

The Influence of China's Pension System in the Context of Aging: with A Computable General Equilibrium Analysis

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Abstract

China's population is aging rapidly, China's economic reform, therefore, is facing a seriously problem: how to keep a reasonable developing speed while stay stability. One of the most obvious obstacles is that China does not have a sustainable and effective pension system. The old pension system is essentially a pay-as-you-go (PAYG) system, in 1993, China tried to establish a mandatory national individual account, thereby forming a mixed pension system. The main purpose of creating such account is to ease the burden of public finance, which still exists. The trend of China's pension reform is therefore to limit the scale of PAYG part and to increase the individual account part. We will finish this paper with 5 sections, in the first two sections we will introduce China's population aging problems and current pension system, and discuss the ongoing reform. The third section describes the structure and calibration of the computable general equilibrium model; the fourth section simulates a baseline case and the alternative scheme under the ongoing reform plan. The last section summarizes and offers conclusion.

JEL Codes: C68, D58, H55

Key words: pension reform, aging, CGE, PAYG

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1. China: a rapid Population Aging

In 2000, the Chinese government started the fifth population census. According to this report, there are 129.98 million people who are over 60 years old living in China, meaning 10.46% Chinese are officially recognized as "the old". More precise, 44.41million people who lived in the urban area are the old, with a proportion of 6.42%; while for the rural area, there are over 10.92% people are the old, with a number of 85.57 million. The number of the old who lives in the country is twice as the old who lives in the urban. This means, the rural area faces a tougher pension situation.

Table 1 Population Aging in China (million)

Area	Total population	People Over 60	People (male) Over 60	People (female) Over 60	Percentage%
Nation	124,261	12,998	6,338	6,660	10.46
Urban	45,877	4,441	2,161	2,280	9.68
Rural	78,384	8,557	4,178	4,379	10.92

Source: the fifth population census project, China,2000

Unlike other countries on the issue of population aging, China faces a harder challenge, a rapidly growing old population with limited social wealth, also known as "old before rich". When developed countries face the problem of population aging, they usually get a high GDP per capital approximately 10,000USD, however, by the time of 2009, this figure of China is still 3,668USD.

Another problem China has to face is the inequality between urban and rural. Besides, as we mentioned before, there are more people in the rural area than in the urban area requiring pension support. Less developed area need to finance more to payout, this is a situation might never happened before.

From 1990 to 2030, the proportion of the world's population that is over 60 is estimated be double. In China, this figure would be triple, from9% in 1990 to 22% in 2020 and in 26% in 2050.

Table 2 current and projected share of the elderly in the population (percent)

Country/Region	1990	2000	2010	2020	2030	2050
China	8.9	10.1	11.7	15.6	21.5	25.9

Developing region	7	7.6	8.4	10.6	13.6	18.8
Developed region	17.1	18.7	20.8	24.8	27.6	29.6
World	9.3	9.9	10.8	13.1	15.9	20.3

Source World Bank Population Projection 1994-1995 Edition

From 2030, the absolute size of labor force in China would begin to decline, if the current retirement policy remains stable. By 2050, the ratio of workers to pensioners is projected to decline from 7 to 1 to 2 to 1. This change will be more dramatic in urban areas.

2. China Pension System Reform Process

After the "Opening-up policy" has been implemented in 1978, the number of pensioners nearly doubled. Expenditure increased almost 19 times between 1978 and 1988. In 1978, there were 30.3 workers per pensioner; while in 1988 this ratio had fallen to 6.4 to 1 (OECD, 2007). In 1986, the government introduced a policy requiring all new State owned enterprise (SOE) employees to make contributions of up to 3% of their basic wages, along with employer contributions of 15% of the enterprise's pre-tax wage bill. As a result, the enterprise ceased to be seen as the main provider of social security.

However, this policy did not cover other workers from non-SOEs such as private and joint-venture enterprises. Therefore, in 1991, the center government issued another policy, encouraging some provinces to develop new pension programs to set up fully funded pension project covering all enterprises. Besides, the 1991 resolution constituted a significant step in the further development of the pension system. It brought all workers in SOEs into a uniform pension scheme with three tiers. These were basic pension for all retirees financed by the state, enterprise and the employees; a supplementary scheme funded by the enterprise and an account funded by workers themselves.

State council Document 26 of July 1997 defined a further pension reform, under this document, a multi-tier pension system combining social pooling with individual account was instituted by 2000. Funds are pooled in the province level. The basic pension system consists two parts, a PAYG component and a mandatory individual

account, managed by a government entities. Document 42 of 2000 requires the segregation of the management of individual accounts from the administration of the social pooling funds.

As for rural area, on September, 2009 the state council issued the Guidance on Launching Experimental Pilots of New Rural Endowment Insurance, before 2020, this project should cover all the eligible rural residents.

Some achievements has reached since these policies were implemented, however, more problems are urged to be solved. One of the biggest is how to integrate so many pension systems. Most pension system China now is implementing has two elements, one is the individual account, which is directly linked to one's contribution, and the other is the social pooling fund, which differ from various pension projects. Pensioner might find it's difficult or even imposable to transfer his or her own parts of social pooling from one project to another. This becomes a big obstacle for labor force movements.

3. Reform: From PAYG to Funded

Academically, there are two basic types of pension system, Pay-as-you-go system and the Funded system. In China's case, the public pooling funds are still using the PAYG system, while the individual account applies the funded system. The PAYG system is simple and easy managed, while this system faces some problems such as low coverage, low replacement rate and uneven development among provinces.

Under the PAYG system, the growth of the funds depend on the growth of the population((Samuelson,1958), when the population growth rate is n , the interest rate of pension contributed by the old generation is exactly n . After implementing the "one-child" policy, the population growth rate in China is decreasing, while the old over 60 is increasing, this situation means the financial pressure of PAYG system is much more heavily than ever before.

Besides, even the PAYG system could survive from such financial pressure, it should be still reformed, the reason is that under the funded system, the investment rate of return is much higher than under the old system, for the funded system is much more effective in terms of reflecting the technology progress than that of PAYG system.

4. Model

This model contains an OLG structure, and this model follows the tradition in the computable OLG structure, therefore the household behavior is based on the life-cycle of savings. For simplification, there are only 13 generations, the young would work and save, the old are eligible for the pension. Generally, this model consists four parts, those related to production, household agents, government and those related to equilibrium conditions. Each enterprise maximize its profits under a Cobb-Douglas function, the government receive its income by tax and pension contribution, the household agents maximize its utility under a constant elasticity of substitution function.

4.1 Production sector.

The firm's production power would follow a Cobb-Douglas function:

$$Y_t = A_t K_t^\alpha L_t^{1-\alpha}$$

The term Y_t is total output in period t, K_t is the capital stock, L_t is the effective labor force, α is the share of capital income of the national firm, A_t represents a scaling variable of the technological progress. The firm generates a demand for capital and labor force by maximizing profits with factor wage and rental rate of capital determined in perfectly competitive markets.

The firm sets the marginal product of capital equal to the interest rate r_t at every period of time t:

$$r_t = \alpha A_t K_t^{\alpha-1} L_t^{1-\alpha}$$

The same, the wage in period time t, w_t must equal to the marginal product of labor:

$$w_t = (1-\alpha) A_t K_t^\alpha L_t^{-\alpha}$$

These two function means that the marginal products equal marginal costs.

4.2 Consumer sector.

We assume that the individual lives for a fixed number of years. Each individual is regarded fully independent from outsources when he or she is at work. Each generation maximizes a utility function U of consumption subject to his or her income. The utility function is represented by the following constant elasticity of substitution function:

$$U = \sum_{g=1}^{13} \left(\frac{1}{1+\rho} \right)^g C_{t+g-1,g}^{1-\theta}, 0 < \theta < 1$$

The variable $C_{t,g}$ is consumption of an individual member of generation g at time t , ρ is the pure rate of time preference, and θ is the inverse of the intertemporal elasticity of substitution.

The generation's budget constraint in each period includes disposable income, savings, assets and pension. The disposable income is the net sum of wage and interest income after deductions for tax and pension contributions:

$$DI_{t,g} = w_t(1 - cr_t)(1 - tw_t)h_{t,g} + r_t(1 - tr)AS_{t,g} + (1 - tw_t)(1 - h_{t,g})P_{t,g} - tc * C_{t,g}$$

cr is the mandatory PAYG contribution rate at every time period t , AS_t is accumulated wealth, $h_{t,g}$ is the effective labor supplied by an individual of generation g at time t , tr and tc are the tax rates on interest income and consumption and are constant over time, $P_{t,g}$ is the pension benefits, tw_t is the tax rate on wage including pension income. In China, the wage tax are different in various income level, so we assume that:

$$tw_{t+1} = tw_t \left(\frac{w_{t+1}}{w_t} \right)$$

Savings and assets equations are the following forms:

$$SV_{t,g} = DI_{t,g} - C_{t,g}$$

$$AS_{t+1,g+1} = AS_{t,g} + SV_{t,g}$$

The disposable income includes wage income, interest income, accumulated savings, public and private pension benefits. When an individual is at work, the consumption is assumed below the total disposable income, therefor, the savings are positive. When an individual retires, disposable income declines while the consumption remain a constant level.

The first order condition for the household agents takes the following form:

$$C_{t+1,g+1} = \left(\frac{1+r_{t+1}(1-tr)}{1+\rho} \right)^{1/\theta} C_{t,g}$$

In the PAYG system model, the pension benefits replace a fraction of last period work wage income:

$$P_{t+1,g} = pr_t w_t (1-h_{t,g})$$

where pr_t is the retirement replacement rate. In this paper, it is fixed at 0.7. Under the Funded system, the pension benefits takes the following form:

$$V = cr_t * w_t * \frac{(1+r_t)^n - (1+a)^n}{r-a}$$

$$P_t = \frac{cr_t * r_t * w_t * [(1+r_t)^n - (1+a)^n]}{(r-a) * [1 - (1+r_t)^{-m}]}$$

where V means the total value of pension, a represents the growth rate of wage. (For convenient, we assume that the interest rate r_t is not equal to the growth rate of wage a), m means the years that a pensioner could receive the pension benefits.

4.3 Government sector.

The government sector is relatively simple, the first equation below express the total government income, which includes wage tax income, capital tax income, consumption tax income and the pension contribution income.

$$T_{t,g} = tw_t(1-cr_t)w_t h_{t,g} + tr * r_t * AS_{t,g} + tc * C_{t,g} + tw_t P_{t,g}$$

The second equation explains the budget:

$$G_t = \sum_g POP_{t,g} T_{t,g}$$

where $POP_{t,g}$ is the number of people of generation in time t .

4.4 Equilibrium conditions.

In this model, no resources are wasted, so all markets are perfectly competitive. In the capital market, in period t , the domestic capital stock equals to total private assets in the economy:

$$K_t = \sum_g AS_{t,g} * POP_{t,g}$$

For the public pooling PAYG program, benefits received at time t should be equaled to all the contributions pooled by working generation at such time:

$$\sum_g POP_{t,g} * P_{t,g} = cr_t \sum_g (ht_{t,g} POP_{t,g} w_t)$$

In goods market, the final goods output in period t equals total consumption plus total savings and government's tax revenue:

$$Y_t = \sum_g POP_{t,g} (C_{t,g} + SV_{t,g} + T_{t,g})$$

5. Parameters and calibration

China is a low tax rate country as she belongs to a low income country. Most her income tax comes from enterprises, informal sectors' owners and some professional individuals. From some empirical investigation, we can assure that this taxation should not exceed 10%.

The consumption tax in China are included in goods prices and is not an explicit tax rate except for some special goods. The average consumption tax rate in China is below 5%.

China taxes capital return since 1999 at 20%, a rate smaller than in other industrialized countries. In this model, we choose the benchmark values of the interest rate (for five years) to be 0.34, which represents an annual interest rate of 6%.

The model is easier to solve for the steady state, since the interest rate, pension contribution rate and the tax rates are all constant on such a path. Some parameters and ratios were based on Chinese data and empirical studies. These include the capital share of output and the real return on capital. The Inter temporal elasticity of

substitution is taken from Auerbach & Kotlikoff (1987). The initial population growth rate is taken to fit the average old-age dependency ratio between 1950 and 1990. The scaling variable, gross wage rate, consumer's time preference and contribution rate are generated by the calibration procedure. The benchmark values of the model are presented below:

Production sector		
α	Production sector capital income share	0.3
A	Scaling variable	0.3387
r	Real return on capital	0.34
w	Gross wage rate	0.1413
Consumption sector		
$1/\theta$	Inter temporal elasticity of substitution	1.25
ρ	consumer time preference	0.15
pr	Pension rate	0.7
cr	Contribution rate	0.0927
Taxes		
tr	Effective tax rate on capital	0.2
tw	Effective tax rate on wage income	0.1
tc	Effective tax rate on consumption	0.05

6. Simulations design & analysis

6.1 Design

As we mentioned before, the basic idea of our model is to change the public pooling from PAYG to fully funded. So, what is the consequence of this shifting? Perhaps one of most significant fact is, our first scheme, the reduce of the replacement rate hold other fact status quo. A less replacement rate means a less contribution rate. However, it does not mean a less benefit. People are encouraged to transfer part of their mandatory savings into other individual accounts. And because these individual accounts are fully funded, the benefits pensioners expected to

receive are hardly less but likely more.

Since China implement a "reform and open-door" policy, her economy has enjoyed a surprising booming with an annual growth of GDP of 7%, which is not an usual figure around the world and in the history of human beings. The growth of social wealth and increasing social savings accelerate the capital stock; with a better basic and higher education, her human stock is also playing an important role in the success of economy. We assume in Scheme 2 that from 2000, the Total Factor Productive (TFP) increases by an additional 3% per year.

6.2 Analysis: The baseline scenario

At the beginning of the 21st century, GDP and consumption per capita keep rising. After 2025, as the growth rate of aggregate effective labor supply becomes negative, all of these variables begin to experience negative growth. From this time period, the pension benefits to GDP ratio rises significantly, whereas disposable income and consumption per capita decline. The living standard declines significantly for young and future cohorts with the population aging shock. The results are shown in Figure 1~5.

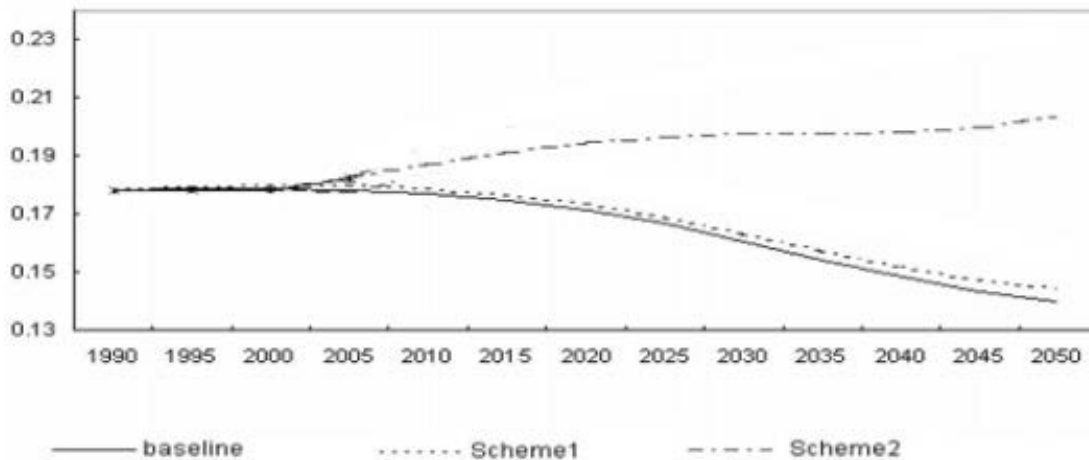


Figure 1. Effect of reforms on output per capita

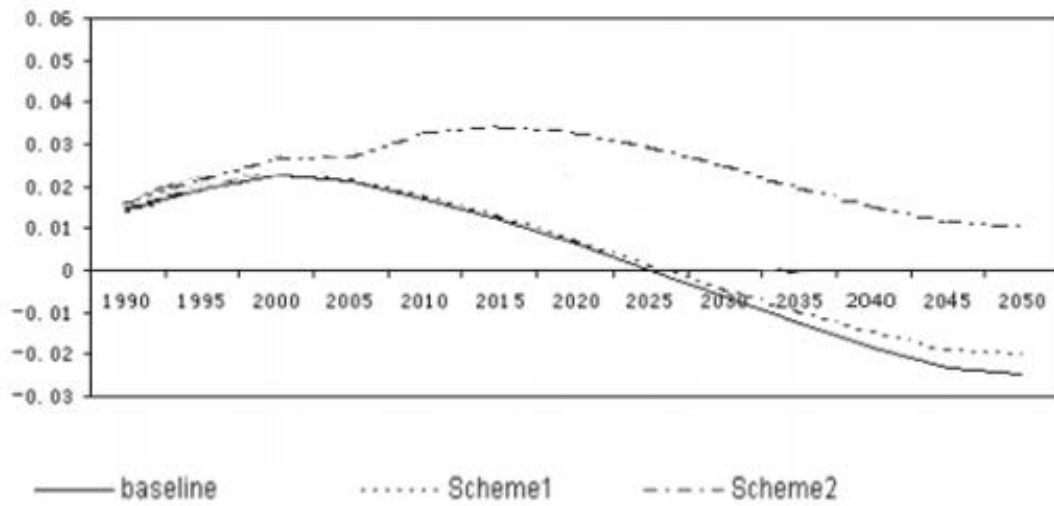


Figure 2. Effect of reforms on growth of consumption per capita

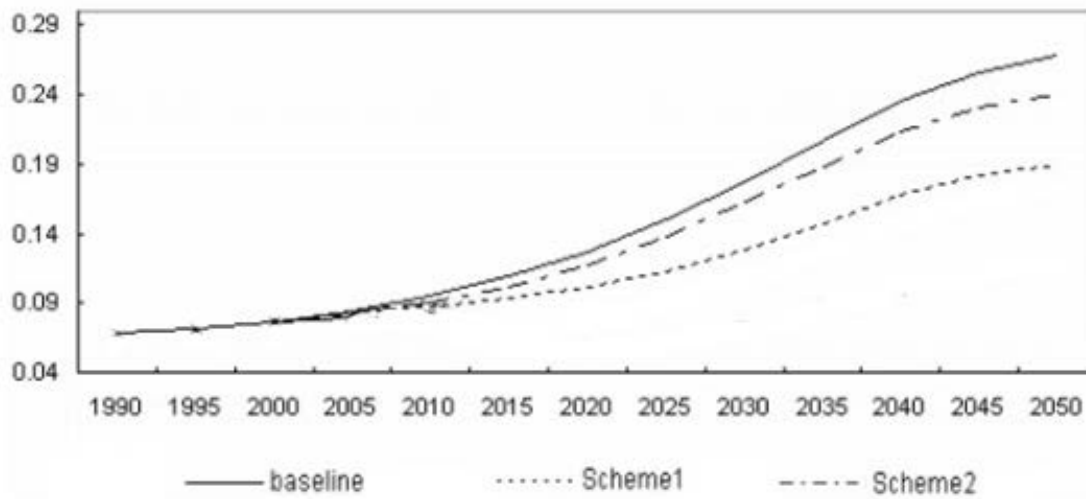


Figure 3. Effect of reforms on pension-GDP ratio

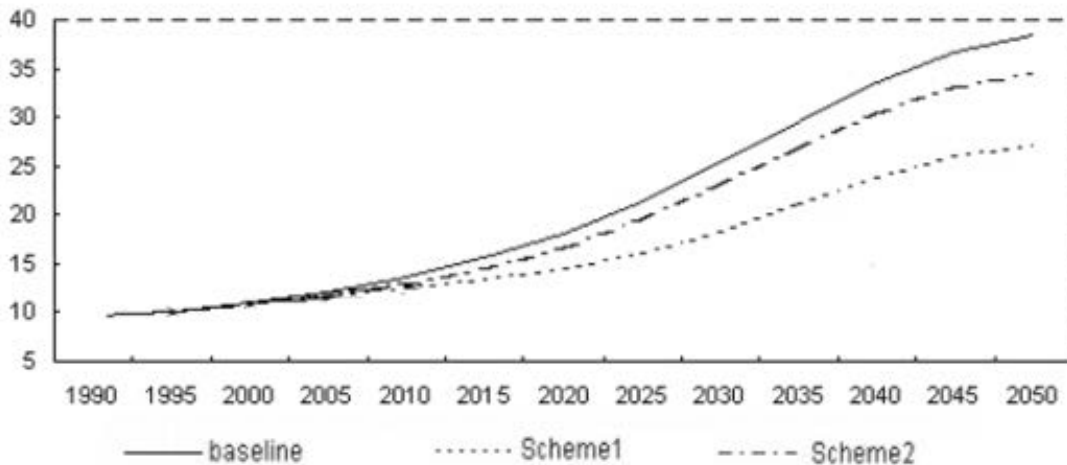


Figure 4. Effect of reforms on contribution rate

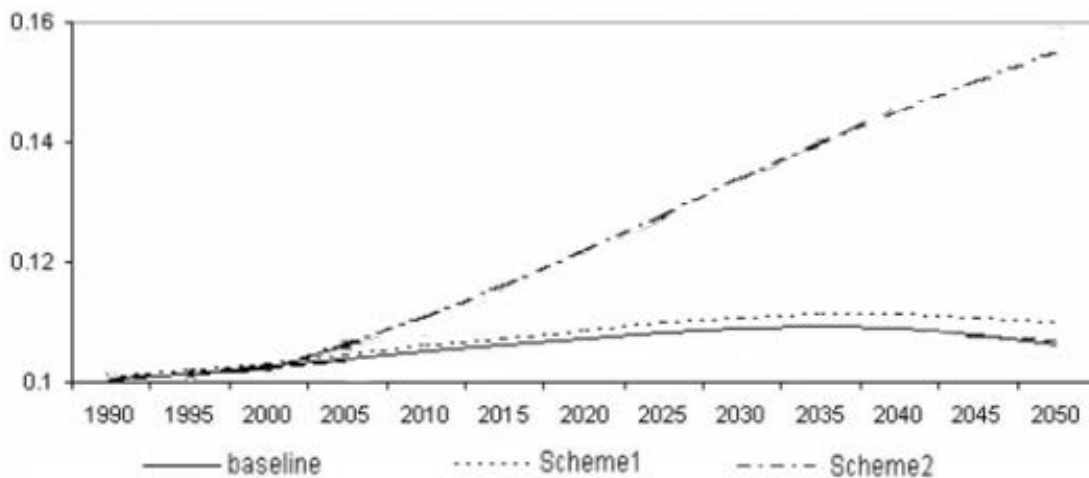


Figure 5. Effect of reforms on wage-tax ration

Scheme 1. Reduction of the replacement rate

During the transition period, we can not cut down the benefits suddenly. The replacement rate is projected to decline gradually during the transition period. In the model, the value of a pension is a proportion of the worker's wage during his last period of work (last 5 years) . We adjust gradually the benefit rate from 70% at the end of the 1990s to a replacement rate of about 50% by 2015.

Figure 4 shows the difference in ratios between the baseline's benefit rate and the gradual reduction of the benefit rate by about 30% between 2000 and 2015. The

contribution rate still increases from 2020, but it does so later and at a slower rate compared with the baseline scenario. Simulation results show that the reduction of the benefit rate increases GDP per capita (Figure 1), the capital–labor ratio and the average wage rate. It also decreases the interest rate, and reduces pensions- to-GDP (Figure 3).

Scheme 2: An Increase in Total Factor Productivity

We assume in Scheme 2 that from 2000, TFP increases by an additional 3% per year. Based on the economic development, capital-labor ratio, output per capita and the ratio of wage tax to government revenue increase relative. In the household sector an increase in total factor productivity raises the disposable income per capita and consumption per capita.

7. Conclusion

The current pension system is unstable both in financially and economically, with a rapidly population aging process, such weakness is much more vulnerable. A projected downside productive as well as a decreasing consumption level may make the transformation of economy of China more difficult. However, an increase of contribution rate and pension-GDP ratio would destroy a basic faith on such system that people hold.

Besides, not so much like what we supposed, the reform that transforms the system from PAYG to fully funded can not reverse such trends, but only light some burden. It seems that only with a decent average growth rate of Total Factor Productive can we completely solve the problem of population aging, while how to keep such rate will not be discussed in this paper.

In the next 50 years, if the current PAYG pension system remains untouched, the rapid aging population would lead a decrease in the growth rate of national income and the level of consumption, However, if the government could build a complete and integrated pension system to cut down the replacement rate to unburden the obligation of the working generation as well as keep a reasonable pace of development, we may have a chance to ease the impact of aging population.

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