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Calculation of the transition coefficient and moderate level of China's pension system unification

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ABSTRACT

In this paper, the transition coefficient of replacement rate is taken as the breakthrough point for studying the pension system unification of China's government and public institutions. We present the basic principles and mathematical model of the transition coefficient for the pension replacement rate based on horizontal unification and vertical transition characteristics using time smoothing methods. We construct a general measurement model for calculating the pension unification transition coefficient and further transform it based on the current policy and the moderate replacement rate. On this basis, we introduce the pension account rate of return in order to simulate the realisation of the transition coefficient and determine the characteristics of the transition coefficient under the different rates of return, thus providing an important reference for the coordinated development of pension unification transition and the individual and occupational pension accounts. Based on this, we put forward relevant countermeasures and suggestions.

1. Introduction

The unification of government and public-institution pensions is an important step in the development of the Chinese social security system. However, the transitional pension for the 'middle-person' has not been issued after the unification. This directly affects the potential effectiveness of and extent of trust in the policy. A key reason for this is that the theoretical problem of the pension transition coefficient for the 'middle-person' has not been resolved, which makes it difficult to provide an effective basis for the relevant policy. The main purpose of this paper is therefore to analyse and propose potential solutions to this problem.

Since pensions provide the means for retirees and the elderly to formulate withdrawal and consumption strategies and to ensure well-being and satisfaction (Chen et al., 2021; Nguyen, 2021), as well as serving as a key research object in corporate finance (Qin et al., 2021; Yang and Cai, 2021), it is clear that pensions are of high research value. Indeed, the nature of pensions in the national public sector is an important area of concern (Pallares-Miralles et al., 2012; OECD, 2005), but, until now, there has been limited academic research into the pension system of government and public institutions. Palacios and Whitehouse (2006) conducted a comparative analysis of the costs and benefits of civil-service pensions in developed and developing countries and found their costs were higher than the benefits they offered. Moreover, the expenditure pressure of civil servants' pension insurance is higher in developing countries than it is in developed countries. Rothenbacher (2004), meanwhile, analysed the burden of government debt and the impact of population ageing on the pension system for civil servants in France, Great Britain, and Germany, whilst simultaneously

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studying the reform of the pension system for civil servants and the national pension system. Furthermore, Thurley (2014) analysed the reforms made to civil service pensions and paid attention to issues such as contribution increases, scheme design, and pension age. On the basis of the above research results, considering the academic value of the research related to China's pension reform, taking the rural public pension as an example (Fang and Shi, 2021), as well as the value of calculation and simulation of the replacement rate in pension research (Cannon and Tonks, 2004; Gonand and Legros, 2009; Fehr and Uhde, 2013), under the background of the pension unification reform of Chinese government and public institutions, it is clear that to conduct an in-depth analysis of the replacement rate and transition coefficient is of major significance .

It can be seen from the reality of China's pension reform that the current transitional pension policy is suitable for the calculation and evaluation of vertical transition pensions for similar groups but not suitable for the horizontal transition pensions across different groups. Based on the principle of balanced distribution of national wealth and population structure, we explore a transition coefficient that is suitable for both vertical transition and horizontal unification, and further propose the basic principles, mathematical models, and measurement methods of the transition coefficient, including quantitative calculation and analysis of the moderate level. This paper helps to improve the transition coefficient theory and measurement methods, and provides a reference for the path optimisation of pension unification in China's government and public institutions.

2. Theory and model of the transition coefficient

2.1. Theoretical analysis and general model

The transition coefficient for pension system unification of government and public institutions has two dimensions: vertical transition and horizontal transition. Vertical transition means connecting with the pension level of the 'old-person' under the original system and with the pension level of the 'new-person' under the new system. Horizontal transition, by contrast, not only matches the pension level of the 'old-person' under the original system of government and public institutions, but also matches the payment level of the 'new-person' under the enterprise pension system after the unification. We take into account the binary transition characteristic and propose the transition coefficient for quantitative analysis as shown in Eq. (1). GR_n represents the transition coefficient for pension unification, TR_1 represents the upper limit of the pension unification replacement rate,[1] TR_L represents the lower limit of the replacement rate, G_t represents the deemed payment years, and$N_t$is the difference between G_t and the actual number of years paid by the 'middle-person'.

$$GR_n = (TR_1 - TR_L) \times \frac{N_t}{G_t} \tag{1}$$

We follow the theory of moderation in our parameter selection and set the replacement rate connected to the original system's pension level as the upper limit of the transition coefficient; the replacement rate connected to the pension level of the enterprise replacement rate is the lower limit of the transition coefficient.

2.2. Transition coefficient model based on the current policy parameter

The first step in pension system unification is to integrate it with the current pension system of private enterprises. Therefore, the optimal way to conduct model construction and quantitative analysis is to decompose the relevant parameter under the current policy and improve the general model to the transition coefficient model based on the current policy parameter, as shown in Eq. (2), where GR_1 represents the transition coefficient based on the current policy and TR_2 represents the replacement rate under the current policy of the linkage of the replacement rate and the payment period. For the payment period of 40 years, the replacement rate is 40%.

$$GR_1 = (TR_1 - TR_2) \times \frac{N_t}{G_t} \tag{2}$$

2.3. Transition coefficient model based on the moderate replacement rate

The pension unification of government and public institutions can be divided into two phases from the perspective of the dynamic development process. The first phase is the system unification, and the second phase is the essential unification. System unification is the integration of the pension system in public institutions and enterprises, while essential unification indicates the further integration of this system to a moderate level on the basis of the system merger. Based on this concept of essential unification, we further study the moderate level of the coefficient, which allows us to propose some basic principles, models for quantitative analysis, and indicators of the moderate level of the transition coefficient. The key to the construction of a transition coefficient model based on the moderate level is to solve the objective standard of the moderate level of basic pension payment rate. According to the research of Mu and Chen (2019), the transition coefficient model based on moderate level parameter is constructed as shown in Eq. (3):

[1] According to the standard of pension benefits for employees of government and public institutions, for 20 years of work experience, the replacement rate is 80%; for 30 years of work experience, the replacement rate is 85%; and for more than 35 years of work experience, the replacement rate is 90%. We choose 85% as the upper limit of the pension unification replacement rate.

$$ER \times TR_3 \times W = LR \times PR \times W \tag{3}$$

where TR_3 represents the moderate replacement rate, ER represents the proportion of the elderly population, LR represents the proportion of the working population, W represents the total wages, and PR represents the moderate contribution rate of pay-as-you-go pension insurance, which can be expressed as shown in Eq. (4):

$$PR = LR \times ER \tag{4}$$

According to Eqs. (3) and (4), the transition coefficient model can be further expressed as shown in Eq. (5). Here, GR_2 represents the replacement rate transition coefficient based on the moderate level:

$$GR_2 = (TR_1 - TR_3) \times \frac{N_t}{G_t} = \left(TR_1 - LR^2\right) \times \frac{N_t}{G_t} \tag{5}$$

2.4. Transition coefficient model based on the rate of return

In the reality of pension system unification, the return rate of individual account and occupational pensions is an important factor in realising the unification and the transition to a moderate replacement rate, which is worthy of effective research and analysis. Based on this, we build a transition coefficient model based on the rate of return, as shown in Eq. (6):

$$GR_3 = TR_1 - TR_4 = TR_1 - TR_2 - PA - OA \tag{6}$$

where GR_3 represents the replacement rate transition coefficient based on the rate of return, TR_4 represents the comprehensive replacement rate, PA is the replacement rate of individual account, and OA is the replacement rate of occupational pension. The calculation methods of PA and OA are shown in Eqs. (7) and (8):

$$PA = \frac{A_t^{PA} \times \beta^{PA}}{W_t} = \frac{\left[\theta^{PA} W_t + (1+r) A_{t-1}^{PA}\right] \times \beta^{PA}}{W_t} \tag{7}$$

$$OA = \frac{A_t^{OA} \times \beta^{OA}}{W_t} = \frac{\left[\theta^{OA} W_t + (1+r) A_{t-1}^{OA}\right] \times \beta^{OA}}{W_t} \tag{8}$$

where A_t^{PA} and A_t^{OA} are the cumulative amounts of individual account and occupational pension account in the current year respectively, β^{PA} and β^{OA} are the coefficients of individual account and occupational pension account calculated according to the number of payment months, θ^{PA} and θ^{OA} are the payment rates of individual account and occupational pension account respectively, and r is the rate of return.

3. Quantitative analysis of the transition coefficient of pension unification

Based on the theory and model of the transition coefficient, we further calculate the actual level of the transition coefficient of pension unification, which provides a realistic reference for pension unification and future decision-making in government and public institutions.

3.1. Calculation of the transition coefficient under the current policy parameter

According to the fact that the basic working ages of employees in government and public institutions are mostly between 20 and 60

Table 1
The Transition coefficient for pension unification under the current policy parameter.

Retirementtime	Age	Number of payment years	Number of transition years	Transitioncoefficient	Equivalent to current policy
2015	60	1	39	0.439	2.10
2016	59	2	38	0.428	2.07
2017	58	3	37	0.416	2.04
2018	57	4	36	0.405	2.01
2019	56	5	35	0.394	1.99
2020	55	6	34	0. 383	1.96
2025	50	11	29	0.326	1.82
2030	45	16	24	0.270	1.68
2035	40	21	19	0.214	1.54
2040	35	26	14	0.158	1.40
2045	30	31	9	0.101	1.25
2050	25	36	4	0.045	1.11
2053	22	39	1	0.011	1.03
2054	21	40	0	0.00	1

years old, we choose 40 years as the average period of pension payments for employees in government and public institutions, and substitute the relevant parameter into Eq. (2) to obtain the transition coefficient under the current policy parameter. The calculation results are shown in Table 1.

Notes: (1) The Chinese government issued the policy for the pension unification of government and public institutions in 2014, before it was implemented in 2015. We determine the retirement time and age accordingly. (2) The replacement rate is linked to the payment period. The maximum payment period for 20- to 60-year-olds is 40 years. (3) The number of payment years and the number of transition years should be in accordance with the policy of 2014. In 2015, the number of payment years is 1, and the number of transition years is 39. (4) The equivalent to current policy is calculated using the following formula: $(TR_2 + GR_1)/\ TR_2$.

Based on the general transition coefficient model for pension unification and the evaluation of the transition coefficient under the current policy, the transition coefficient range of the dual-docking unification under the current policy is 0.011 to 0.439, which satisfies the binary docking property. According to the calculation results of the equivalent to the current policy, the transition coefficient corresponding to the current policy transition coefficient of 1.4 is approximately 0.158, and that corresponding to the current policy transition coefficient of 1.1 is approximately 0.045.

The calculation and evaluation of the current policy transition coefficient show that the transition coefficient selected under the current policy is in the range of 1.1 to 1.4. For the 35-year-old employee who will retire in 2040, the best choice for the transition coefficient is 1.4, whereas for the 25-year-old employee who will retire in 2050, the best choice for the transition coefficient is 1.1. As a result, the current transition coefficient cannot achieve smooth docking.

The dynamic development of the transition coefficient based on the current policy shows that the transition coefficient of the 60-year-old employee of 0.439 in 2015 gradually declines to the 40-year-old 'middle-person' transition coefficient of 0.214 in 2035. In addition to the basic pension replacement rate of 0.40, it is close to the current pension system's target replacement rate of 0.60. It can be seen from the implementation of the unification policy in 2015 that the replacement rate of the current corporate pension system will be achieved by 2035, and the transition period will be 20 years. Compared with the 10-year transition period for the current pension unification of government and public institutions, there is a 10-year difference in the number of docking years. During the 20-year transition period, pension benefits will not be reduced in the first ten years, but the gradual connection with the target replacement rate of the pension system will be achieved in the subsequent ten years.

3.2. Calculation of the transition coefficient under the moderate replacement rate

As China's trend of population ageing has become increasingly prominent, risks associated with balancing the supply and demand of the pension fund have started to emerge. Indeed, some provinces have seen funding gaps in the supply and demand of basic pension insurance, which makes it necessary to match the moderate level of pension insurance with the change in the population structure. The transition coefficient based on the moderate replacement rate is calculated using the relevant population data from 2015 to 2054 and Eq. (5), as is shown in Table 2.

According to Table 2, the range of the transition coefficients based on the moderate replacement rate is 0.015 to 0.392. Compared with the result based on the current policy, the range of the transition coefficients based on the moderate replacement rate is relatively narrowed because it takes into account the declining trend of the proportion of the working population in the context of population ageing, which makes the transition coefficient consistent with the change in the population structure and the supply-demand balance of the pension funds. As the results indicate, in 2035 the transition coefficient of the 40-year-old 'middle-person' is 0.25, which is close to the target replacement rate of the current pension system after it is added to the moderate replacement rate. It will also enable the smooth transition and gradient docking of the pension system unification, which is largely consistent with the result based on the current policy parameter.

Table 2
The Transition coefficient for pension unification under the moderate replacement rate.

Retirementtime	Age	Proportion of working population	Number of transition years	Transitioncoefficient	Equivalent to current policy
2015	60	0.669	39	0.392	1.98
2016	59	0.664	38	0.389	1.97
2017	58	0.661	37	0.382	1.96
2018	57	0.657	36	0.377	1.94
2019	56	0.653	35	0.371	1.93
2020	55	0.649	34	0.364	1.91
2025	50	0.619	29	0.338	1.85
2030	45	0.594	24	0.298	1.76
2035	40	0.569	19	0.250	1.62
2040	35	0.558	14	0.188	1.47
2045	30	0.542	9	0.125	1.31
2050	25	0.512	4	0.059	1.15
2053	22	0.503	1	0.015	1.04
2054	21	0.502	0	0.000	1

Data sources: The population data from 2015 to 2018 comes from the relevant year *China Statistical Yearbook*. The population forecast data comes from the United Nations *World Population Prospects 2019*.

3.3. Calculation of the transition coefficient under the rate of return

The measurement of the transition coefficient for pension unification is based on the moderate replacement rate. In order to maintain consistency, we can also consider the return of individual accounts and occupational pension corresponding to the transition coefficient. Therefore, we can calculate the transition coefficient according to the account return rate, which is a more practical way of realising the pension unification. The transition coefficient related to the rate of return is calculated according to the individual account contribution rate of 8%, the occupational pension contribution rate of 12%, and the payment period of 40 years, combined with the different rates of return, as is shown in Table 3.

From the calculation result of the transition coefficient based on the rate of return, it can be seen that in the pension unification of the government and public institutions, both of the options can achieve the unification goal and the speed of merging is faster than the return rate of 4–7% when the return rate of personal account and occupational pension is 5–8%. From the target replacement rate of 0.6 in 2035, the return rate of 5–8% is closer to the target, while the return rate of 4–7% does not deviate greatly. The above findings provide a reference for the realisation of pension unification in the context of rate of return.

4. Conclusion and countermeasures

This paper takes the transition coefficient as the starting point to study the perfection of the pension system unification of government and public institutions. Based on the horizontal and vertical transition characteristics and the time smoothing method, the paper puts forward the basic principle and mathematical model of the transition coefficient, and carries out a quantitative calculation and analysis of the moderate level under specific conditions. On this basis, the following suggestions are made.

First, the transition coefficient for pension integration determined in this paper is conducive to the reasonable issuance of the transitional pension for ‘middle-person’, which also provides a basis and reference for the implementation and improvement of China’s pension policy. Second, under the guidance of the current policy and the moderate replacement rate, the pension unification of government and public institutions can have a dual and rational connection to the process of dynamic development, which is applicable to the basic situation and goal realisation of China’s current pension unification reform. Third, the pension system and the pension investment policy need to be further optimised and improved, while the rate of return and the corresponding transition coefficient level should be clarified, so as to provide conditions for the pension unification of government and public institutions.

Statement

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All the authors of the above article agree to submit the manuscript to "Finance Research Letters", the first author and corresponding author promise the following:

The content of this manuscript has not been officially published, and has not been submitted to other publications. The authors’ signatures and the ranking, as well as the funds filling status have been confirmed by all authors, and there is no objection.

Table 3
The Transition coefficient for pension unification under the rate of return.

Retirementtime	Age	Transition coefficient(return rate is 5–8%)	Transition coefficient(return rate is 4–7%)
2015	60	0.441	0.441
2016	59	0.432	0.433
2017	58	0.423	0.423
2018	57	0.413	0.414
2019	56	0.403	0.404
2020	55	0.393	0.394
2021	54	0.383	0.385
2022	53	0.372	0.375
2023	52	0.361	0.364
2024	51	0.349	0.353
2025	50	0.337	0.342
2030	45	0.272	0.285
2035	40	0.211	0.235
2040	35	0.145	0.183
2045	30	0.080	0.135
2050	25	0.011	0.087
2054	21	–	0.042

Note: For the investment rate of return, the staged rate of return is selected. As an example, work is assumed to commence at the age of 20 and retirement at the age of 60, thus yielding 40 years of payments: under the first plan for those aged 20–35, the rate of return is 8%; for those aged 36–45, the rate of return is 6%; for those aged 46–60, the rate of return is 5%; under the second plan, for those aged 20–35, the rate of return is 7%; for those aged 36–45, the rate of return is 5%; and for those aged 46–60, the rate of return is 4%.

Data Availability

Data will be made available on request.

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