

Resolving the Pension Payment Crisis: Effect of the Central Adjustment System

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The central adjustment system is the first step of the national coordination of basic pension, which can alleviate the pension payment crisis in some provinces. This paper establishes an actuarial model, measures the financial status of the central adjustment fund, and simulates the impact of the central adjustment system on the sustainability and subsidies of the basic pension funds in each province (municipality). The results show that: (1) Before the central adjustment fund system, the first accumulated deficit of basic pension occurred earlier in central region than that in eastern and western region. (2) After the implementation of the central adjustment system, the basic pension funds in 19 provinces (municipalities) experienced a decline in the scale of the first accumulated deficit, and the time of the first accumulated deficit in Sichuan and Liaoning was postponed. (3) Increasing the handover ratio of the central adjustment system will enhance the adjustment effect. (4) The adjustment effect of the central adjustment system is positively affected by the effect of the delayed retirement policy. (5) Under the current handover and appropriation method of central adjustment system, a higher contribution rate means more fund revenue for areas with a higher proportion of retirees. The central adjustment system is conducive to the sustainability of the pension fund in West China and other areas with underdeveloped market economy, but the actual effect depends on the retirement age, the subscription rate, the wage level and so on. When strengthening pension fund adjustment, the government should take into account the current operation status of pension funds to ensure both fairness and efficiency.

Keywords: pension, central adjustment system, fiscal burden, sustainability

1. Introduction

The report of the 19th National Congress of the Communist Party of China clearly put forward that the national coordination of pension funds should be realized as soon as possible. Because of the unbalanced development of pension funds in various regions of China, the gap is large, the pension information system is not perfect, and national coordination cannot be realized in one step but in “multiple

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steady steps”.¹ On June 13, 2018 *Notice of the State Council on the Establishment of a Central Adjustment System for the Basic Pension Funds for Enterprise Employees* (hereinafter referred to as No.18 [2018] document of the State Council) proposed the establishment of the central adjustment system as the first step to achieve national coordination of pension funds. The adjustment of the pensions funds among provinces will balance the burden of the funds between regions to achieve the sustainable development of the pension system. Therefore, can the central adjustment system improve the sustainability of pension funds in various provinces? What is the financial status of the central adjustment fund? What is the impact on the deficit and financial subsidies of the provincial pension funds? Will the implementation of delayed retirement policy and the *State and Local Tax Collection and Administration System Reform Program* affect the effect of the central adjustment system? The actuarial analysis and scenario analysis of the operation of pension funds and the scale of financial subsidy under the central adjustment system from a long-term perspective are not only beneficial to the quantitative analysis of the impact of the current system, but also provide data support for the further development of scheme with stronger adjustment.

Scholars at home and abroad have proved that the aging of the population and the risk of longevity will increase the expenditure of pension funds, thus reducing the sustainability of the pension funds (Wang, 2002; Engelen, 2003; Machnes, 2003; Banks and Blundell, 2005; Liu, 2014). Due to the different measurement objectives and methods, there are differences in the final measurement results of scholars. For example, the results of Ai *et al.* (2012) show that the current deficit of basic pension funds for urban employees appears between 2018 and 2036. Zeng *et al.* (2016) argue that under the “one-child” policy, the basic pension funds will experience a current deficit in 2023, while the accumulated deficit will appear in 2076, and that the implementation of the “two-child” policy would delay the time point of the deficit occurs. However, it needs to be acknowledged that the situation of pension fund revenue and expenditure in China is not optimistic, and in recent decades there will be a serious payment gap, resulting in a huge fiscal burden (Yu and Zhong, 2009; Wang, 2012). Therefore, the reform of the current pension system is an inevitable choice to improve the sustainability of pension funds.

The reform measures proposed by scholars to improve the sustainability of pension funds can be summed up into three categories: the reform of institutional parameters, the institutional reform of the departments involved in the system, and the addition of

¹ By the end of 2016, the current revenue of the pension funds in 7 provinces in China was lower than the expenditure. The development gap of the funds is not only reflected in the imbalance of fund revenue and expenditure among eastern, central and western region, but also within each region. For example, expenditure in the eastern region in 2016 was 1.6363 trillion yuan, representing 51.38% of the total expenditure of the basic pension funds for the year, among which the pension funds expenditure of Shanghai is 3.68 times and 12.14 times of that in Fujian and Hainan respectively.

new institutional provisions. Many scholars have studied how to reform the parameters of retirement age, contribution rate and substitution rate in the system to improve the sustainability of pension funds. In the context of population ageing, most scholars (Bovenberg, 2003; Cremer and Pestieau, 2003; Rao, *et al.*, 2005; Breyer and Hupfeld, 2010; Gong and Yu, 2015) believe that the delayed retirement can ease the pressure on pension payments; there are also academics (Weller, 2002; Zhang, 2011; Yu, 2012; Cipriani and Pascucci, 2018) who believe that delayed retirement may increase the revenue and expenditure of the funds at the same time, or have a negative impact on fertility, exacerbating population ageing, so that there is uncertainty about its ultimate effect. The adjustment of contribution rate and substitution rate have a reversely affected by the sustainability of the funds and the effect of organization and individual rights and interests. For example, reducing pension substitution rate can reduce pension fund expenditure, but it “undermines” the rights and interests of insured persons (Samuelson, 1969; Yang, 2008; Kang, 2012). Therefore, due to the rigidity of welfare and other reasons, to increase the contribution rate or reduce the substitution rate is not favored by organizations, individuals and the government. Although the reform of the parameters in the system is controversial, it is unanimously recognized by scholars to improve the efficiency of system management and operation. That includes to reform the departments involved in the system, to ensure the implementation of the system, and to further improve the efficiency of the funds’ operation by achieving the objectives of coverage, fund rate of return, collection rate, etc. (Holzmann and Stiglitz, 2001; Gui, 2015; Vogel *et al.*, 2017).

Based on actuarial principles, this paper calculates the operation of the pension funds and the scale of the financial subsidy required under the central adjustment system, and clarifies the impact of the central adjustment system on the time and scale of the accumulated deficit of the pension funds in each province. At the same time, considering the influence of delayed retirement policy, contribution rate and handover ratio, the effect of central adjustment system on the transfer of pension funds in different scenarios is simulated. The innovation of this paper is mainly embodied in the following. First, by taking into account the latest birth policy, this paper does not artificially set models, but sets models according to the latest survey on fertility intentions. Secondly, scenario simulation is of practical significance for the further development of the reform plan by simulating the impact of increasing the strength of the central adjustment system, of implementing the delayed retirement policy, and of reforming the departments involved in pension contribution on adjustment effects.

2. Models and Methods

After the implementation of No.18 [2018] document of the State Council, the impact

of the external financial flows of the basic pension funds is not taken into account, and the revenue of the provincial funds includes the disbursement of the central adjustment fund, interest income, the payment of insured personnel and the payment of enterprises; the expenditure of provincial funds includes the amount handed over to the central adjustment fund and basic pension expenditure. Drawing on the ideas and methods of actuarial modeling in the study of Wang (2002), Yu and Hong (2009), and Zeng *et al.* (2016), this paper establishes an actuarial model based on the provisions about the calculation and payment of pensions in No.26 [1997] document and No.38 [2005] document of the State Council and the provisions about the management of the central adjustment fund in No.18 [2018] document of the State Council.

2.1. Pension Fund Expenditure

2.1.1. Central Adjustment Fund Drawing a Certain Portion from the Provincial Capital Pool

No.18 [2018] document of the State Council stipulates that the amount of handover funds from provinces (municipalities) is based on a certain proportion of the average wage of employees in the province (municipality) and the number of working employees contributing to pension. Let $CAFC_t^i$ indicate the amount turned over to the central adjustment fund by province i in the year of t , W_t^i indicate the average wage of the employees in province i in the year of t , α indicate the proportion of handover base in the average wage, β indicate the proportion of handover, $L_{x,t}^i$ indicate the number of insured workers in province i in the year of t , and $i=1,2,\dots,31$ respectively indicate Beijing, Tianjin ... Xinjiang.¹ Then,

$$CAFC_t^i = W_t^i \times \alpha \times \beta \times \sum_{x=e}^{r-1} L_{x,t}^i \quad (1)$$

2.1.2. Paying Basic Pensions

At present, there are differences in the calculating and paying of pensions in the basic pension system due to differences in the number of working years of insured personnel, and differences in contributing time. Accordingly, the basic pension can be divided into basic old-age benefit, transitional pensions, personal account pensions and personal account expenditure return, represented by $(AC)_{t,b}$, $(AC)_{t,g}$, $(AC)_{t,i}^1$, and $(AC)_{t,i}^2$, respectively.

Basic Old-Age Benefits. Insured persons will receive a basic old-age benefit upon retirement. The three main factors that determine the level of the basic old-age

¹ The provincial order is sorted by the first two digits of the identity card number.

benefits for retirees are the calculation base, the proportion of the calculation, and the growth coefficient. In order to improve the accuracy of measurement, the insured persons are divided into the elderly, the old, the new and the newcomers, expressed as $i=1,2,3,4$ respectively. Among them, the calculation base of basic old-age benefit of the elderly and the old is the average social wage in the year before retirement, and the basic old-age benefit of the new and the newcomer is the mean of the average annual social wage and the exponential average annual contribution wage in one year before retirement. The insured persons are divided into female workers, women cadres and men according to different job categories, expressed in $j=1,2,3$ respectively. $N_{t,x}^{ij}$, $\bar{B}_{t,x}^{ij}$ and $S_{t,x}^{ij}$ represent number of insured workers in the categories of i and j in the year of t , the calculation base of basic old-age benefit, and the proportion of calculation respectively; $1+g_t$ indicates the growth coefficient of the annual basic old-age benefit; b_t^j and C_t^j represent the retirement age and the ultimate age of the insured j workers in the year of t respectively.

$$(AC)_{t,b} = \sum_{i=1}^4 \sum_{j=1}^3 \sum_{x=b_t^j}^{c_t^j} \left[N_{t,x}^{i,j} \times \bar{B}_{t,x}^{i,j} \times S_{t,x}^{i,j} \times \prod_{s=t-x+b_t^j}^t (1+g_s) \right] \quad (2)$$

Transitional Pensions. The old and the new will receive a transitional pension when they retire. The factors affecting the transitional pension level are the calculation base of transitional pension, the proportion of the calculation, the deemed payment years, and the growth coefficient. The calculation bases of transitional pensions of the old man and the new are the average social wage and the exponential average contribution wage in one year before retirement, respectively. $\bar{G}_{t,x}^{ij}$ and $v_{t,x}^{ij}$ represent the calculation base and proportion of the transitional pension of x -year-old insured workers in the categories of i and j in the year of t respectively. a_t^j indicates the entry age of category j of insured workers for the year of t , $1998-(t-x+a_t^j)$ is the deemed payment years.

$$(AC)_{t,g} = \sum_{i=2}^3 \sum_{j=1}^3 \sum_{x=b_t^j}^{c_t^j} \left\{ N_{t,x}^{i,j} \times \bar{G}_{t,x}^{i,j} \times [1998-(t-x+a_t^j)] \times v_{t,x}^{i,j} \times \prod_{s=t-x+b_t^j}^t (1+g_s) \right\} \quad (3)$$

Personal Account Pension. The old, the new, and the newcomers will receive a personal account pension upon retirement. The level of personal account pension is determined by the amount of personal account balance and the number of calculation months as of the insured person's retirement. m_t^{ij} represents the number of calculation months of insured workers in category i and j ; r represents the interest rate on bank deposits for one year; $\bar{w}_s$ and R_s^2 represent the contribution wages and contribution rates of the insured at the age of s , respectively.

$$(AC)_{t,i}^1 = \sum_{i=2}^4 \sum_{j=1}^3 \sum_{x=b_t^j}^{c_t^j} \left\{ \left[N_{t,x}^{i,j} \times 12 \times \left[\sum_{s=a_t^j}^{b_t^j-1} \bar{w}_s \times R_s^2 \times (1+r)^{b_t^j-s-1} \right] \right] / m_t^{i,j} \right\} \times \prod_{s=t-x+b_t^j}^t (1+g_s) \quad (4)$$

Personal Account Expenditure Return. Personal account expenditure return means that if there is a balance in his or her personal account when the insured person dies, the balance will be returned to his/her heirs. If the insured person dies in the calculation months after retirement, the personal account expenditure returned to his heirs is shown in the first formula on the right of equation (5); If he/she dies before retirement, the personal account expenditure returned to his/her heirs is shown in the second formula on the right of equation (5). $D_{t,x}^{i,j}$ is used to represent of the number of deaths of insured workers in category i and j , and the return of personal account expenditure is expressed as:

$$(AC)_{t,i}^2 = \sum_{i=2}^4 \sum_{j=1}^3 \sum_{x=b_t^j}^{b_t^j+m_t^{i,j}/12} \left(D_{t,x}^{i,j} \times \left(b_t^j + \frac{m_t^{i,j}}{12} - x \right) \times \left(12 \times \left[\sum_{s=a_t^j}^{b_t^j-1} \bar{w}_s \times R_s^2 \times (1+r)^{b_t^j-s-1} \right] / m_t^{i,j} \right) \right) \\ + \sum_{i=2}^4 \sum_{j=1}^3 \sum_{x=a_t^j}^{b_t^j-1} \left(D_{t,x}^{i,j} \times \left(\sum_{s=a_t^j}^x \bar{w}_s \times R_s^2 \times (1+r)^{x-s} \right) \right) \quad (5)$$

2.2. Pension Funds Revenue

2.2.1. Allocation of Central Adjustment Fund

The expenditure of central adjustment fund depends on its collection, all of which is disbursed to the provinces (municipalities). The central adjustment fund is allocated in accordance with the per capita quota and the amount of funds allocated is determined on the basis of the number of retirees in the provinces approved by the Ministry of Human Resources and the Ministry of Finance. The national allocation per capita = The central adjustment fund raised ÷ approved number of national retirees, of which, the allocation of a province's adjustment amount = The national allocation per capita × the number of the province's retirees. Let $CAFI_t^i$ represent the amount of the central adjustment fund received by province i in the year of t , then:

$$CAFI_t^i = \sum_{x=e}^{r-1} L_{x,t}^i \times CAF C_t / \sum_{i=1}^{31} \sum_{x=e}^{r-1} L_{x,t}^i \quad (6)$$

where, $CAFC_t = \sum_{i=1}^{31} CAFC_t^i$.

2.2.2. Contribution Revenue

The contribution revenue of pension funds is divided into enterprise contribution and individual contribution according to the difference of payers. Enterprises and individuals pay the basic pensions in a certain proportion on the basis of contributory wages. Let $(AI)_t$ represent the pension fund revenue in the year of t , let $\bar{w}_t$, k_t , and R_t respectively represent the contribution base of pension in the year of t , the contribution base growth rate and the contribution rate; let t_0 represent the starting year for the measurement period. Then

$$(AI)_t = \left(\sum_{i=1}^4 \sum_{j=1}^3 \sum_{x=a_t^j}^{b_t^j-1} N_{t,x}^{i,j} \right) \times \bar{w}_t \times R_t = \left(\sum_{i=1}^4 \sum_{j=1}^3 \sum_{x=a_t^j}^{b_t^j-1} N_{t,x}^{i,j} \right) \times \bar{w}_{t_0-1} \times \prod_{s=t_0}^t (1+k_s) \times R_t \quad (7)$$

2.3. Accumulated Balance of Pension Funds

The current balance of a provincial pension fund = The amount of the provincial fund contribution revenue—the basic pension distributed + the central adjustment fund disbursement—handover to the central adjustment fund. The accumulated balance of a provincial pension fund is equal to the sum of the principal and interest of the accumulated balance of the previous year and the accumulated balance of the current period. When the current expenditure of the pension fund is greater than the revenue, there is a current fund deficit, and the provincial government needs to fulfill the guaranteeing responsibility to ensure the payment of pensions. F_t^i is used to represent the accumulated balance of the pension fund of province i in year t , then:

$$F_t^i = F_{t-1}^i \times (1+r) + \left[(AI)_{t-1}^i + CAFI_t^i - (AC)_{t-1}^i - CAFC_t^i \right] \times (1+r) \quad (8)$$

3. Population Structure and Basic Parameter Hypotheses

3.1. Population Projections

3.1.1. Forecast of Urban Population Structure in Provinces

Based on the data of the sixth census, this paper uses the cohort-component method to predict the age and gender structure of population in 31 provinces (municipalities).

First, the number of newborns is obtained through the number of women of childbearing age and the corresponding fertility rate. $P_{t,x}^{f,j}$, $f_{t,x}^j$, $q_{t,x}^{f,j}$ and $l_{t,x}^{f,j}$ indicate the average female population of x years old, the corresponding fertility rate for women, mortality rate, and number of females. sr_t^j represents the proportion of male infants, $j=1, 2$ represents urban and rural areas, respectively; the number of newborns B_t^j can be expressed as: $B_t^j = \sum_{x=15}^{49} P_{t,x}^{f,j} \times f_{t,x}^j = \sum_{x=15}^{49} [l_{t,x}^{f,j} + l_{t,x-1}^{f,j} \times (1 - q_{t,x-1}^{f,j})] f_{t,x}^j / 2$. The age and gender structure of population for the following year is obtained on the basis of the previous year's population structure and mortality rate. Let $l_{t,x}^{m,j}$ and $q_{t,x}^{f,j}$ represent the number of males aged x and the corresponding mortality rate respectively, then $l_{t,x}^{m,j} = l_{t-1,x-1}^{m,j} \times (1 - q_{t-1,x-1}^{m,j})$, $l_{t,x}^{f,j} = l_{t-1,x-1}^{f,j} \times (1 - q_{t-1,x-1}^{f,j})$. Finally, the actual population structure of the provinces is obtained by taking into account the migration of rural population to towns in the province, the migration of the rural population of the province to the towns of other provinces, the migration of the rural population from other provinces to the towns of the province, and the migration of the urban population from other provinces to the province.

The sum of intra-and inter-provincial migrations is 0, with cross-border migration ruled out. The national urbanization rate is affected by the migration of rural population to towns and cities in the provinces, and the migration of rural population from other provinces to the cities and towns of the provinces, but not by the inter-provincial migration of the urban population to towns. According to international experience, the steady-state urbanization rate is 75%, and it is assumed that the average urbanization rate in China can reach this level in 2051. The province is a “net immigration” province of the rural population when the scale of rural population migrating to the province's towns is greater than that migrating to other provinces, while the province is a “net emigration” province of the rural population when the former scale is less than the latter. According to the sixth census on the scale of migration of provinces, Beijing, Tianjin, Inner Mongolia, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Guangdong, Hainan, Yunnan, Tibet, Qinghai, Ningxia, Xinjiang are the “net immigration” provinces, and the remaining 16 provinces are the “net emigration” provinces. Assume that the scale of intra-provincial migration of the rural population to the towns in “net immigration” provinces is twice the scale of migration to other provinces, then the future urbanization rate of cities such as Beijing, Tianjin and Shanghai is above average, between 90% and 100%. Future intra-and inter-provincial migrations are calculate based on the scale and proportion of migration in each province released by the sixth census. Assume that the migration structure remains unchanged in the future, population of 1 to 19 years of age, 20 to 49 years of age, and 50 to 89 years of age accounts for 19%, 19% and 62%, respectively, in the migrating population.¹ The

¹ According to 1992 statistics, the migrating population of 20 to 49 years of age as a proportion of the total migrating population is about 62.4%; the median age of the migrating population is 36.6 years old (Zhou, 2004), according to which the migrating population is appropriately revised in this paper.

age and gender structure of migrating population is the same as the corresponding age and gender structure of population. According to the relevant steps of the cohort-component method, the age and gender structure of population the provinces and towns can be calculated. According to the investigation report on the impact of the implementation of the universal two-child policy on family education, the sum of definite and indefinite intention to give birth to two children is 46.7%.¹ Number of qualified families under the “universal two-child” policy is simulated based on the “421” family microscopic simulation model.

3.1.2. F Forecast of the Population Structure of the Insured

Calculation Ideas. The numbers of employees and retirees covered by the basic pension of provinces (municipalities) in 2016 are obtained from *China Statistical Yearbook 2017*. For example, in 2016, the employees covered by the basic pension in Beijing were 12.712 million and the retired covered were 2.754 million. Assume that the population structures of employees and retirees covered by the basic pension in Beijing in 2016 are the same as that of the urban population in the corresponding age group in 2016 respectively, then the age and gender structure of the employees covered in Beijing in 2016 can be obtained. Based on the cohort component method, the age and gender structure of the employees covered in the next year can be obtained from the age and gender structure of insured employees and the mortality rate of each age in the previous year, of which the newly enrolled insured population is calculated from the provincial employed population and the coverage rate.

Urban Employed Population and Coverage Rate. The age of men and women in the employed population is mainly concentrated at 20~59 years and 20~54 years.² The proportion of the male and female employed population in the urban population of the provinces can be obtained from the sixth census, and assume that the proportion remains unchanged. Based on the structure of male population 20~59 years old and the structure of female population 20~54 years old, the age and gender structure of urban population employed can be obtained. The actual urban employed population is not fully involved in the pension insurance. According to sixth census, only the coverage rate of employees in Beijing and Shanghai is more than 90%, and assume that the provincial coverage rate gradually increases to 100%.³ In the current context, our country will raise the retirement age. In view of the lack of specific implementation measures, this paper draws on the experience of international delayed retirement and divides the delayed retirement scheme into two categories, based on the distinction

¹ Details of the report: http://news.ifeng.com/a/20161224/50468025_0.shtml.

² According to the sixth census: the male employed population aged 20~59 accounted for 93.83% and the female employed population aged 20~54 years accounted for 90.9%.

³ The coverage rate and growth rate of coverage in each province are detailed in Zeng (2017).

between gender differences: one is to increase the retirement age for women workers, cadres and men in turn at the pace of raising one year every two years with gender differences taken into account; the other is to increase the retirement age for both men and women at the same time. The increase in the retirement age will be introduced in 2022 until the retirement ages reaches 65.

3.2. Parameter Setting

3.2.1. Wage Growth Rate and Contribution Base

Based on data of the pension fund revenue, the number of people covered, and the average wage of employees in *China Statistical Yearbook* over the years, the average growth rate of contributory wages can be calculated. The average growth rate of contributory wages from 2000 to 2015 was about 11.66%, roughly the same as the growth rate of GDP per capita. Considering the downward trend in per capita GDP growth, and drawing on the calculations of economic growth under China's "new normal" by Yan and Liu (2015), it is assumed that the national average wage growth rate before 2020 is 7%, after 2020 it decreases by 0.5% every five years until 2066, when it falls to 2% and remains at that level. Based on the annual average national and provincial (municipal) social wage levels released in *China Statistical Yearbook* from 2006 to 2016, the proportion of the provincial annual social average wage in the national annual average social wage from 2006 to 2016 is calculated, and by assuming that the proportion remains unchanged, the average wage growth rate of the provinces (municipalities) is obtained.

Considering that the actual contribution base of pension funds is lower than the contribution base stipulated in the policy,¹ in order to better reflect the revenue of pension fund, this paper's calculation is based on the actual contribution base. Based on the annual revenue of pension insurance funds, the number of people covered by the pension fund, and the average wage of employees published in *China Statistical Yearbook*, it can be calculated that the actual contribution wages of pension insurance in the past 15 years account for about 80% of the real wages.² The General Office of the CPC Central Committee and the General Office of the State Council issued *The Reform Plan of Collection & Management of National Tax and Local Tax*, stipulating that the social insurance fees will be uniformly collected by the tax authorities since 2019. More efforts in the collection is conducive to raising the actual contribution

¹ The contribution base specified in the policy document is the average wage of employees on duty in the previous year.

² The actual contribution wage of pension insurance = The contribution revenue of pension funds ÷ the number of insured persons ÷ the contribution rate of pension insurance. The proportion of actual contributory wages for pension insurance in real wage from 2001 to 2016 is 87.8%, 93.6%, 90.8%, 88.4%, 86.5%, 86.8%, 87.7%, 84.1%, 79.1%, 75.5%, 75.3%, 73.2%, 70.4%, 67.6%, 69.7% and 71.1%, respectively.

base, so the paper will further simulate the effect of the central adjustment system as the contribution rate increases.

3.2.2. Contribution Rate, Proportion of Pension Payment and Number of Months Paid

The No.38 [2005] document of the State Council adjusted the contribution rates of insured workers and enterprises to 8% and 20%, respectively. The proportion of the basic old-age benefit paid for the elderly and the old is 70% and 20% respectively, and that for the new and the newcomer is 1% for each full year of the contributory period. The proportion of transitional pensions paid for the old and the new is 1.2%. Suppose this contribution rate remains the same in the future. According to the No.26 [1997] document and the No.38 [2005] document of the State Council, the number of months of personal account pensions paid to the old is 120. The number of months of personal account pensions paid to the new and the newcomer corresponds to the retirement age.

3.2.3. Per Capita Pension Growth Rate and Interest Rate

The average growth rate of per capita pensions accounted for 90% of the average annual growth rate of the contribution base from 2000 to 2017, and it is assumed that it remains unchanged in the future.¹ Considering that the current 1-year term deposit rate is between 1.5% and 3.5%, this paper takes an interest rate of 2.5%.

4. Simulation and Prediction

4.1. Scenario 1: The Operation of Provincial Funds without the Central Adjustment System

Based on equations (1)~(8) and parameter hypotheses, this paper first simulates the operation of the pension funds in the provinces (municipalities) from 2018 to 2098 if the adjustment system is not implemented, and years and the scale of the first accumulated deficit in the provincial pension funds are shown in Figure 1.² Prior to 2019, 14 provincial (municipal) basic pension funds were in deficit for the first time, and the time points of the first deficit in the provincial (municipal) basic pension funds after 2019 were relatively scattered. A deficit in the basic pension

¹ Based on the data published in *China Statistical Yearbook*, the average per capita pension growth rate and the contribution base grew by 12.88% and 11.6%, respectively, from 2000 to 2017.

² The starting time point of this paper is 2018. Taking into account that some provinces had seen more expenditure than revenue before 2018 years ago, the starting time point of figures in this paper is 2015 in order to fully show the situation when accumulated deficit of the basic pension funds appeared in the provinces for the first time.

fund first hit Heilongjiang in 2016, then Jilin and Liaoning in 2017. Qinghai, Sichuan, Chongqing, Guangxi, Hubei, Inner Mongolia and Tianjin experienced the deficit in the basic pension fund in 2018, and the scale of the deficit decreased in turn. In 2019, Gansu, Hainan, Hunan, and Jiangxi experienced the deficit of basic pension funds. A total of 26 provinces (municipalities) in the country experienced the accumulated deficit of pension funds in 2027 and before. Regionally, the basic pension funds in the central region has the first accumulated deficit earlier than in the eastern and western regions. In the eastern region, with the exception of Beijing and Guangdong, the remaining 9 provinces (municipalities) experience their accumulated deficit in the basic pension funds before 2026. The provinces (municipalities) in the central region experience their first accumulated deficit in the pension funds before 2027. The retirement ratio¹ of provinces (municipalities) with a later accumulated deficit of in the pension funds is significantly smaller than that of the provinces where the accumulated deficit occurs earlier. A lower retirement ratio is conducive to improving the sustainability of basic pension funds. For example, the retirement ratio of Yunnan in 2017 is 0.7902, and that of Tibet in 2077 is 0.7804, while that of Heilongjiang in 2018 had reached 0.7954. The first deficit will hit the pension fund of Tibet in 2092.

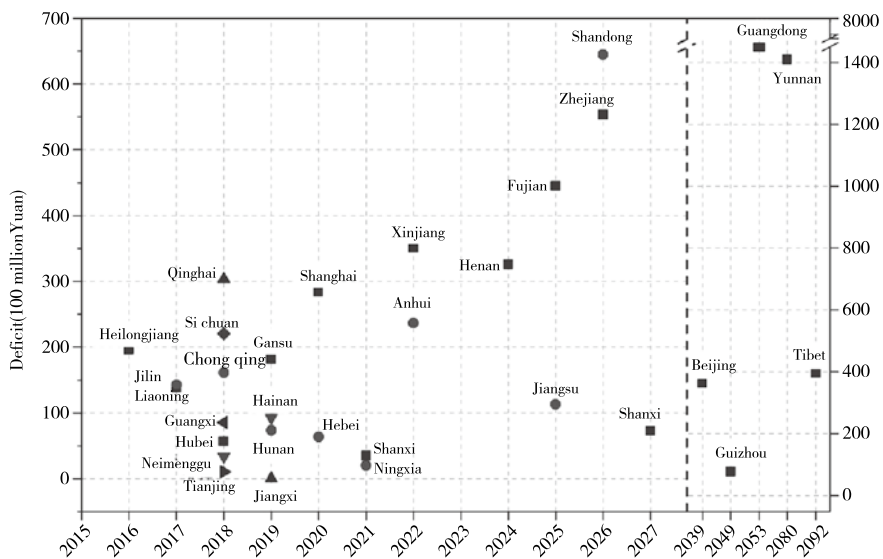


Figure 1. Time Points and Scale of First Accumulated Deficit in Pension Funds of the Provinces (Municipalities) under Scenario 1

¹ The retirement ratio is the number of retirees divided by the number of incumbents, which reflects the local demographic structure and the pressure on the current generation to raise retirees, and the decrease in the retirement ratio is conducive to the increase in the fund revenue and the reduction of expenditure, that is, to the sustainability of the fund.

Of all the provinces (municipalities), the accumulated deficit in the basic pension fund hits Tibet the latest, and the accumulated deficit in Tibet is the smallest, with a size of 454.2 billion yuan by 2098. The basic pension fund in Tibet remains strong and sustainable, on the one hand because of the high contribution rate in Tibet and, on the other hand, because of the absence of fertility restrictions in ethnic minorities and the high level of fertility in the Tibetan region. Although the level of economic development in Yunnan is not high, its basic pension fund has a cumulative deficit at a later point, and the deficit lasts for only 18 years. Although the accumulated deficit in the basic pension fund appears relatively late in Guangdong and Guizhou, the accumulated deficit is relatively large, which shows that there is no absolute positive relationship between the time point of occurrence and the scale of the accumulated deficit. The sustainable operation of Tibet's basic pension fund requires the shortest period of financial subsidy, followed by Yunnan and Guizhou. The number of years in need of financial subsidy for the operation of the basic pension fund in the western region is less than that in the central and eastern region. The accumulated deficit in the basic pension fund in the eastern, central, and western region is 1063 trillion yuan, 568 trillion yuan, and 414 trillion yuan respectively. It can be seen that although the accumulated balance of the basic pension fund in the eastern region is higher at this moment, when the deficit appears, the total size of the deficit is much higher than the size of the deficit in the central and western region. The accumulated deficits in the basic pension funds of Liaoning, Jiangsu, Zhejiang, Shandong and Guangdong in the eastern region exceeds the mean of the accumulated deficit of the eastern regional funds. The accumulated deficits in the basic pension funds of Guangxi, Chongqing and Sichuan in the western region exceeds the mean of the accumulated deficit of the western regional funds. The accumulated deficits in the basic pension funds of Heilongjiang, Henan, Hubei and Hunan in the central region exceeds the mean of the accumulated deficit of the central regional funds.

4.2. Scenario 2: Operation of Provincial Funds under the Central Adjustment System Alone

With the introduction of the central adjustment system, the first year of the deficit in the provincial (municipal) basic pension fund and the change in its scale are shown in Figure 2. The central adjustment system has less impact on the time point of the first accumulated deficit in the provinces (municipalities), and the impact on the scale of the deficit is relatively obvious. According to marketization rankings published by Wang *et al.* (2017), the top one was Shanghai, Zhejiang, Jiangsu,

Guangdong, Beijing, Fujian from 2008 to 2014¹. Except Guangdong, under the central adjustment system, these high-marketization provinces (municipalities) see an increase in the scale of the first deficit in basic pension funds. This is due to a marked increase in the proportion of retired people in Guangdong province after 2043, with a positive net disbursement of central adjustment, which increases the revenue of the fund.² It can be seen that after the implementation of the central adjustment system, the financial sustainability of the basic pension fund in the western region and regions with a low degree of marketization is improved, while the financial sustainability of the basic pension fund in the eastern and regions with the high degree of marketization is reduced. After the introduction of the adjustment system, the scale and changes of the accumulated deficit in the provincial (municipal) funds up to 2098 under different handover proportions are shown in Figure 3.

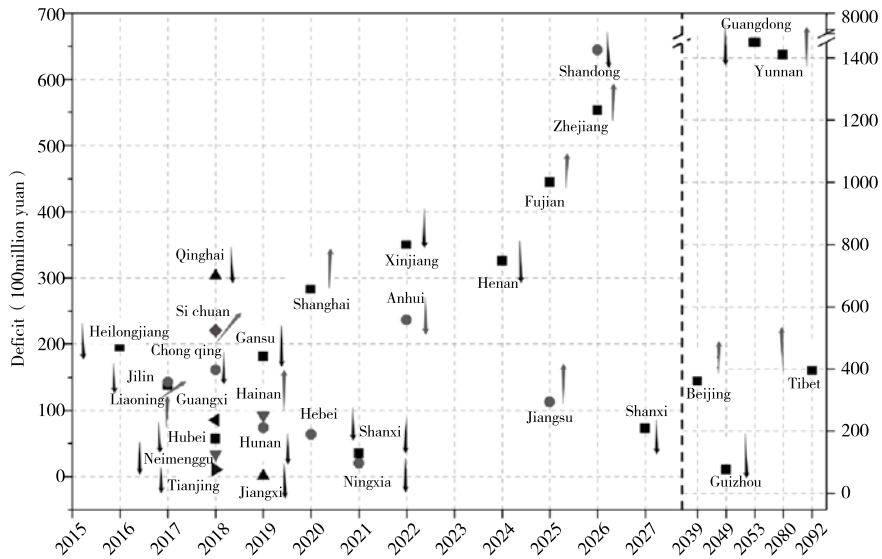


Figure 2. Changes in the Time Points and Scale of the Basic Pension Fund in Eastern Provinces (Municipalities) after the Introduction of the Central Adjustment System

Note: ↑ indicates that the scale of the first deficit in the basic pension fund has risen; ↓ indicates that the first deficit in the basic pension fund has declined; ↗ indicates that the first deficit in the basic pension fund has been delayed and the first deficit has risen.

¹ Wang *et al.* (2017) define the degree of marketization in the region by measuring the degree of change in economy, society, law, information and market, and the region with fast marketization process has relatively perfect mechanism and high level of economic development. <http://www.aisixiang.com/data/99120.html>.

² The positive net disbursement means that the province receives a higher disbursement of the central adjustment fund than the handover.

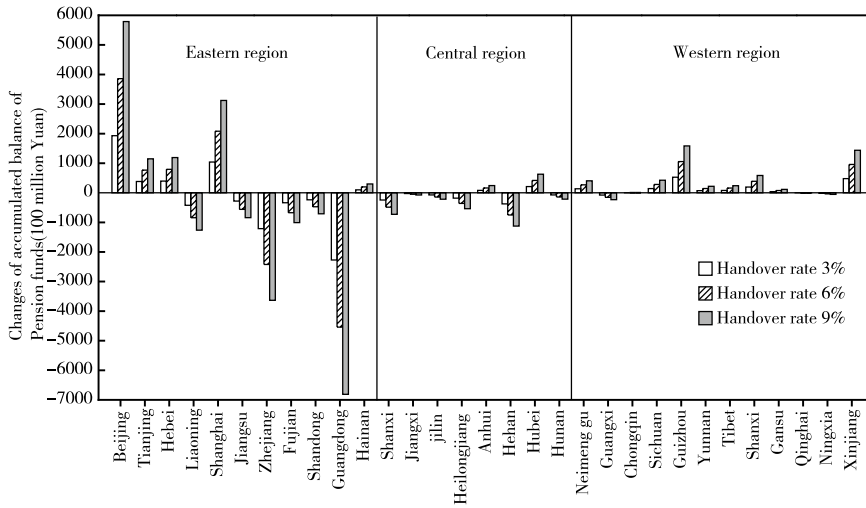


Figure 3. Changes in the Accumulated Deficit in the Basic Pension Funds of the Provinces (Municipalities) under Different Handover Proportions

According to the central adjustment system with the current handover proportion, provinces (municipalities) with accumulated deficit changes in the basic pension funds higher than 10 billion yuan include Beijing, Shanghai, Zhejiang, and Guangdong; provinces (municipalities) with accumulated deficit changes higher than 10 billion yuan but less than 20 billion yuan are Inner Mongolia, Heilongjiang, Hainan, Sichuan, and Shanxi; provinces (municipalities) with accumulated deficit changes less than 10 billion yuan are Jilin, Anhui, Jiangxi, Hunan, Guangxi, Chongqing, Yunnan, Tibet, Gansu, Qinghai, and Ningxia; the remaining provincial (municipal) funds have an accumulated deficit change between 20 billion yuan and 50 billion yuan. Because of the different development status of the basic pension fund in each province (municipality), there is no one-way relationship between the relative level and the absolute level affected by the central adjustment system. The accumulated deficit of the fund of Tibet has increased by 8 billion yuan as a result of the central adjustment system, but the rate of change is 1.7642%, which is the largest relative change among regions. The impact on the accumulated deficits of Chongqing and Qinghai's funds is weaker, less than 0.001%. It is due to the relatively small population of Qinghai and the large number of ethnic minorities, due to the lack of fertility restrictions of ethnic minorities, and due to the high contribution rate that the net allocation is low. Chongqing is a city of net emigration, and its net emigration is higher than that of Guizhou and Yunnan. The actual contribution rate in the western region is higher than that in the central and eastern regions. When the handover proportion doubles, both the absolute level and relative level of the change

in the accumulated deficit of the basic pension fund in each province (municipality) increase. Increasing the handover proportion exacerbates the accumulated deficit of the basic pension funds in Beijing, Tianjin, Hebei, Inner Mongolia, Shanghai, Anhui, Hubei, Hainan, Chongqing, Sichuan, Yunnan, Guizhou, Tibet, Shaanxi, Gansu, Qinghai and Xinjiang, and reduces the accumulated deficit of the basic pension funds in 14 other provinces (municipalities).

4.3. Scenario 3: Operation of Provincial Funds under the Central Adjustment System Combined with Delayed Retirement

With the combination of the delayed retirement scheme and the central adjustment system, the scale and changes of the accumulated deficit of the basic pension funds in each province (municipality) are shown in Figure 4.

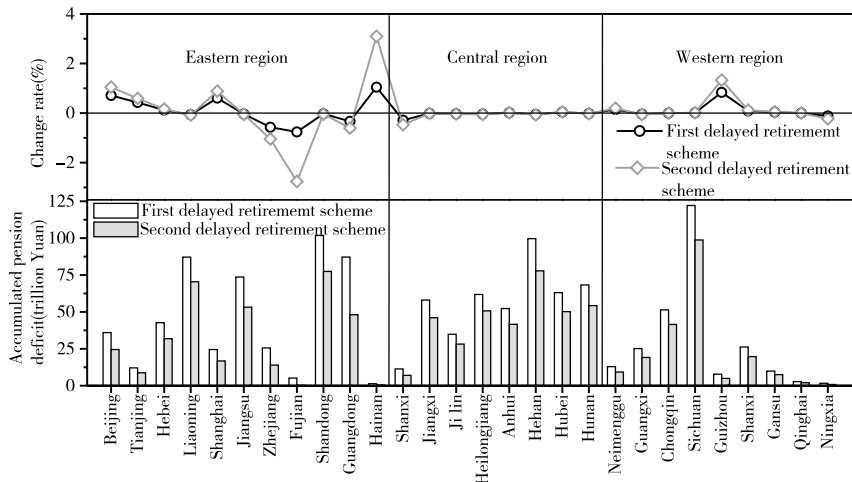


Figure 4. Scale and Changes of Accumulated Deficits of Basic Pension Funds in Provinces (Municipalities) under the Delayed Retirement Scheme

Under the first delayed retirement scheme, the accumulated deficit of the basic pension funds in the eastern, central and western regions decreases by 53.25%, 20.95% and 36.96% respectively compared with the accumulated balance under the non-delayed retirement. It can be seen that delayed retirement has the greatest reduction effect on the accumulated deficit of the basic pension fund in the eastern region, followed by central and western region. After the implementation of the delayed retirement policy, the gap between the accumulated deficit scale of the basic pension funds between the eastern and central regions has narrowed, but the accumulated deficit of the basic pension funds in the western region is still the lowest. Therefore, if the pilot of the delayed retirement scheme starts in the eastern region or the

implementation of the delayed retirement is strengthened in the eastern region, the effect of relieving the pressure on the basic pension funds is obvious.

Under the second delayed retirement scheme, the absolute level of the accumulated deficit changes in the basic pension funds of the provinces (municipalities) is lower than that under the first delayed retirement scheme, but higher than the absolute level of the accumulated deficit changes in the basic pension funds under the central adjustment system alone, and the gap between the eastern, central, and western regions has narrowed. For Yunnan and Tibet with a lower retirement, the basic pension funds in Yunnan and Tibet will no longer have the current deficit and the accumulated deficit after the increase of the retired age. The effect of delayed retirement scheme II is more pronounced if it is aimed only at alleviating the accumulated deficit of the national pension funds. Under delayed retirement scheme I, after the implementation of the central adjustment system, the average change rate of the accumulated deficit of the basic pension funds in the provinces (municipalities) is 0.2451%. Under the scheme two, the central adjustment system is implemented, and the average change rate of the accumulated deficit of the basic pension funds in provinces (municipalities) is -0.28552% , which shows that the implementation of the central adjustment system under scheme II enhances central adjustment and is conducive to reducing the accumulated deficit. It can be seen that the implementation of a central adjustment system in the context of delayed retirement could enhance the degree of adjustment of the central adjustment system.

4.4. Scenario 4: Operation of Provincial Funds under the Central Adjustment System Combined with the Reform of Institutions Involved in the System

After the social insurance fee is submitted to the tax department for uniform collection, the actual contribution rate of the future pension insurance will be improved. The impact of the central adjustment system on the pension insurance funds of the provinces (municipalities) when the subscription rate is 85% and 95% respectively is simulated, and the results are shown in Figure 5.

Under the two levels of contribution rate, the accumulated deficits of the provincial (municipal) pension funds change in the same direction. After increasing the contribution rate, the change rate of accumulated deficits of 16 provincial (municipal) pension funds in the country is positive, among which, there are 5 provinces (municipalities) in the central region and 9 provinces (municipalities) in the western region. When the contribution rate reaches 95%, the change rate of accumulated deficits in pension funds of Beijing and Guizhou is close to 0.04%, higher than that of other provinces and municipalities of the country, and the net handover amount is increased by 19.3 billion yuan and 5.3 billion yuan respectively. Increasing the contribution rate will increase the amount of handover to the central

adjustment fund as well as the contribution revenue of the pension funds, and for regions with lower retirement, the disbursement of the central adjustment will be relatively reduced. Therefore, although there is no doubt about the promotion effect of increasing the subscription rate on improving the overall sustainability of the national pension funds, the actual impact on the provincial pension funds under the central adjustment system is affected by multiple factors such as local retirement ratio and wage level.

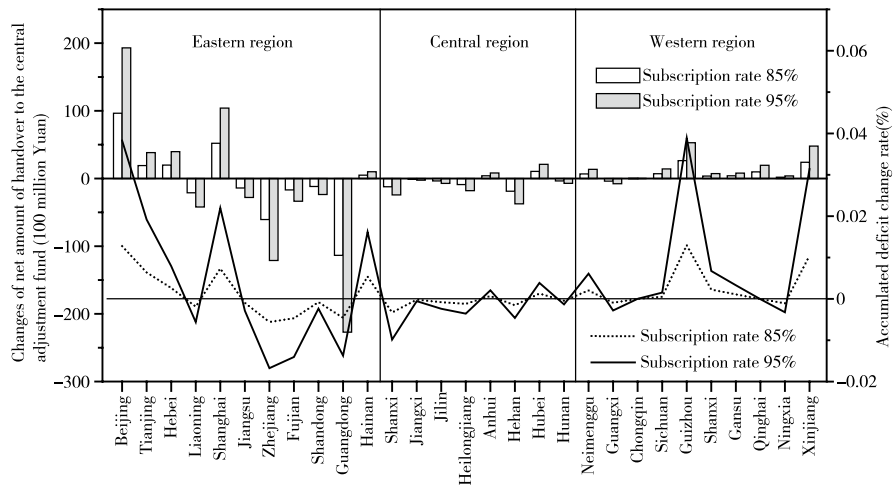


Figure 5. Changes in the Net Handover of Provincial (Municipal) Pension Funds and the Change Rate of Accumulated Deficits with the Contribution Rate at 85% and 95%, Respectively

5. Conclusions and Recommendations

A central adjustment system for basic pension funds of enterprise employees was officially established on July 1, 2018. This paper sets up an actuarial model to simulate the operation of provincial (municipal) basic pension funds under different handover proportion, delayed retirement policy and subscription rate, and obtains the following conclusions. (1) If the central adjustment system is not implemented, accumulated deficits of pension funds hit 26 provinces (municipalities) in the country in and before 2027. The time of first accumulated deficit occurs earlier in the central region than that in eastern and western regions. Compared with those in the central and eastern region, for fewer years provinces (municipalities) in the western region need financial subsidies for their basic pension funds. (2) After the implementation of the central adjustment system, 19 provinces (municipalities) can see a decline in the scale of first accumulated deficit of the basic pension funds. The financial sustainability of pension funds in the western and region with a low degree of marketization is improved, while that in the eastern and region with a high degree of marketization decreases.

(3) The increase in the handover proportion will enhance the adjustment effect of the central adjustment fund. (4) The adjustment effect of the central adjustment system is positively affected by the implementation of the delayed retirement policy. The implementation of the central adjustment system under the background of delayed retirement can enhance the effect of adjustment. (5) Under the current handover and disbursement of the central adjustment fund, the increase in the contribution rate will reduce the net handover to the central adjustment fund in the areas with a higher retirement ratio, thereby increasing the revenue of the fund in the region. It can be seen that the implementation of the central adjustment system is conducive to the circulation of pension funds among the provinces (municipalities), and to improve the sustainability of pension funds in the provinces where pension payments are currently in trouble. But the pool of funds from the central adjustment fund will flow out of certain provinces while flowing to certain provinces. Based on the above empirical analysis results, in order to ensure the implementation effect of the central adjustment system and the sustainability of the basic pension funds in each province (municipality), the following suggestions are put forward.

First, the central adjustment system should be implemented initially with a focus on ensuring the implementation of the system. The purpose of the central adjustment system is to strengthen the inter-provincial mutual assistance and achieve a more equitable and sustainable basic pension system. However, because the overall basic pension has not been fully implemented to the provincial co-ordination and the provincial centralized information system has not been fully established, the initial implementation of the central adjustment system should focus on ensuring that the provinces (municipalities) handover of capital to the central adjustment fund in time and in full. With the improvement of the management and informationization level of the basic pension funds in each province (municipality), the central adjustment system is further reformed and perfected. Only when it has a “steady start”, can the follow-up be “steadily improved”.

Second, the central adjustment system should take into account both fairness and efficiency. The central adjustment system can alleviate the problems of unfair and unbalanced development in various regions by adjusting the inter-provincial flow of funds, but there is no “guarantee” responsibility for inter-provincial finance, and inter-provincial mutual assistance is not equal to inter-provincial guarantee. Therefore, it cannot be expected that the gap will be bridged through a central adjustment fund.

Third, a dynamic adjustment mechanism including indicators such as the central adjustment system parameters, retirement age, and wage level should be established. The calculation results show that the way of delayed retirement affects the actual adjustment effect of the central adjustment system. At present, China’s delayed retirement scheme has not been officially launched, therefore, the establishment of an adjustment mechanism with the delayed retirement scheme should be taken into

account to improve the central adjustment system. At the same time, the effect of the central adjustment system on the basic pension fund of each province (municipality) is affected by the actual local subscription rate and wage level.

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