to the resource endowment effect and identify the dominant value of home base transfer according to local conditions to promote the standardized home base transfer and implement the rural revitalization strategy.

Keywords: Homestead transfer, Rural revitalization, Farmers' income, Value path

1. Introduction

Since the reform and opening up of China, the rapid economic development of China has led to an influx of a large number of people who move from rural areas to cities, and the traditional dual structure of urban and rural areas has been suffered. Besides, along with population mobility, the phenomenon of "hollow villages" and "hollow houses" in China's rural areas has become serious. According to relevant research data, the scale of unused residential bases reach 13.3 billion square meters in 2020, and 1.643 billion square meters of unused residential bases which are caused by migrant workers moving to cities for work. The residential bases account for the highest proportion in the construction of rural

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collective land, also the most important property of rural residents and an important carrier of rural revitalization. In this context, in order to wake up a large number of "sleeping" land assets, the central government has issued "Several Opinions on Adhering to the Priority Development of Agriculture and Rural Areas and Doing a Good Job in the Work of the Three Rural Areas", "Circular on Actively and Steadily Carrying Out the Work of Revitalizing and Utilizing Idle Rural Residential Bases and Idle Houses A series of policies and measures have been introduced, including the "Notice on the Active and Steady Implementation of the Work of Revitalizing and Utilizing Unused Rural Residential Land" and the "Pilot Program for Deepening the Reform of the Rural Residential Land System", to continuously promote the reform of the rural residential land system and explore the "separation of the three rights" of ownership, eligibility and use of residential land. Under these measures, more market players have been included in the scope of subjects transferred with the right to use residential bases, and the boundary between residential bases and collective land has been opened up, which is expanding the market demand for residential bases. Thus, with this condition, the supply of residential bases remains unchanged. The shortage of supply will lead to higher prices for residential bases, which is conducive to the appreciation of the value of residential bases. How to revitalize and use idle house bases with local conditions, promote the flow of urban and rural land elements, and boost rural revitalization has become a theoretical and practical problem that needs to be solved at present and even in the future for some time.

The direction of reforming and utilizing different types of residential bases has gradually become a hot topic of academic research. There have been extensive discussions on various modes of home base transfer. Although a more unanimous opinion has not been formed, it has laid an important foundation for further research on the reform and use direction of different types of home bases. In terms of the functional transformation of homestead bases, Qi et al. (2020) condensed three models based on the mechanism of functional transformation of homestead bases based on the division of the flow function and concluded that the selection of the functional transformation model of homestead bases should consider factors such as the inner core and the outer edge system [1]. In terms of rights function, Wu Di et al. (2020) use the SWOT model to explore three types of transfer, such as type the rights of market-driven, member rights and interests protection, and ownership normative management [2]. In terms of labor transfer, Yu Rong et al. (2020) analyzed the difference between the type of home base transfer and the type of arable land transfer, the type of forest land transfer, and the type of pasture land transfer, and pointed out that the validity of different land types acting on rural labor transfer is different [1]. In terms of dominant agents, Liu Weibai et al. (2019) categorized the behavior of several pilot homestead base system reforms into the local government-led model, market transaction-led model, village collective-led model and double-led model [3] of local government and village collective. In terms of transfer location, Lou Wenlong et al. (2018) based on the reform practice, formed the model of "residential bases for houses" in Tianjin, the model of "land ticket" in Chongqing and the model of "same land, same right and same price" in Guangzhou. "model [4] in Guangzhou. In terms of idle residential bases, Wei Hui et al. (2020) found that the types of idle residential bases can be divided into idle residential bases built without demolishing the old, idle residential bases inherited, idle residential bases granted but not built, and seasonal idle residential bases for migrant workers, and proposed categorical management countermeasures for these types of idle residential bases [2]. On the whole, although theoretical research on home based transfer models has many results, less research has been conducted from the perspective of value-driven home bases, taking into account the differences in the functions of home bases with different property attributes that lead to differences in exit transfers, and exploring how to more efficiently achieve income growth for farmers. Besides, the "separation of three rights" of residential bases decomposes the right of use under the original "separation of two rights" system into the right of qualification and the right of use, which expands the scope of residential base transfer, further relaxes the restrictions on the right of usage, and promotes the continuous appreciation of the economic value of the right of using itself. By transferring part or this right, the subject of the right to use the residential land can prove the economic value of the residential land and meet the real needs of rural residents to get economic benefits. Besides, by attracting more social capital to flow into rural areas, it promotes the integration of primary, secondary and tertiary industries and financial development in rural areas, and further combines the value appreciation of use rights, independent or cooperative development, industrial integration, the manifestation of the potential value of qualification rights and other diversified transfer mechanisms to drive the growth of farmers' property income from commercialization, capitalization and non-farm employment. Furthermore, the local government assists the local land management department, also it gets together with the Ministry of Agriculture and Water Resources, gates the home base transfer transactions,

standardizes the home base transfer process and builds a legal space for home base transfer. Thus, based on the transformation of the resource value of residential bases, this paper analyzes the property owners of residential bases, condenses residential base transfer models with different income attributes and proposes relevant countermeasures, emphasizing the property rights of land while safeguarding "property rights", to transform them into replicable results adapted to the use of different rural residential bases, to activate rural The aim is to translate the results into replicable results that can be adapted to the use of different rural residential bases, to activate the idle value of rural residential bases. Ultimately, it can improve the use rate of land resources and promote rural revitalization.

2. Case Selection and Data Source

According to the current trend, the function of rural homestead in China is increasingly evolving from a single guaranteed residential use to a multi-functional non-residential guaranteed function by reviewing and summarizing relevant literature. Furthermore this trend is closely related to local socio-economic conditions. This paper selects from the pilot cases of homestead reform before 2018, Chongqing City land ticket reform, Tianjin Xiaochuanfangyu Village. This paper selects three cases, namely the Chongqing land ticket reform, the Tianjin Xiaochuanfangyu Village "homestead replacement to revitalize the cultural tourism industry" reform and the Baitafan Village "land into shares" reform, as the objects of analysis to condense the typical patterns of reform pilot flows, mainly for the following reasons:

(1) In terms of regional functions, all three pilot areas have taken on the mission of pilot reform of homesteads, and all have innovated in line with local development needs, and all three areas have a certain regional feature to their reforms.

(2) From the perspective of land characteristics, three pilot areas have a single function of the homestead and their functions are declining, the efficiency of the use of land resources can hardly match the actual local development requirements, and there is an urgent need for the conversion of the functions of the homestead.

(3) From the perspective of geographical location, in view of China's wide geographical, three pilot cases are located in areas with different socio-economic conditions and different capacity and resource endowments.

The suburbs of Chongqing have a more developed economy and a faster urbanization process. Xiaochuan-

Table 1. Location conditions of the three homestead pilot cases

pilot case	Type of flow	Location status	Background of the reform	Routes of movement	Effectivenesof the transfer
Chongqing City	Reclaimation transaction-driven	The country's largest municipality with vast rural land areas and generally low land prices in the suburbs.	The accelerated urbanization process, the intensification of the conflict between people and land, and the oversupply of urban construction land in 2008, the Ministry of Land and Resources proposed linking the increase and reduction of urban and rural construction land	Farmers voluntarily reclaim restricted and abandoned residential land for cultivation, and enter the market in the form of “land stamps” after deducting the area needed for rural construction and development.	Improved urban and rural land use, bringing urbanization dividends to remote suburbs.
Baitafan Village	Dividend-driven	Located in Jinzhai County, Lu’an City, Anhui Province, the border area of southern Anhui Province, the hinterland of Dabie Mountain.	Jinzhai County has backward agricultural production methods and fragile agro-ecology; in 2015, the state proposed innovative land transfer methods to encourage land shareholding.	With the right to use the land to share in Baitafan Township Minfa Oil Tea Professional Cooperative, the cooperative relies on Anhui Dabie Mountain Science and agriculture Technology development Co.	The economy is growing faster and modernizing and transforming agriculture.
Xiaofang Yu Village	Industry revitalization driven	Located in northeast of Jizhou District, Tianjin, at the intersection of Beijin, Tianjin, Tangshan and Chengde, with a more developed tourism industry.	Low utilization of land resources, abundant tourism resources but inadequate land planning, lack of land and financial support for tourism industry.	Implementing the model of homestead base for housing optimizing land planning digging deeper into the value of humanities and history, revitalizing vacant resources to implement homestead base rental cooperation, and developing cultural tourism industry.	To achieve spatial restructuring, transformation and upgrading of rural industries, and to highlight the property function of residential land.

fangyu Village relies on tourism development, has particular potential for developing tourism industry development and is economically underdeveloped. While Baitafan Village is in a remote and economically backward area, and rural revitalization requires a large area of The three pilot areas show a "strong-medium-weak" difference in terms of economic and social conditions, which can provide suggestions for a differentiated model of homestead transfer for areas with different levels of economic development.

3. The Types of Manifestation of Homestead Property Ownership in a Value-driven Perspective

3.1 Capitalized Income from the Rural Homestead

Capital is an objective existence with which material interests can be created. From the perspective of capitalization, the fundamental reason for the increment of collective land value lies in the realization of profit or increment of collective land use right in the market [7]. With the deepening of China's market-oriented reform, the inherent capital attribute of the rural homestead is gradually revealed. However, as a kind of national welfare distribution resource, the rural homestead cannot flow freely between urban and rural areas, and it is difficult to realize the property ownership of farmers attached to the rural homestead. Only emphasizing the social security value of the rural homestead while ignoring its capital value violates the principle of equity in the socialist market economy. Based on this background, the pilot areas with suitable conditions began to excavate the capitalization income of the rural homestead.

The capitalization of the land is to promote the interests of the market and government guidance, village collective farmers or will be in the form of lease, a stake in temporary housing land use right to collective economic organizations outside of the individual or entity, convert the land into have continued the capitalization of the profitability of products, activation of idle rural homestead, broadened the source of the farmers' income. It is now more common through idle rural homestead development village hotel, farmhouse, tea processing, such as new industry such as the Dali in Yunnan province due to travel in a booming economy, local rural homestead leasing demand rising. In particular, Linhai short-cut plot of farmers to circulate the idle rural homestead into the hands of the village collective outside of the lessee, used to carry out the hotel, catering and other business services. Alternatively, after buying shares of the rural homestead, cooperatives shall be unified in planting, management and sales, and distribute the profits to farmers. The operation mode of "membership + cooperative + company" in Jinzhai County, Anhui Province, is typical of this kind of capitalization mode. Jinzhai monastery for transhipment villagers hair oil-tea professional cooperatives through cooperation with the Dabie mountain in Anhui science and technology development co. LTD, the member's right to use the rural homestead in cooperatives, and centralized management of the rural homestead in its own name, farmers as shareholders enjoy the profits and dividends, improve the efficiency of the rural homestead, increase the farmers' property rights [8].

Most of the pilot projects to explore the capitalization of the rural homestead have following characteristics: first, the local policy guidance, the large number of migrant population, or the development of local characteristic economic industries such as tourism and tea industry, the demand for leasing is increasing; Second, the idle rural homestead is distributed in a decentralized manner and has the condition of integrated and intensive development. In the process of capitalization of the rural homestead, farmers and village collectives inject market elements into the rural homestead in the process of capitalization of the rural homestead with the help of local development needs, and the property value of the rural homestead is highlighted, the intrinsic value of the rural homestead is more prosperous, and farmers realize income increase. Secondly, the capitalization of the rural homestead is usually accompanied by the transfer of corresponding rights, through which the rural homestead can be transferred outside the village collective economic organization, the using efficiency of the rural homestead is improved, and the collective income of the rural homestead is increased. Thirdly, the intensive and professional management of the rural homestead by enterprises not only reduces the economic risks that farmers themselves have to bear in agricultural operation activities but also gives full play to land agglomeration and scale effect [9]. With the continuous expansion of economies of scale, the reduction of the unit cost of production and the increase of property income, farmers and enterprises can achieve a win-win situation. Finally, from the macro aspect, the capitalized income of the rural homestead makes the rural homestead get treatment with urban land equally, which can effectively narrow the gap between urban and rural areas as well as match the goal of optimizing the allocation of market resources in China's economic system reform.

3.2 Income from the Commercialization of the Rural Homestead

With the continuous influx of surplus rural labour from

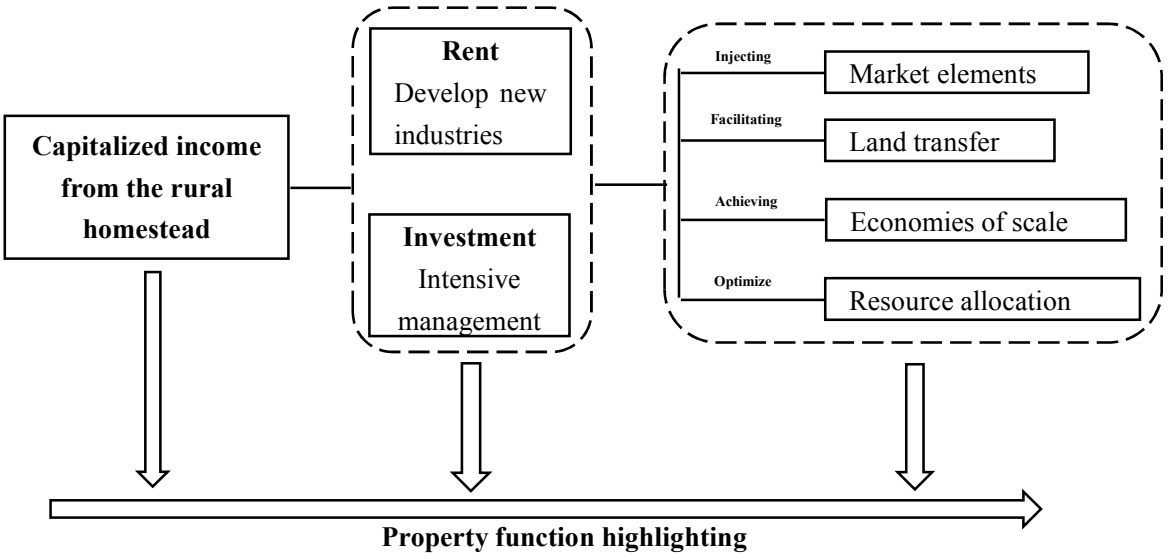

Figure 1. Homestead capitalization income model

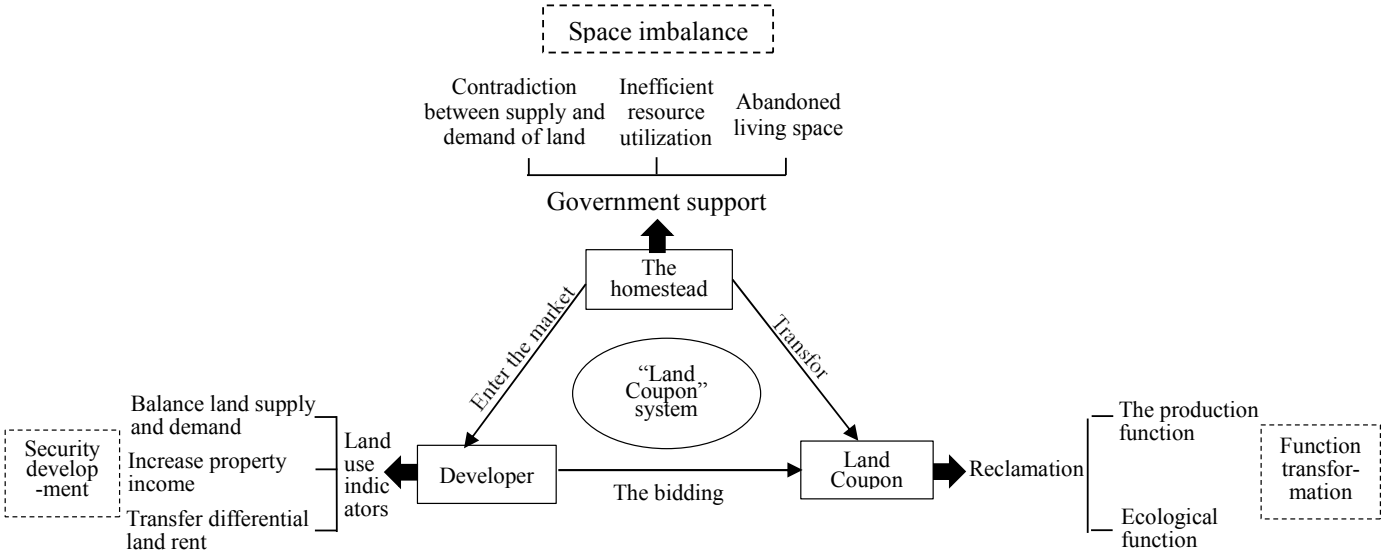

Figure 2. Income model of homestead commercialization

the countryside to the cities, the decay of rural areas has inevitably led to population loss and the abandonment of residential bases. At the same time, population movement has led to a change in the spatial organization of urban and rural areas, with the urgent need for cities to vacate construction land for farmers moving to the cities and the abandonment of rural residential bases intensifying the contradiction of unbalanced land use. Chongqing is located in the western hills, combining a largely rural area, a large reservoir area, a large mountainous area and an ethnic area. As a specific area of China's urban-rural dual structure system, Chongqing is extremely imbalanced developed. The large number of farmers working outside the city's relatively backward regions has led to many new residential bases in the countryside. At the same time, the demand for urban construction land in relatively developed areas is very urgent, and this contradiction between the protection of rural arable land and the need for urban construction land is becoming increasingly prominent. To solve this dilemma between the supply of construction land and the security of arable land in rural areas, the State Council issued the "Opinions on Promoting Chongqing's Urban and Rural Reform and Development" (Guo Fa [2009] No. 3) in 2009, which proposed to steadily carry out the pilot project of linking urban and rural construction land, set up the Chongqing Rural Land Exchange, and gradually establish a unified urban and rural construction land trading market. The

spirit of the document mentioned above has opened up a new path for Chongqing to optimize the layout of urban and rural construction land and promote the reform of the rural land system.

Chongqing's "land ticket" trading system refers to the conversion of unused and abandoned rural residential bases and farm buildings into arable land after professional reclamation and strict acceptance by the relevant land management departments. Apart from the indicators used for rural construction and development, the remainder is traded at local rural property rights trading centres. As residential bases and other rural collective construction land are mainly close to or surrounded by arable land, and Chongqing is a typical mountainous region with interspersed hills and hilly valleys. Based on the natural endowment, the cultivated land obtained from the reclamation of residential bases in Chongqing has a transparent quality advantage over the cultivated land developed by land development, achieving a practical protection function for cultivated land. The "land ticket" transaction is an institutional change between the leading suppliers of rural construction land and the main demanders of urban construction land in pursuit of profit opportunities. On the one hand, Chongqing Municipality has transformed idle rural residential land resources from a physical form to a liquid virtual commodity utilizing the market-based trading system of the balance of arable land occupation and the linkage between urban and rural construction land increase and decrease, thus building an effective rural asset trading model. In the process of market competition and price formation, the market price of the "land ticket" transaction is driven by the game between the demand and supply sides of the "land ticket", the essence of which is that people buy the "land ticket "The essence of the market price is a reflection of the rights and interests that people receive for the purchase of the commodity. Through the creation and trading of "land stamps", collective construction land assets such as rural residential bases are made visible and provide a strong guarantee for the transformation of the solid assets of residential floors into real income for farmers and rural collective economic organizations, thus narrowing the income gap between urban and rural residents and changing the dual structure between urban and rural areas. On the other hand, "land ticket" transactions can spatially transfer the differential land rent brought about by different locations, allowing remote areas to enjoy the dividends brought about by urbanization [11], while alleviating the problem of unbalanced supply and demand for urban construction land and amplifying the value of idle, low-value rural construction land asset value, further safeguarding farmers' rights and interests, and increasing their property income.

3.3 Non-farm Employment Income from the Rural Homestead

The transformation of the value of the rural homestead, a multifunctional composite space on which the Chinese rural population depends for survival and development, depends on the transformation of how the rural homestead is used. At present, the transformation of the function of the rural homestead is occurring to varying degrees in a wide range of rural areas, with higher-level social demand values constantly derived from the original residential use-values [11]. Among them, when farmers prefer the convenient lifestyle in towns and cities, and production activities are mainly non-farm employment, as farmers' non-farm employment time increases and the degree of non-farm employment increases, farmers rely less on rural life and production links, and the security role of the rural homestead for farmers will gradually decline. Farmers will rely less on the rural homestead in terms of both psychological and practical needs. At this time, farmers hope to realize the property owner of the rural homestead through increasing non-farm employment income and have a higher degree of cooperation in participating in the rural homestead replacement [10]. The push-pull theory perspective integrates the above scholars' views and sorts out the logical chain of the rural homestead withdrawal from the perspective of non-farm employment. The theory argues that the functional transformation of the rural homestead can meet the requirements for the property function and asset value realization of the rural homestead during the urbanization of the population of farmers moving to the city, which in turn can motivate farmers who are eligible to exit the rural homestead voluntarily and actively, forming a driving force. Farmers who prefer non-farm employment have a greater tendency to demand residential living space to meet the future development needs of their families. Therefore, farmers will pay more attention to the living environment and quality in choosing their residential living space. Moreover, their needs have changed from the most basic needs of survival and production to higher-level needs of enjoyment, which will have a specific pulling effect on farmers' withdrawal from their rural homestead and promote farmers who will withdraw from their rural areas homestead voluntarily [13].

Based on the advantages of economic resource endowment, rural suburbs with good economic and geographical location and adjacent to cities are most strongly influenced by urbanization, with more non-farm employment opportunities for farmers and a more

robust demand from farmers to transfer their useful rural homestead to realize them, with the rural homestead and farmhouses being used for transfer in addition to satisfying their use, to obtain more capital from them [12]. In Wuhan Jiangxia District, which is adjacent to the main urban area, a comprehensive rural property rights trading centre was set up in 2009 to market the rights to use idle rural homestead and rural house ownership. Furthermore, there are more transactions cases, with a high degree of property value manifestation and active turnover transactions of the rural homestead. For example, in Tianjin Jixian County, the scenic rural areas in the distant suburbs do not have the advantage of economic location. However, the good natural ecological environment makes rural tourism increasingly hot, and the rural homestead's asset properties are becoming more and more apparent. The village of Xiaofang Yu Village in Ji County, Tianjin, is located in the northeastern part of Jizhou District, Tianjin, adjacent to the bridge reservoir to the south and the Jiulong Mountain National Forest Park to the north, and its rich natural scenery and ethnic history and culture are the cornerstones of its tourism industry. However, as a typical tourist village in the Jizhou district, it has always had problems such as sloppy land use, a shortage of land for tourism development and limited funding for the tourism industry. In this regard, the village has taken the opportunity to build residential buildings in the northeastern part of the village and guide the villagers to live together while using the vacated rural homestead to concentrate on the development of new industries such as farm caravans and bed and breakfasts to create a rural tourism cluster. By establishing a village tourism company to centralize the management rights of the rural homestead, farmers and village collectives receive a certain percentage of the annual operating surplus share to achieve the residential base from a single residential value function to multiple economic value function transformation. Driven by the tourism industry, Xiaofang Yu Village fully exploits the value function of the idle rural homestead in terms of industry and ecology. They were taking the increase of farmers' non-farm employment income and the improvement of land resource utilization efficiency as the intrinsic value driver and realizing the policy objectives of rural industrial revitalization and ecological livability by reconfiguring the spatial layout of the village.

4. Conclusions and Recommendations

4.1 Conclusions

Based on the characteristics of value transformation of the rural homestead, this paper explores the direction of value transformation of the rural homestead. Following the path of "case selection - value analysis - model condensation" , this paper draws the following three conclusions.

(1) The value of the rural homestead has changed from a single guaranteed value to a multifaceted compound value. The motivation is mainly expressed in three aspects: capitalized income from the rural homestead, income from the commercialization of the rural homestead, and non-farm employment income from the rural homestead. As the original value of residential security no longer meets the requirements of the current high-quality development of the rural economy and then deduces capital production value, commodity exchange value, ecological protection value, and other derivative values.

(2) Farmers' choice of the rural homestead transfer mode is driven by the dominant value of the rural homestead. The dominant value of the rural homestead is the core of its value system, which is in a dominant position in the direction of transfer and has a decisive influence on the transfer speed and quality. Driven by the dominant value of the rural homestead, farmers can fully and effectively utilize the rural homestead. When the capitalization value of the rural homestead dominates, there is a tendency to address the spatial imbalance and secure development needs by bidding for the rural

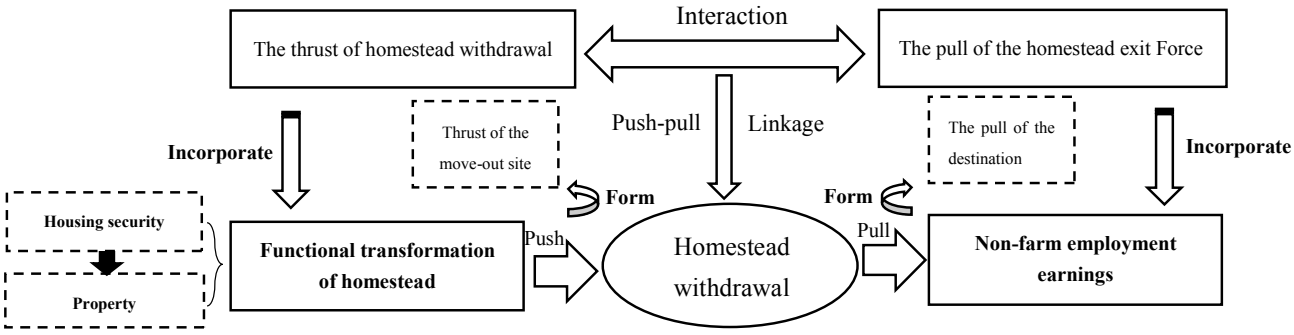

Figure 3. Non-agricultural employment income of Homestead

homestead on the market. When the commercialization value of the rural homestead dominates, the spatial disequilibrium and development need more often resolved by bidding for the rural homestead in the market. When the value of non-farm income from the rural homestead dominates, they are more likely to satisfy the requirement of homestead property realization by withdrawing from the rural homestead, which means farmers rely less on it.

(3) Different value types of the rural homestead correspond to the different modes of transfer. According to the conversion trends of capital production value, commodity exchange value, and ecological protection value of the rural homestead, the capitalization, commercialization, and non-farm employment income modes of the rural homestead can be adopted accordingly to realize the flow of the rural homestead. When the commodity exchange value of the rural homestead is greater than the residence guarantee value, choosing the commercialization mode of the rural homestead can meet the commodity transaction demand of the farmers. When the capital production value of the rural homestead is greater than the residence guarantee value, choosing the capitalization mode of the rural homestead can meet the capital operation demand of the farmers. When the ecological protection value of the rural homestead is greater than the residence guarantee value, choosing the non-farm employment income mode of the rural homestead can meet the ecology development needs.

4.2 Recommendations

With the high-quality development of the rural economy and the steady implementation of the rural revitalization strategy, the dynamic transformation trend of the rural homestead's value is becoming more and more distinct. However, the diversification of regional types and values of the rural homestead is the crux of the difficulty in implementing a unified circulation mode. How to find the right direction of the rural homestead transfer according to local conditions is the current problem.

(1) The selection of the rural homestead transfer mode should combine the location conditions and the resource endowment of the rural homestead. Different location conditions and resource endowments possess diverse resources, and their optimal allocation of resources also differs. Regions with better location conditions and resource endowments also have relatively better conditions to support non-agriculturalization, such as capital, technology, human resources, and social security. The commercialization and capitalization trend of the rural homestead is more distinct. This region can transform the rural homestead into forms of commodity trading and capital production by carrying out large-scale, intensive, modernized, and personalized production and operation, which can give full play to the attributes of production materials of the rural homestead. However, in areas with relatively poor location conditions and resource endowment, the rural homestead has a small scale, scattered distribution. Transaction uncertainty is high. The layout of the rural homestead can be optimized from points by replacing housing or reclaimed cultivated land to increase the property income and social security welfare of non-agricultural employment.

(2) The selection of rural homestead transfer mode should drive by the dominant value of the rural homestead. The value of the rural homestead is diversified and dynamic, and different dominant values have a decisive influence on the direction, speed, and quality of the rural homestead transfer. Farmers should find the dominant value of their rural homestead by analyzing several angles and develop the secondary values of their rural homestead in concert. The relevant departments should clarify the current trend of regional economic development and policy system. Eliminate the cognitive bias of farmers on the dominant value of the rural homestead. Besides, coordinate the conflicts between various values, give full play to their dominant values and maximize their utility.

(3) The development of the rural homestead transfer mode can be explored based on the dominant value to diversify. In addition to the single transfer, mortgage, lease, or other forms of transfer for their rural homestead, they can also unite other subjects to transfer the use rights of rural homestead in new ways such as combined transfer. The entities with the same circulation value can combine their rural homestead and enjoy the right to use them together in proportion. The entities with different circulation values can hand over the right to use the rural homestead centrally to economic organizations, who can introduce social capital, excellent talents, advanced equipment, and other foreign factors of production to carry out diversified construction. Giving play to the synergy of operation, financial synergy, and management synergy brought by different circulation values, the synergistic effects of various transfer values, such as operating synergy, financial synergy, and management synergy, can realize the effective allocation of the rural homestead resources and the overall improvement of value.

(4) The limitation on the transfer of the rural homestead can be appropriately reduced. The implementation of the rural homestead reform is to make farmers turn idle assets in their hands into capital and increase their property income. Although China has set many restrictions on rural homestead transfer, the pilot counties have achieved good

results in exploring diversified rural homestead transfer models, which brings confidence to reduce the limitations on rural homestead transfer. Farmers can learn from the successful homestead transfer models in the pilot counties and combine their respective actual transfer values for transfer. While keeping the red line of arable land protection, reduces the obstacles to the transfer of rural homestead as much as possible. Increase the enthusiasm of farmers to transfer their rural homestead and explore the mode of transferring rural homestead in line with national policies and their own needs.

Author Contributions

C-CC: conceptualization, methodology and arrangement. A-LL and S-QF: data acquisition and curation writing-original draft preparation. J-XC and W-BL: writing-original draft preparation. Y-YM and Y-CW: writing-reviewing and editing. All authors contributed to the article and approved the submitted version.

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ARTICLE

Fiscal Sustainability: Public Revenue-Expenditure Nexus in a Few Asymmetric Countries in the Globe

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Abstract: This article examines the public revenue and expenditure patterns and its nexus of a few countries. This paper employs panel unit root, panel cointegration and Vector Error Correction Model to analyze the inter-temporal association among the variables of government revenues, expenditures and the growth of GDP through the panel data of ten divergent nations over the period 2001 to 2017. The study exercised three cointegration tests and these estimates find the evidence of long run association among articulated three variables. To know the cross-section status of different nations this paper diverted Phillips-Peron test with bandwidth statistics and it asserted that, all ten countries secured the long run association among the variables. The study uncovered that, growth of GDP has escalated in 0.78% by one percentage increase in revenue expenditure; meanwhile, 1.41% lessening in GDP growth by one percentage increase in revenue income. The specified model is supported by a few diagnostic tests.

Keywords: Government revenues income, Government expenses, GDP growth, Panel unit root, Panel cointegration, Fiscal synchronization hypothesis

1. Introduction

Each and every economy has been facing challenges of their allocation of resources and its distribution to their respective agents of the economy. Proper resource allocation and its distribution are the exigent affair for all states in the globe. The volume of government revenue income and it's spending principally based on the capability of production, that is, however recognized as GDP of a nation. The trends of GDP growth of an economy might be an instrument to exhibit the level revenue income as well as revenue expenditure for a particular country. The aim of this study is to scrutinize the inter-temporal association among GDP, government revenues and government expenditures for a panel of ten nations over the period from 2001 to 2017.

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According to the fiscal *synchronization hypothesis*, revenue income and expenditures decisions are constituted conjointly. In practice, the department of revenue and the department of expenditure of a government are working separately. So, it can be assessed that government revenues and government expenditures are not entirely related to each other. Meanwhile, some countries have been trailing their revenue income and expenditure target under their central planning. To judge the limit or fixing the level of both variables, the size of GDP and its growth need to be contemplated as a pivotal matter. The pattern of GDP of a country and its share can make a guideline to figure out the frontier of the uttered departments of the government revenue income and revenue expenditure. This article aims to assess the relationship among GDP, government revenues and government revenue expenditures in a panel data of ten nations. The variables of panel data of ten nonhomogeneous nations, with different socio-economic pattern, must be varied vastly in numeral. The study intends to examine the relationship among the variables.

Public revenue income and expenditure are the common stand to apprehend public financing and its process of synchronization with the growth of GDP for each and every country around the globe. From the viewpoint of public finance, the stem of revenue expenditure come first as an explanatory variable which determine the volume of revenue income for a particular country in each year. Every single component of revenue expenditure has been selected and approved by the state policy with their ruling government. Usually, social needs as well as public demand are reflected on revenue expenditure, such as expenditure on health, education, various development activities and so forth. These expenditures, precisely the sources of expenditure and its volume, mainly based on the capacity of an economy (GDP) and it also depends on noneconomic factors, such as socio, geographical, political, environmental shape of a nation. In addition to that, cultural and historical background of a nation play an important role to determine the social needs and the choice of public expenditure. To comprehend the *fiscal sustainability*, this study intends to understand the dissimilar capacity of different nations and its articulated asymmetric socio, political and geographical patterns which could explore their fiscal linearity in terms of revenue income and revenue expenditure and examine the actual consequence of *fiscal sustainability* among a few nations. In the view of uttered asymmetry, this study takes into account ten countries, such as Bangladesh, India, Israel, Malaysia, Poland, Switzerland, Thailand, United States, United Kingdom and Sri Lanka, that might be more relevant than other homogenous countries.

Customarily, the choice and the quantity of revenue expenditure are not solely depending on economic analyses. Economic optimization, such as welfare optimization does not assure the actual decision of expenditure of a particular country. Similarly, revenue income did not materialize only with the basic theme of public finance, expressly, social equity and justice. So, the policy of fiscal matter could be justified by the regular framework of economics as well as outside the economic analyses. But whatever the outcome made of fiscal variables, it requires to be harmonized with the capacity of an economy, namely, the growth of GDP for the all nations. Finally, the empirical investigation of *fiscal sustainability* could be ensured as well as be justified the former fiscal decisions. In this regard, some research experiences might be justified and rationalized the empirical analyses. By considering selected South Asian Countries (SANs), BRICS and other emerging nations, an empirical modeling analyses of [1] and covered the period of 2007 to 2016 through U-shaped hypothesis (Armey curve, 1995) and system of Generalized Method of Moments (GMM) technique. The study examined the linkage between government spending and economic growth. The investigation unearthed that, a rise in the public spending followed in a significant change in the growth rate when the public spending was attain the optimal threshold level, indicating a non-monotonic association. Furthermore, it suggested a policy consequence that public spending could only be a short-term determine to share out with crises in any nation, but not a long-term solution. To comprehend the impact of monetary and fiscal policies on economic growth in Malaysia, Singapore and Thailand, the analyses of [2] employed Autoregressive Distributed Lag (ARDL) to establish a long-run relationship. The examination vintages a consistent result and find the government spending had a negative impact on economic growth in Malaysia and Singapore, but it had a positive effect in Thailand. The analyses also specified that monetary policy is more effective in Malaysia and Singapore, while fiscal policy is more effective in Thailand. The study recommended that, in spite of the countries' results are asymmetric, due to the mutually dependency of monetary and fiscal policies, it needs a consistent and sustainable policy-mix structure to escape possible inconsistencies. Meanwhile, for the single economy of cross section analyses, a study [3] examined the nonlinear link between government expenditure and government revenue for South African economy. This study comprises quarterly data from the first quarter of 1965 to the second quarter of 2019 with the dynamic mechanism of threshold Vector Autoregression (VAR) and

threshold Vector Error Correction Model (VECM), finally, Markov Switching model is employed to determine the tendency of the variables. The results exhibited that the presence of nonlinear but one-way casual relation between government expenditure and revenue. Additionally, the adjustment mechanism of government expenditure towards the equilibrium is more persistent than government revenue when the threshold level is attained.

Under the articulated ten nations, this paper concentrated on the causality, inter-temporal relation and fiscal sustainability of the two basic fiscal variables with the progression of GDP. In particular, the study examines the causality between government revenue and government expenditure with respect to GDP. In addition to that, this study investigates cointegration relationship and inter-temporal relationship among the uttered three variables and finally check the *fiscal sustainability* thru fiscal synchronization hypothesis.

The manuscript is arranged as follows: Section 2 Literature Review, Section 3 deliberates the Data and Methodology are used in the study, Section 4 Results and Discussion, while Section 5 tenders some concluding remarks.

2. Literature Review

In the fiscal policy research, there are lots valuable research outcomes have taken into account of this study. To seizure the field of fiscal policy, this review has comprised most pioneer study outcomes of this arena and the outcomes precisely based on panel and time series estimates and analyses consist of a particular nation or cluster of nations. In Taiwan's analysis [4] employed the technique of VECM and suggest that unidirectional causality running from government revenues to government expenditures which leads support to the *tax and spend hypothesis*. The major consolation was the government of Taiwan should be more focused on spending cuts rather than look for ways to raise revenues from taxes or from any other means. Considering the causality test of the revenue and expenditure nexus of the experience of Ghana disclosed through a study [5] comprised the time series period 1980 to 2013. This study unearths that, in short run, upsurges in taxes have a rather negative impact on government expenditure, indicating the possibility of an absence of fiscal illusion. The Granger Causality Test (GCT) outcomes, however, indicate a unidirectional causal association between government revenue and government expenditure.

The study furnish emphasis on particular worthwhile research outcome have investigated by supporting *fiscal synchronization hypothesis* which shielded a *feedback mechanism* between government revenue income and spending. In this connection, a South African study deals with articulated the main three variables have taken into account with the time period from 1960 to 2013. The study [6] identified that there exists a long run association ship in terms of threshold cointegration. The data only exhibit a symmetric cointegration relationship between government expenditures and revenues. In addition to that, the results explored the short and long run causality relationships between the variables and thus support the *fiscal synchronization hypothesis*. For the viewpoint of Turkey, a specified research outcome has signified by [7] concerning the time series analysis of taxes and expenditure variables encompassed data from 1950 to 2007. The study recommended that there occurs a *feedback mechanism* between government revenue and expenditure. In other words, in Turkish budgetary process, both revenue income and expenditure levels modify each other; so that higher tax levels and caused by higher expenditure levels and vise-versa. Another analysis [8] advised that, fiscal legislators in 40 Asian nations should set revenues and expenditures simultaneously. Under this situation the fiscal specialists of these nations with budget shortfalls should raise revenues and decrease expenditure simultaneously in order to curb their budget deficits. This panel study also corroborates that GDP, revenue income and expenditure variables are cointegrated and surveyed *a bidirectional causal relation* between government revenues and government expenditure, which leads defend to the *fiscal synchronization hypothesis* in these nations. A research work [9] of Chinese experience was considered the objectives of *fiscal synchronization* its relative issues over the period of 1997 to 1999. The research employed GCT based on the corresponding multivariate VECM and the outcomes of this study recommended *feedback existed* between government revenues and government expenditures. Explicitly, for China, it was supporting the fiscal synchronization. To understand the fiscal sustainability of 15 European Union (EU) nations for the sequences from 1970 to 2003, the study [10] recommended that, small number of nations appear as less likely to unveil sustainability glitches, such as, Germany, Netherlands, Finland, Austria the UK. Another study of *fiscal sustainability* of 28 EU nations accomplished by [11] and revealed that the panel estimates of the cointegration relationships point to a positive long run co-movement between government revenue and expenditures.

In the Bangladeshi perspectives, a time series analysis comprised data information for the period of 1972 to 2015, examined by [12]. The result infers that GDP and tax are having long-run negative affiliation, which also showed that tax has significant adverse impacts on GDP

and hindrance to achieve sustainable economic growth. They argued that, the burden of sizeable direct tax badly effect on the wage employees, infant and small business firms. Another research of [13] examined the relationship between GDP and indirect tax, it encompassed an econometric model for time series data of Bangladesh over a period of 43 years. This study exposed that, if the government, in the long run, upsurges the indirect tax revenue by one percent (USD 167.511 million) then the GDP has decreased to a 0.96 percent (USD 2,572 million). In the viewpoint of Romanian economy, an investigation [14] of VAR model stated that whether government revenues have or not a more influent role than government expenditures on controlling economy. Additionally, this examination showed that GDP increases in both cases: positive government expensive shock and positive government revenues shock. This study employed GCT through cointegrated VAR methods for time series quarterly data over the period 1998q1-2014q1, as a fiscal policy of the state, controlling economy instrument might play a significant role.

As a concept of GDP, it has been presenting a final yearly performance of an economy and to figure out the inter-temporal relationship among the articulated variables, public debt become an influential and most interrelated variable to justify decisions relating to the matter of fiscal policy. With contemplation of the matter of fiscal policy, a study of debt was roofed by [15] in the context of Malaysia. The paper incorporated public debt as another variable to determine and justify the government budget relating to fiscal variables and GDP. The analysis investigates the time series data of Malaysia for the period of 1970 to 2006. The examination authenticated a long run affiliation between GDP and all types of public debt in Malaysia. It was uncovered that; all debts influence negatively and significantly to the economic growth. Overall findings uncovered that; all types of debts unveiled adverse long run association with the progress of an economy. From the study of negative sign denotes that if the volume of debt increases then the particular GDP has decreased. By using the time series data for the Namibian perspective, an investigation [16] conducted thru the relationship between government expenditure, government revenue and public debt and these variables covered for the period of 1980 to 2018. An error correction model (ECM) was employed to analyze the short-run dynamics and a positive relationship depicted between government expenditure and government revenue. By the application of pair-wise GCT, the evidence failed to support the spend-revenue hypothesis. Moreover, the study suggests that, the policy maker requires to review meticulously government expenditure and carry it to optimal levels in order to avert the widening of public debt.

To understand the usefulness of fiscal policy and its impact on macroeconomic activities, a study conducted by [17] in the context of Pakistani economy during the period of 1972 to 2008. With the help of ARDL model, this examination unearths that, in the long run, the overall fiscal deficit exerts a negative effect on economic growth. The analysis acclaims that, the shortfall of budget should be in the narrow band of 3 to 4 percent of GDP. Away from this limit, the unsustainable shortfall of budget could have detrimental macroeconomic costs and the macroeconomic aims of government such as low inflation and high economic growth might be in distress. Another study [18] of Pakistani economy based on *fiscal synchronization hypothesis*. To understand the government revenue and income nexus of Pakistan, this investigation employed non-linear cointegration technique and contained data information from 1972 to 2014. The study evidence established *fiscal synchronization hypothesis* with cointegration between revenues and expenditures. These two components of public finance unveiled an asymmetric and negative changes in revenues and expenditures have a greater impact than the positive ones.

Regarding the fiscal policy and sustainability of government debt contained panel data research [11] in EMU countries. The investigation explored that, panel unit root tests in the attendance of cross section dependence showed that the government debt series was stationary, indicating that the affluence condition would be satisfied for these countries. The study of *Wagner's Law* and *Keynes approach* conducted by [19] for the Italian economy and this experiment covered the period of 1960 to 2008. The association between various entries of government expenditure and national income is keener to practice by Keynesian than Wagnerian views. Thus, to reduce the gap between revenue-expenditure, the dependency on public debt is not a wise decision. So, fiscal issue needs to be settled by the specific endogenous fiscal variables. On the other hand, by considering the capacity of GDP, an affluent country may find the result by changing public debt variable or even the rational level of negative debt, such as EMU countries.

Decisively, in the long run, the mismatch of government revenue income and revenue expenditure or any distortion of fiscal policy of a particular economy may have been adjusted the capacity of an economy, that is, the rate of growth of GDP. A steady state growth rate of an economy is the prerequisite to justify the proportional expansion or progression of the variables relating to fiscal policy. Actually, an optimal level of revenue income

and revenue expenditure are the desirable components to corroborate the proper usages of resources of an economy. But it is arduous to accomplish the said goals properly for a particular economy. In that case, a rational question needs to be considered of this study regarding the intertemporal relationship between revenue income and revenue expenditure. The results of the articulated relationship will be figured out and justified about the previous fiscal decisions are congruent or indistinct from the rate of growth of GDP for the specific economy.

In practice, fiscal policy decision has not been always exactly depending on the outcome of economic analyses, such as optimization of resources, citizen benefit maximization, consumer utility maximization, sustainability of development, public welfare maximization, and so forth. We are observing that, sometimes, it depends on the specific outline of a ruling party, like a commitment which had given before election, specific public interest (may or may not be supported by the outcome of economic analyses), nurturing religious and cultural issues, supporting custom and heritages, and many more. In that case, fiscal policy judgement may not always purely purely reinforced by the optimal choice of economics. So, fiscal policy pronouncement could be originated from outside the box of the analyses of economics, but it is factual that, whatever the execution conducted by the policy of fiscal instruments, a synchronization needs to be considered among the variables of revenue income, revenue expenditure and the growth of GDP in the long run for a particular economy. Eventually, a policy maker of a particular country put emphasis on the harmony between the growth of GDP and change of fiscal variables. So, the inter-temporal relationship among revenue income, revenue expenditure and GDP need to be investigated and the analysis of the cointegration relationship becomes an exigent question of this research.

3. Data and Methodology

The study takes in to account ten countries and the countries are: Bangladesh, India, Israel, Malaysia, Poland, Switzerland, Thailand, United States, United Kingdom and Sri Lanka. The data information's are collected from WDI and this annual data comprised 2001 to 2017 years. All three variables are formed by percentage and logarithmic in nature. For three variables: Government revenue income (lnreve), Government revenue expenditure (lnexpe) and Gross Domestic Product (lngdpg) of seventeen years annual data of each country are most found from the source.

With the purpose of establish the association between fiscal policy variables and economic growth, the study applied panel unit root tests. The panel unit root tests investigated the stationarity of the variables by using the Augmented Dickey-Fuller (ADF) [20], the Phillip-Perron (PP) and Levin, Lin and Chu (LLC) [21], tests. The Fisher Phillips-Perron (PP) test was proposed by [22] and [23]. In contrast to the IPS (Im, Pesaran Shin) Test, which is a parametric and asymptotic test, the PP test is a nonparametric and exact test. Subsequently, the study took into account the unrestricted VAR and then determined lag length to run the VECM. In addition to that, to work out the long run relationship among the variables, the analysis introduced three panel cointegration techniques: a) Johansen Fisher Panel Cointegration Test, [24] and [25], b) Pedroni Residual Cointegration Test [26] and c) Kao's Residual Cointegration Test [27]. Through these Tests of Cointegration, the study established the long run association among the three pronounced variables. Finally, VECM specify exact relationship between government expenditure to GDP and between revenue incomes to GDP. The net effect was carried out among the fiscal policy variables. All estimations were carried out using Econometric analyses (Eviews11 sv (X64) package, Microsoft Office Professional Plus 2010 for Excel and Word software.

3.1 Objective

The study is based on the following objectives:

i) To estimate causality between government revenues and government expenditures with respect to GDP.

ii) To figure out the cointegrating relationship among three variables of revenue income, revenue expenditure and growth of GDP.

iii) To find out inter-temporal relationship and specific effect on GDP growth to change of revenue income-expenditure variables.

iv) To understand the relationship between the basic fiscal variables with GDP under *fiscal synchronization hypothesis.*

3.2 Hypothesis

The null hypotheses of the experiment are

i) Ho: There is a cointegration occur among three variables of revenue income, revenue expenditure and growth of GDP of the ten nations.

ii) Ho: A feedback will be endured between government revenues and government expenditures, i.e., accompanying the "*Fiscal Synchronization*" hypothesis.

3.3 Model and Model Specification

The economic growth of a nation and her fiscal policy related major issue of revenue income and expenditure are interdependent with each other. An equation for

time series has been formed in pursuance of expose the association the aforesaid three variables.

Model-1 (General):

$$Y_t = \alpha + \beta_1 X_t + \beta_2 Z_t + \varepsilon_t \quad (1)$$

Model-2 (Specific):

$$\ln GDPg_t = \alpha + \beta_1 \ln \mathrm{Re}v_t + \beta_2 \ln Exp_t + \varepsilon_t \quad (2)$$

Model-3 (Panel):

$$\ln GDPg_{i,t} = p_i \ln GDPg_{i,t-1} + q_i \ln \mathrm{Re}v_{i,t} + r_i \ln Exp_{i,t} + \varepsilon_{i,t} \quad (3)$$

t =2001, 2002……..…2017 and i = 1, 2, 3,……10, nations

Where, Y or GDP consists of Gross Domestic Product, X or Rev represents revenue income, Z or Exp consists of revenue expenditure and t signifies the time periods. In the models β_1 and β_2 and are a deterministic constant factor and ε is a stochastic disturbance expression with period 2001 to 2017 of the ten nations.

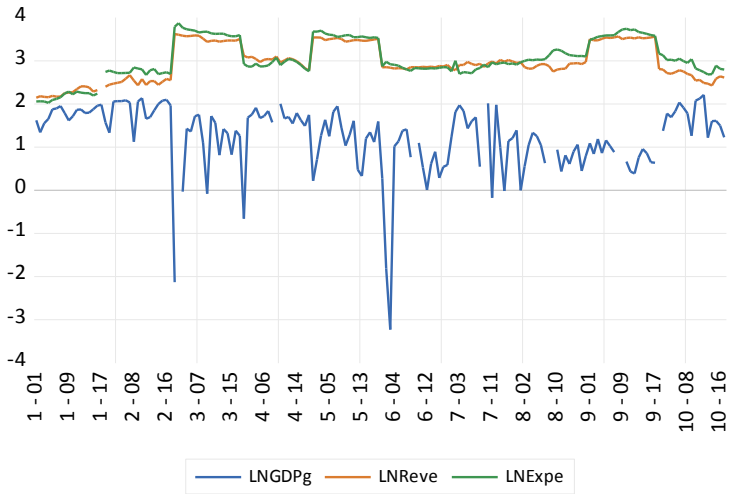

Figure 1. The Basic Status of the Ten Nations

Note: Each number indicates a particular country, Bangladesh 1, India 2, Israel 3, Malaysia 4, Poland 5, Switzerland 6, Thailand 7, United States 8, United Kingdom 9 and Sri Lanka 10

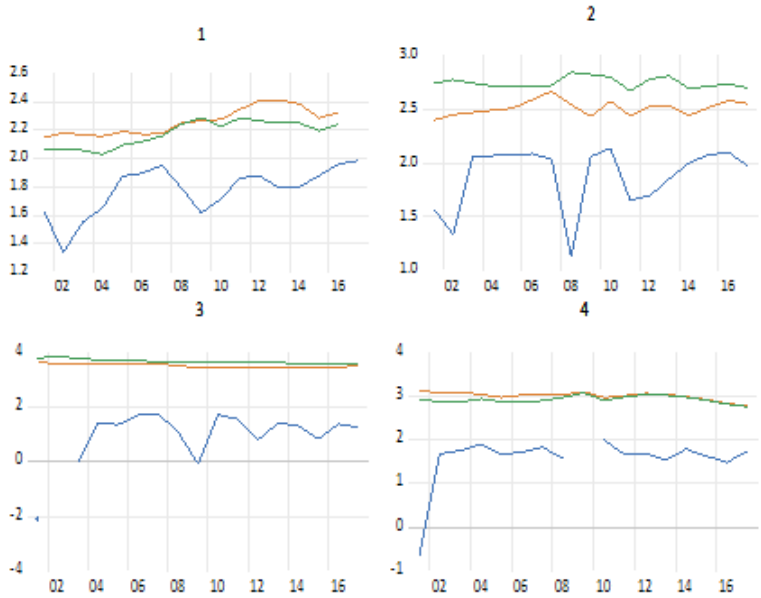

Figure 2. Individual Country Status

Note: Graph No. 1, 2, 3 and 4 consists of Bangladesh, India, Israel and Malaysia respectively.

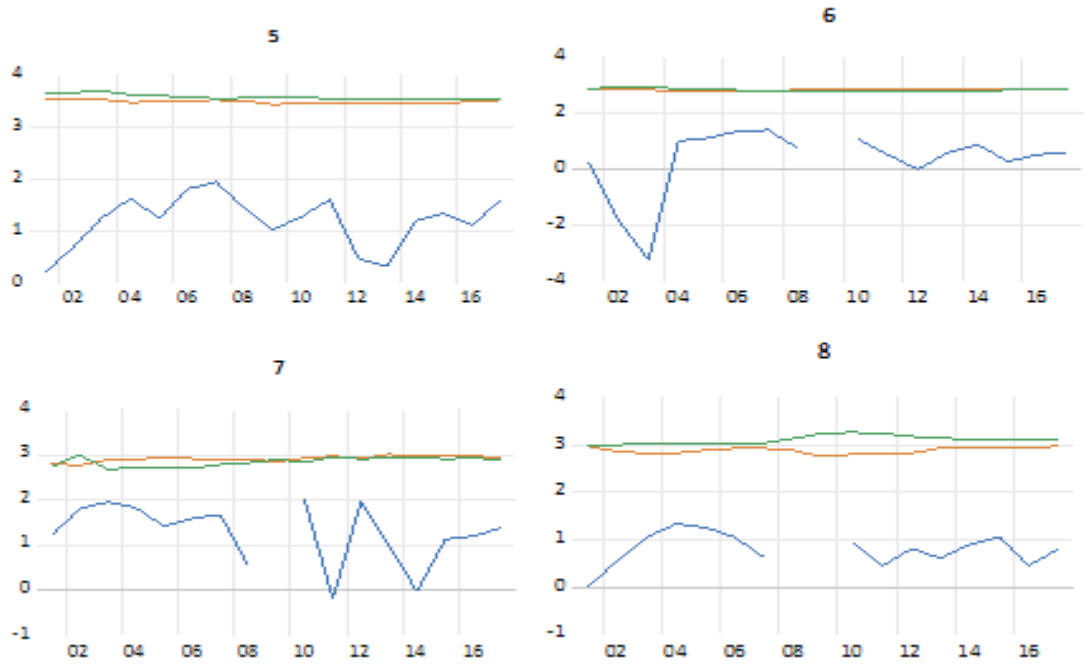

Figure 3. Individual Country Status

Note: Graph No. 5, 6, 7 and 8 consists of Poland, Switzerland, Thailand and United States respectively.

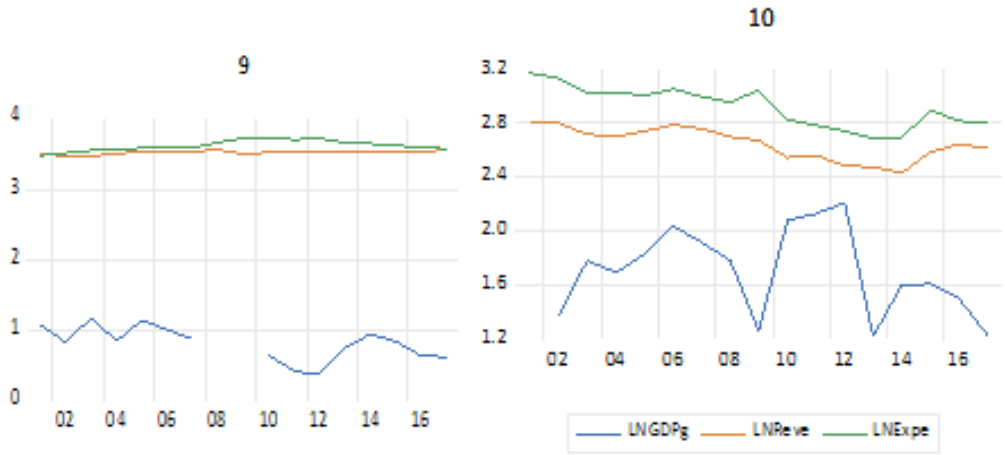

Figure 4. Individual Country Status

Note: Graph No. 9 and 10 consists of United Kingdom and Sri Lanka respectively.

4. Results and Discussion

After specifying the model, the study primarily requires grasping the quality of the model (please see Appendix A, for more). By estimating general regression, the estimates regress panel data (considering Cross-section none and period none and cross-section fixed and period fixed) and perceived that, F - statistics are significant at the less than 1% level and the value of the R^2 is greater than Durbin-Watson Statistic (DW) (0.8845>0.1195, please see Appendix B, for more), that is, regression line is not spurious.

4.1 Unit Root Test

To examine the panel properties of the statistics the Augmented Dickey-Fuller (ADF), the Phillip-Perron (PP) and Levin, Lin & Chu (LLC) tests were exercised to verify the stationarity standpoint of the specified statistics.

Table 1. Results of Unit Root Test at Level and Individual Intercept

Variables	ADF		PP		LLC		IO
	Trend	P-Value*	Trend	P-Value*	Trend	P-Value*	
lngdpg	76.2169	0.0000	89.1579	0.0000	-19.6639	0.0000	I(0)
lnreve	23.4559	0.2670	23.5547	0.2624	-1.64495	0.0500	X
lnexpe	26.0980	0.1626	22.4810	0.3150	-3.37017	0.0004	X

* Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality; ADF, PP and LLC consist of Augmented Dickey-Fuller, Phillip-Perron and Levin, Lin & Chu respectively. Note: *IO* represents Order of Integration

Source: The statistics reflect on the time period of 2001 to 2017 from WDI, ten nations, through the assistance of software Eviews 11 sv (X64).

Table 2. Outcomes of Unit Root Test at First Difference and Individual Intercept

Variables	ADF		PP		LLC		IO
	Trend	P-Value*	Trend	P-Value*	Trend	P-Value*	
lngdpg	120.727	0.0000	172.216	0.0000	–14.6789	0.0000	I(1)
lnreve	103.302	0.0000	115.798	0.0000	–11.0696	0.0000	I(1)
lnexpe	117.552	0.0000	126.823	0.0000	–12.2434	0.0000	I(1)

* Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other analyses assume asymptotic normality. Note: *IO* represents Order of Integration

Source: The statistics reflect on the time period of 2001 to 2017 from WDI, ten nations, through the assistance of software Eviews 11 sv (X64).

Table 3. Results of Unit Root Test at First Difference and Individual Intercept with Trend

Variables	ADF		PP		LLC		IO
	Trend	P-Value*	Trend	P-Value*	Trend	P-Value*	
lngdpg	86.6438	0.0000	145.049	0.0000	–11.2224	0.0000	I(1)
lnreve	82.6308	0.0000	107.080	0.0000	–10.4957	0.0000	I(1)
lnexpe	73.7646	0.0000	128.336	0.0000	–7.04008	0.0000	I(1)

* Probabilities for Fisher tests are calculated applying an asymptotic Chi-square distribution. All other tests assume asymptotic normality. Note: *IO* represents Order of Integration

Source: The statistics reflect on the time period of 2001 to 2017 from WDI, ten nations, through the assistance of software Eviews 11 sv (X64).

Table 4. Results of Unit Root Test at First Difference and None

Variables	ADF		PP		LLC		IO
	Trend	P-Value*	Trend	P-Value*	Trend	P-Value*	
lngdpg	154.910	0.0000	186.149	0.0000	–16.1203	0.0000	I(1)
lnreve	146.768	0.0000	160.984	0.0000	–12.1063	0.0000	I(1)
lnexpe	159.832	0.0000	163.179	0.0000	–13.5846	0.0000	I(1)

* Probabilities for Fisher analyses are calculated applying an asymptotic Chi-square distribution. All other tests assume asymptotic normality. Note: *IO* represents Order of Integration

Source: The statistics reflect on the time period of 2001 to 2017 from WDI, ten nations, through the assistance of software Eviews 11 sv (X64).

All three statistics for the results of three variables, namely, government revenues, government expenditures, and GDP are exhibited in Table 1, Table 2, Table 3 and Table 4 to test the stationarity standpoint of the panel statistics. In the results of order of integration, that is, other than first difference [I(0)], For the levels of the three tests statistics of the articulated three variables do not decline the null hypothesis of a unit root. Though, the analyses took into account the first difference of each of the variables, statistics acquired higher than their corresponding critical values at the 1% level. Thus, it infer that all three variables (lngdpg, lnreve and lngdpg) are integrated of order one or I(1).

4.2 Cointegration Test

To understand the long run association including the three variables of panel statistics, the experiment engaged three cointegration tests. The tests are a) Johansen Fisher Panel Cointegration Test b) Pedroni Residual Cointegration Test and c) Kao's Residual Cointegration Test. Before studying the Cointegration the study requires to determine lag length of the model.

Lag length fixation

The study find that three variables are stationary at first difference [I(1)], then perform Johansen cointegration test with (*p*) lags. To do so, the study incorporates and estimates the unrestricted VAR model and then determines level of lag of the model. The lag estimation based on Akaike information criterion (AIC), the outcome of optimal lag is Two. Moreover, LR (sequential modified LR test statistic) and FPE (Final prediction error) both support the findings of AIC. (Please see Appendix C, for more).

4.2.1 The Outcome of Johansen Fisher Panel Cointegration Test

The hypothesis of Johansen Cointegration Test stated that Ho: No Cointegration equation and H_1: Ho is not true. According to the decision criterion of the test, the study compels to decline the null hypothesis and if the value of the Trace and Max is less than 5% critical value, otherwise, fail to reject null hypothesis. The results of the joint analysis explored that Fisher statistics of trace test max-eigen test rejected the hypothesis none of Cointegration equation and also reject the hypothesis at most 1 and at most 2. So, the series are cointegrated, that is exhibited a long run relationship, which infers the series are associated and can be merged in a linear manner.

Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Table 5. Johansen Fisher Panel Cointegration Statistics

Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Fisher Stat.* (from max-eigen test)
None	134.6***	119.4***
At most 1	115.9***	104.6***
At most 2	826.4***	826.4***

Note: *Probabilities are calculated applying asymptotic Chi-square distribution, Sample: 2001 2017, Incorporated observations: 170, Trend conjecture: Linear deterministic trend, Lags interval (in first differences): 1 2; *** shows the level of significance at 1% level.

The results of the individual analysis of the cross section data asserts that, the two statistics of Trace and Max-Eigen value reject all three hypothesis (No cointegration, At most 1 Cointegration relationship and At most 2 cointegration relationship) of Cointegration at 1% level of significance revealed by Bangladesh and India. In terms of Cointegration status Poland, Thailand and Sri Lanka also utters significant at 1% by two null hypotheses. Malaysian and Switzerland also signifies the result of statistics at 1% level by rejecting hypothesis at most two Cointegration relationships. So, eight countries acquired the long run association with the pronounced three variables. The results of the investigates explored that, even if there are distresses in the short run, which might affect the movement in the individual series, they would converge with time, even, in the long run. Hence, there is a possibility to estimate the model both in the short-run and in the long-run. It also asserted that, the suitable guesstimate practices are the vector autoregressive (VAR) and VECMs.

4.2.2 The Outcomes of Pedroni Residual Cointegration Test

There are seven statistics exhibited under two dimensions: within the dimension and between the dimensions of Pedroni residual cointegration test [26]. The results of the analysis statistics are compiled and furnished by *individual Intercept, no intercept and individual intercept and trend*.

The results of cointegration investigates that, out of eleven test statistics in the individual intercept six are significant at 1% level one is significant at 10% level. Similarly, other two indicators of *Pedroni test statistics* also depicted the

Table 6. Cointegration Test: Individual Cross section Outcomes

Panel Code	Cross Section Panel ID	Hypothesis of no Cointegration		Hypothesis of at most 1 Cointegration relationship		Hypothesis of at most 2 Cointegration relationship	
		Trace Test Statistics	Max-Eign Test Statistics	Trace Test Statistics	Max-Eign Test Statistics	Trace Test Statistics	Max-Eign Test Statistics
1.	Bangladesh	102.3905***	59.6671***	42.7233***	34.1065***	8.6169***	8.6169***
2.	India	111.9221***	76.9141***	35.0081***	19.4513***	15.5567***	15.5567***
3.	Israel	NA	NA	17.5413	17.4751	0.0662	0.0662
4.	Malaysia	NA	NA	NA	NA	353.5051***	353.5051***
5.	Poland	99.9526***	66.9763***	32.9764***	30.8900***	2.0863	2.0863
6.	Switzerland	NA	NA	NA	NA	356.3819***	356.3819***
7.	Thailand	NA	NA	628.9432***	323.0598***	305.8833***	305.8833***
8.	United States	(DT)	(DT)	(DT)	(DT)	(DT)	(DT)
9.	United Kingdom	(DT)	(DT)	(DT)	(DT)	(DT)	(DT)
10.	Sri Lanka	59.7047***	45.2211***	14.4836*	13.8388*	0.6448	0.4220

Note: The level of significance is considered by [28] p-values and ***, ** and * show level of significance at 1%, 5% and 10%, respectively, DT consist of Dropped from Analysis.

Table 7. Country Pedroni Cointegration Test

Pedroni Test Statistics	Individual Intercept		Individual Intercept and Trend		No Intercept	
	Statistics	Weighted Statistics	Statistics	Weighted Statistics	Statistics	Weighted Statistics
				Within-dimension		
Panel v-Statistic	–0.9632	–1.466	–2.955	–3.356	0.060	–0.248
Panel rho-Statistic	–1.380*	-0.883	0.029	0.618	–3.207***	–2.424***
Panel PP-Statistic	–6.101***	–4.538***	–6.743***	–5.083***	–5.131***	–4.365***
Panel ADF-Statistic	–5.996***	–4.866***	–5.489***	–5.032***	–5.164***	–4.647***
				Between-dimension		
Group rho-Statistic	0.219		1.605		–1.523*	
Group PP-Statistic	–9.046***		–7.044***		–6.963***	
Group ADF-Statistic	–7.801***		–7.095***		–7.842***	

Note: Null Hypothesis: No Cointegration. For work out of optimal lag lengths used Akaike information criterion (AIC) and Schwarz information criterion (SIC) with maximum lag length 2, bandwidth selection by Newey-West and kernel estimation by Bartlett automatically selected by Eviews software 11sv (***, ** and * show level of significance at 1%, 5% and 10%, respectively).

existence of Cointegration. In the *individual intercept and trend index* represented that six statistics are significant at 1% level and lastly, there are nine statistics of *no intercept* indicator are statistically significant (In the nine significant results, eight statistics are significant at 1% level). So, the study clearly upheld that, there are long run associations existing among the specified variables of revenue income, revenue expenditure and GDP of exclaimed ten countries. So, there is a long run affiliation i.e Cointegration occurs in the model.

4.2.3 The Outcome of the Kao's Residual Cointegration Test

In the Kao test assumed no cointegration for null hypothesis. The result found that it rejects the null hypothesis at 1% level of significance. In addition to that, considering first difference of residual variable, it accomplishes reject null hypothesis at 1% level. So, both results unearth that there were long-run relationship exists among revenue income, revenue expenditure and GDP.

Table 8. Kao's Residual Cointegration Test Result

Factor	t-Statistic	Probability
ADF	–3.321043	0.0004
Residual variance	0.460256	
HAC variance	0.127445	

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID(–1)	–0.791107	0.074616	–10.60243	0.0000

Note: Null Hypothesis: No cointegration. Trend assumption: No deterministic trend Automatic lag length selection based on SIC with a max lag of 3 Newey-West automatic bandwidth selection and Bartlett kernel.

4.3 The Outcome of Phillips-Peron Cross Section Test

In the Kao test assumed no cointegration for null hypothesis. The result found that it rejects the null hypothesis at 1% level of significance. In addition to that, considering first difference of residual variable, it accomplish reject null hypothesis at 1% level. So, both results unearth that there were long-run association exists amid revenue income, revenue expenditure and GDP.

In the cross section specific results of Phillips-Peron with bandwidth results asserted that all ten countries secured the long run association among the uttered three variables. Unambiguously, six countries explored unique long run relationship considering all three test indexes (individual intercept, individual intercept and trend lastly, no intercept) with more than zero bandwidth results. These countries are Bangladesh, India, Malaysia, Poland, Switzerland and Thailand. Although, the three indicators of Phillips-Peron test are unearthed different results. In the rest of four countries, United States and Israel signifies the said relationship by two test indicators with nonzero bandwidth and United Kingdom and Sri Lanka are exhibited those relationship by one indicator.

4.4 The Outcome of VECM Estimates

The study examined the VECM test to understand the specific performance of each variable of the panel data of ten countries.

The result stated that one percentage change in revenue income (lnReve) affected 1.407 percentage decreases in GDP growth (lnGDPg). On the other hand, to explain government revenue expenditure, one percentage variation in revenue expenditure (lnExpe), upheld in a 0.784 percentage escalation in GDP growth (lnGDPg).

Table 11 specified that the appraised coefficient of

Table 9. Phillips-Peron Cross section Specific Country-wise Result

Panel ID	Individual Intercept	Individual Intercept and Trend	No Intercept	Panel ID	Individual Intercept	Individual Intercept and Trend	No Intercept
	Bandwidth	Bandwidth	Bandwidth		Bandwidth	Bandwidth	Bandwidth
Bangladesh	1.00	1.00	1.00	Switzerland	4.00	4.00	2.00
India	15.00	15.00	12.00	Thailand	13.00	7.00	1.00
Israel	0.00	2.00	1.00	United States	0.00	1.00	1.00
Malaysia	2.00	2.00	2.00	United Kingdom	0.00	2.00	0.00
Poland	2.00	3.00	2.00	Sri Lanka	0.00	8.00	0.00

Note: Cross-sections Included: 10, Null Hypothesis: No Cointegration, Phillips-Peron results (non-parametric)

Table 10. VECM Long-run Estimates

No. of Variables/ Parameter	Cointegrating Equation	CointEq1	Standard Error	t- Statistics
1	LNGDPG(-1)	1.000000		
2	LNREVE(-1)	1.408708	2.07153	[2.07153]
3	LNEXPE(-1)	–0.783761	–1.22197	[–1.22197]
4	C	–3.093423		

Note: Sample (adjusted): 2003 2017, included observations: 129 after adjustments, the statistics reflect on the time period of 2001 to 2017 from WDI, ten nations, through the assistance of software Eviews 11 sv (X64).

Table 11: VECM Short-run Estimates

Error correction/Coefficient	D(LNGDPG)		D(LNREVE)		D(LNEXPE)	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Cointegrating Eq1	–0.479803*	–6.61511	–0.008681***	–1.24222	0.005954***	0.78946
D(LNGDPG(-1))	–0.013303*	–0.18249	0.017929***	2.55265	–0.005571***	–0.73491
D(LNREVE(-1))	–0.649310	–0.71157	–0.052440*	–0.59646	0.044774*	0.47185
D(LNEXPE(-1))	–0.279102	–0.36270	0.043032*	0.58040	–0.252993*	–3.16168
C	0.038070**	0.82858	0.001277***	0.28835	–0.009307**	–1.94798

Note: Sample (adjusted): 2003 2017, included observations: 129 after adjustments, the statistics reflect on the time period of 2001 to 2017 from WDI, ten nations, through the assistance of software Eviews 11 sv (X64).

the Error Correction Term (ECT) had its anticipated sign and it was significant. This denotes that there is a joint significance of the long-run coefficients. The estimated coefficient of the ECT is -0.479803 which suggests that the speed of adjustment is nearly 48 percent per year. The negative and significant coefficient is a signal that cointegrating association occurs including the variables.

Adjustment Coefficient (–0.4798)

Previous year deviation from long run equilibrium is modified in current period an adjustment speed at 48%. A percentage change in Revenue Income (lnReve) is associated with a point 0.6493 percent (65%) decrease in GDP growth (lnGDPg) in last year on average and other things remaining the same in the short run. Again, Revenue Expenditure (lnExpe) is associated with a point 0.2791 percent (28%) decrease in GDP growth (lnGDPg) in last year on average and other things remaining the same in the short run.

Model Equation Result

All variables of VECM test results are in educational form. The first equation of VECM has stated our study specification model. Rest of two equations (Please see Appendix D, for more) are the probable option of the study. The equations are specified in first difference form.

Specified Equation from VECM

D(LNGDPG)=C(1)*(LNGDPG(-1)+1.4087084999* LNREVE(-1)-0.783760913785*LNEXP(-1) -3.09342258496)+C(2)*D(LNGDPG(-1))+C(3)*D(LNREVE(-1))+C(4)*D(LNEXPE(-1))+ C(5)

In the Specified Model Equation

ECT=LNGDPG(-1)+1.4087084999*LNREVE(-1)-0.783760913785*LNEXPE(-1)- 3.0934225

The coefficient of ECT is C(1)* (in equation marked as Lambda), which is negative in sign (-0.478) (Please see Appendix E, for more)indicate good result and p-value suggested at below 1% level (0.000) of significance. This study explored that there was a long run association existing in the model. In short run analysis the coefficient C(2), C(3), C(4) and C(5) are not significant, so there are no short run casual effect found in the study. In practice, countries have been trying to adjust their revenue income and expenditure in long term tenure with their respective macroeconomic plan (five years or perspective plan).

4.5 Perform Diagnostic Tests

To understand the quality of specified model, the study took into account and performed three Diagnostic Tests. The tests are: a) Serial Correlation Test, b) Pairwise Granger Causality Tests and c) Normality Test.

4.5.1 Serial Correlation Test

In residual performance of the study, in lag two ensured that no serial correlation exists in the model. (Test has taken H_0: No serial correlation at lag 1 and 2, for more, sees the Appendix F).

4.5.2 Pairwise Granger Causality Tests

By rejecting null hypothesis at 5% level of significance, this test exhibited that, Government revenue income of ten countries is Granger caused by the growth rate of GDP of each nation. The test also estimated that government revenue income is Granger caused by revenue expenditure and rejected the null hypothesis by 5% level of significance. The tests are considered six null hypotheses of pairwise Granger causality tests (Please see Appendix G, for more) of panel data of ten countries.

4.5.3 Normality Test

Among the three parts of normality test and three components of each part included uttered three variables. In all three parts of the tests component two, that is, government income variable are normally distributes and it signifies by more than 5% level of significant. (The main result of showed by Jarque-Bera also supported the statement, please see Appendix H, for more).

5. Conclusions

The study established an inter-temporal association among the basic fiscal variables of government revenue income and expenditure with GDP of the ten countries. In the panel data analysis of ten articulated countries the study critically examined Cointegration relationship and find the existence of Cointegration in the model of the three variables: revenue income, revenue expenditure and GDP. The estimates of Cointegration test the study took into account Johansen Fisher panel Cointegration test, Pedroni residual Cointegration test and Kao's residual Cointegration test. With the Fisher statistics of trace and max-eigen test rejected the hypothesis none of Cointegration equation. Furthermore, the results of the individual analysis of the cross-section data affirm that eight countries acquired the long run relationship with the articulated three variables.

Regardless of individual intercept, individual intercept and trend, and no intercept signs of Pedroni test endorsed that out of eleven test statistics most of the test index are statistically significant. In the third attempt of the Cointegration test also finds the same result by the Kao's residual Cointegration test. So, therefore, the model revealed a long run relationship, which implies the series are associated and can be pooled in a linear manner. In addition to that, the study clearly upheld that, there are long run association existing amid the specified variables; which finally supported by the fiscal *synchronization hypothesis* . So, the studied ten countries, adjusted their revenue income and expenditure with their growth of GDP.

In the cross section specific country wise results of PP test asserted that all ten countries secured the long run association amid the uttered three variables. All three indexes of PP test satisfied by Bangladesh, India, Malaysia, Poland, Switzerland and Thailand with nonzero bandwidth result. By the examination of the VECM test, the study specified that 0.784 percentage increase in GDP growth through one percentage change in revenue expenditure. Meanwhile, one percentage change in revenue income caused 1.407 percentage decreases in GDP growth. This bidirectional causality of three variables also reinforced the *fiscal synchronization hypothesis*.

Policy Suggestions

To achieve a long run harmonious association concerning fiscal policy instruments and growth of GDP, the government of a particular nation should curtail their nonproductive expenditures. In addition to that, tax policy of a nation compels to maintain the level of optimality with their productive resources. The plan of spending in the public sector requires to be addressed on the maximum return or benefit of public of a particular nation in the long run and short run. The policy maker of a precise nation should be given a concentration to their Public Sector Development Plan (PSDP) and it needs to be harmonizing with investment of the private sector. All PSDP require to be developed and it had better be based on optimal fiscal policy examinations. Finally, the examination needs to be cross checked with the context of a particular economy and its socio-economics patterns.

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Appendices

Appendix A: Basic Features of the Model

Table 12. General Feature of the Variables

	LNGDPG	LNREVE	LNEXPE
Mean	1.242120	2.961679	3.040083
Median	1.382633	2.924452	2.952370
Maximum	2.213161	3.624084	3.792413
Minimum	–3.229709	2.146526	2.028803
Std. Dev.	0.775296	0.424377	0.451478
Skewness	–2.281614	0.002240	–0.111319
Kurtosis	11.69650	1.947982	2.400727
Jarque-Bera	643.0142	7.378416	2.724638
Probability	0.000000	0.024992	0.256066
Sum	198.7392	473.8686	486.4133
Sum Sq. Dev.	95.57238	28.63523	32.40928
Observations	160	160	160

Appendix B: Estimate Equation (Panel Least Squares)

In the ten cross section data the study find 160 observations with 17 year each.

Table 13. Results of Panel Least Squares Equation

Dependent Variable	Panel Options				Panel Options			
	Cross-section None and Period None				Cross-section Fixed and Period Fixed			
	DW	R^2	F-statistic	Prob. of F	DW	R^2	F-statistic	Prob. of F
LNGDPG	0.884519	0.119509	10.65480	0.000046	1.515970	0.567646	6.418714	0.000000

Appendix C: VAR Lag Order Selection Criteria

Endogenous variables: LNGDPG LNREVE LNEXPE
Exogenous variables: C
Date: 06/24/20 Time: 22:23
Sample: 2001 2017
Included observations: 41

Table 14. VAR Lag Order Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	–14.50482	NA	0.000471	0.853894	0.979277	0.899551
1	117.4377	238.1402	1.17e–06	–5.143303	–4.641769*	–4.960672*
2	128.5290	18.39540*	1.07e–06*	–5.245319*	–4.367636	–4.925716
3	136.8037	12.51293	1.13e–06	–5.209938	–3.956105	–4.753361
4	144.2000	10.10227	1.27e–06	–5.131709	–3.501726	–4.538159
5	151.5100	8.914566	1.47e–06	–5.049267	–3.043134	–4.318744
6	163.9528	13.35322	1.37e–06	–5.217208	–2.834925	–4.349711
7	170.2149	5.803943	1.81e–06	–5.083654	–2.325221	–4.079185
8	182.1472	9.313026	1.95e–06	–5.226694	–2.092111	–4.085251

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Appendix D: Results of Model Equation

D(LNREVE)=C(6)*(LNGDPG(-1)+1.4087084999*LNREVE(-1)-0.783760913785*LNEXP(-1) -3.09342258496)+C(7)*D(LNGDPG(-1))+C(8)*D(LNREVE(-1))+C(9)*D(LNEXPE(-1))+C(10)

D(LNEXPE)=C(11)*(LNGDPG(-1)+1.4087084999*LNREVE(-1)-0.783760913785*LNEX PE(-1)-3.09342258496)+ C(12)*D(LNGDPG(-1))+C(13)*D(LNREVE (-1))+C(14)*D(LNEXPE(-1)) +C(15)

Appendix E: Specified Model Equations

Estimation Method: Least Squares
Date: 07/13/20 Time: 21:50
Sample: 2003 2017
Included observations: 135
Total system (unbalanced) observations 398

Table 15. Results of Specified Model Equations

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	–0.478382	0.072197	–6.626031	0.0000
C(2)	–0.013421	0.072653	–0.184723	0.8535
C(3)	–0.634248	0.908632	–0.698025	0.4856
C(4)	–0.259006	0.765230	–0.338468	0.7352
C(5)	0.039755	0.045594	0.871933	0.3838
C(6)	–0.007181	0.006933	–1.035681	0.3010
C(7)	0.018287	0.006947	2.632430	0.0088
C(8)	–0.062016	0.087289	–0.710469	0.4778
C(9)	0.053255	0.073302	0.726520	0.4680
C(10)	0.001317	0.004334	0.303817	0.7614
C(11)	0.006092	0.007772	0.783805	0.4336
C(12)	–0.008906	0.007788	–1.143642	0.2535
C(13)	0.050060	0.097853	0.511585	0.6092
C(14)	–0.232812	0.082173	–2.833213	0.0049
C(15)	–0.005626	0.004858	–1.157916	0.2476
Determinant residual covariance		1.72E-06		
Equation: D(LNGDPG) = C(1)*(LNGDPG(-1) + 1.4087084999*LNREVE(-1) - 0.783760913785*LNEXPE(-1) - 3.09342258496) + C(2)*D(LNGDPG(-1)) + C(3)*D(LNREVE(-1)) + C(4)*D(LNEXPE(-1)) + C(5) Observations: 130				
R-squared	0.318070	Mean dependent var		0.038717
Adjusted R-squared	0.296248	S.D. dependent var		0.616386
S.E. of regression	0.517086	Sum squared resid		33.42228
Durbin-Watson stat	2.195217			
Equation: D(LNREVE) = C(6)*(LNGDPG(-1) + 1.4087084999*LNREVE(-1) - 0.783760913785*LNEXPE(-1) - 3.09342258496) + C(7)*D(LNGDPG (-1)) + C(8)*D(LNREVE(-1)) + C(9)*D(LNEXPE(-1)) + C(10) Observations: 134				
R-squared	0.057575	Mean dependent var		0.001571
Adjusted R-squared	0.028352	S.D. dependent var		0.050691
S.E. of regression	0.049968	Sum squared resid		0.322082
Durbin-Watson stat	2.091592			
Equation: D(LNEXPE) = C(11)*(LNGDPG(-1) + 1.4087084999*LNREVE(-1) - 0.783760913785*LNEXPE(-1) - 3.09342258496) + C(12) *D(LNGDPG(-1)) + C(13)*D(LNREVE(-1)) + C(14)*D(LNEXPE(-1)) + C(15) Observations: 134				
R-squared	0.066484	Mean dependent var		-0.004869
Adjusted R-squared	0.037537	S.D. dependent var		0.057096
S.E. of regression	0.056014	Sum squared resid		0.404753
Durbin-Watson stat	1.626667			

Appendix F: VEC Residual Serial Correlation LM Tests

Date: 06/24/20 Time: 23:00
Sample: 2001 2017
Included observations: 129

Table 16. Result of VEC Residual **Serial Correlation LM Tests**

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	35.58634	9	0.0000	4.153772	(9, 289.8)	0.0000
2	11.51372	9	0.2421	1.289175	(9, 289.8)	0.2422

Note: Null hypothesis: No serial correlation at lag h

Appendix G: Pairwise Granger Causality Tests

Date: 06/25/20 Time: 21:37
Sample: 2001 2017
Lags: 2

Table 17. Results of Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
LNREVE does not Granger Cause LNGDPG	129	3.45343	0.0347
LNGDPG does not Granger Cause LNREVE		2.82831	0.0629
LNEXPE does not Granger Cause LNGDPG	129	2.08245	0.1290
LNGDPG does not Granger Cause LNEXPE		0.09989	0.9050
LNEXPE does not Granger Cause LNREVE	149	0.48671	0.6157
LNREVE does not Granger Cause LNEXPE		3.82117	0.0242

Appendix H

Among the three variables No. 1 means LNGDPg, No. 2 consists of LNREVE and 3 for LNEXPE. Here 2, i.e LNREVE is normaly distributed (Which were more than 5% level, in this test Jarque-Bera portion given more emphasized by the researcher, and Joint showed the model is not normally distributed.)

VEC Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: Residuals are multivariate normal
Date: 06/24/20 Time: 22:51
Sample: 2001 2017
Included observations: 129

Table 18. Results of VEC Residual Normality Tests

Component	Skewness	Chi-sq	df	Prob.*
1	–1.256657	33.95250	1	0.0000
2	–0.026211	0.014771	1	0.9033
3	–0.523128	5.883758	1	0.0153
Joint		39.85102	3	0.0000
Component	Kurtosis	Chi-sq	df	Prob.
1	12.83533	519.9432	1	0.0000
2	3.528023	1.498595	1	0.2209
3	8.492181	162.1318	1	0.0000
Joint		683.5736	3	0.0000
Component	Jarque-Bera	df	Prob.	
1	553.8957	2	0.0000	
2	1.513365	2	0.4692	
3	168.0155	2	0.0000	
Joint	723.4246	6	0.0000	

*Approximate p-values do not account for coefficientestimation

8. End Notes

i The tax-and-spend hypothesis advises that modifications in revenues income persuade amendments in government spending's.

ii Once framing a decisiveness in terms of the appropriate levels of government revenues and government expenditures [29] and [30], voters equivalence the marginal benefits and marginal costs of government services. So, revenue income and spending choices are jointly settled under this *fiscal synchronization hypothesis*. Empirically, this hypothesis is categorized by concurrent *feedback or bidirectional causality between government revenues and government expenditures.*

iii Adolph Wagner (1893) was amid the first who perceived the overtime accumulative inclination of public spending. Wagner's Law, states that economic performance has a fundamental positive impact on public sector's growth [31].

iv The Keynesian convention claim that an economy desires a Keynesian-type fiscal stimulus to be assumed temporarily in periods of recession by a functioning government [32], whereas, others, belonging to conventional economics, contend that the government has to be small and not to substitute the market mechanism.

v Guide Line: if six statistics are significant the model depicted a long run Cointegration exists, Pedroni P (2004).

vi **For Long run equilibrium:**

$$ECT_{t-1} = Y_{t-1} + \eta X_{t-1} + \varepsilon_m R_{t-1} + C$$

$ECT_{t-1} = 1.000\ln GDPg_{t-1} + 1.4087\ln Reve_{t-1} - 0.7837\ln Expe - 3.0934$

vii **For Short run equilibrium:**

$$\Delta Y_t = \sigma + \sum_{t-1}^{k-1} \gamma_i \Delta Y_{t-i} + \sum_{t-1}^{k-1} \eta_j \Delta X_{t-i} + \sum_{m=1}^{k-1} \varepsilon_m \Delta R_{t-m} + \lambda ECT_{t-1} + U_t$$

$\Delta \ln gdpg_t = -0.4798ECT_{t-1} - 0.0133\Delta \ln gdpg_{t-1} -0.6493\Delta \ln reve_{t-1} - 0.2791\Delta \ln expe_{t-1} + 0.0380$

viii The fiscal synchronization hypothesis argues that revenues and expenditures decisions are made jointly.

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EDITORIAL

Political Economy of Global Environmental Governance Institutions: Future Collaborations between China and USA

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The ongoing COVID-19 pandemic is a reminder that a major public crisis on a global scale is an extreme problem facing all humanity. The global public crisis fundamentally threatens the security and common interests of all mankind. The increasingly serious climate and environment problems accompanying the large-scale industrialization have long held back all countries in the world, no matter affluent or poor. In recent years, 2021 ranks as Earth's fifth hottest year on record [1]. The average global ocean temperature has broken historical records. The rise in temperature in 2021 is not a very accidental event. 2020 tied with 2016 as the warmest year on record, with the past seven years being the hottest on record [2]. What these data bring to the world is a warning about the future of human governance. The global economy will recover quickly after the pandemic, and data over the past year show that China and the US have led the way in achieving a strong recovery. This will inevitably lead to rising levels of global production and consumption to repair the already badly damaged global economy and employment. In fact, a significant 6.2 percent increase in U.S. emissions in 2021 has already affected the Biden administration's domestic and foreign policy agenda in addressing global climate change [3]. At the same time, the progress of China's carbon reduction policy has been delayed by various reasons, such as lack of electricity.

The capitalist system led by neoliberalism has pushed forward the process of globalization at full speed while taking advantage of information technology to improve the efficiency of capital allocation and the general level of labour productivity. The world's wealth is concentrated in a few countries, even precisely in a few oligopolies and families. The global negative environmental and economic impacts of globalized production, however, are widespread in many poor and developing countries. These realities are highly detrimental to address the dangers of global public crisis such as climate change, pandemic, and global economic crisis. Ecological and environmental crisis is a global issue, which primarily relies on the close cooperation of major economies, especially like the US

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and China [4]. The international academic community has repeatedly voiced the opinion that there can be no real and effective solutions to major crisis concerning the future of mankind, such as climate change, if the West does not cooperate with China.

The current global monopoly on capital, science and technology and information, as well as nationalism and zero-sum game thinking jointly restrict the realization of this equality. Especially when major public crises occur, the estrangement caused by monopoly and protection thinking becomes more and more obvious. The continuing negative impact of COVID-19 has proved that the ultimate challenge of mankind cannot be solved through competition. It is up to big countries such as China and the US, which are highly developed in productivity and social organization capacity, to take the lead and gradually bring emerging or small economies to participate in global governance mechanisms [5]. On the contrary, emerging market countries are more interested in a community of common destiny based on the mechanism of resource and information sharing. In fact, the US has comparative advantages in technology and networks, and China has advantages in manufacturing and infrastructure construction. China and the United States can work together under the principles of peace, development, and mutual benefit to build and protect global information infrastructure, improve international connectivity, bridge the global development gap, and lay a solid foundation for effective responses to major global public crisis.

The strategic intent of the Biden administration at the beginning of its presidency to try to regain global leadership through climate politics was clear [6]. But the United States soon found China's importance unshakeable. As a powerhouse accounting for almost half of the world's growth in renewable energy capacity, China has been leading the world on key green technologies and manufactures in many fields like electric vehicles, batteries and solar power. John Kerry, the US government's special envoy for climate change, visited China several times last year during the pandemic. In mid-November 2021, the annual Global Climate conference was held in Glasgow. On the eve of the conference, China and the United States agreed to do more to reduce fossil fuel pollution this decade by issuing a joint declaration.

Despite the differences in social systems, capital has a huge impact on the economic development of China and the United States and even the whole world. Capital is not the root of all evil in creating climate problems. There is something wrong with human political and economic systems and environmental awareness. Clean energy is the direction of the future of the world, but it needs the assistance of capital and financial markets. A good cooperation mechanism should be established in advance for the geopolitical changes caused by renewable energy between China and the United States [7]. In the future, China and the United States should collaborate more closely, formulate a supervision mechanism for ESG-related funds and bonds in the global financial markets, strengthen cooperation on the implementation and supervision mechanism of the global emission reduction plan, and ensure that countries can achieve practical results in addressing global environmental governance actions.

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