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Social Health Insurance Reform and Economic Growth: Simulation Analysis in China

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Abstract: China has implemented drastic reforms in social health insurance within the past decade. I investigate how social health insurance affects economic growth in China by employing a three-period overlapping generations' model in which social health insurance is determined endogenously. My model consists of three parts: individuals, firms and the government. In my model, social health insurance influences savings, physical capital, human capital and economic growth. I find that the higher the contribution rates of individual accounts to social health insurance, the lower the personal savings rate; with an increase in the personal account payment rate, an increase in the payment rate is associated with an increase in personal account funds, and the medical expenditure will increase; the contribution of each monetary unit will lead to more than one monetary unit of output, representing the multiplier effect of the personal account payment rate on economic growth. So the contribution rates of personal accounts are conducive to physical and human capital accumulation, generating a multiplier effect on economic growth. Simulation results show that a lower rate of pooled account payments and higher rate of personal account payments result in greater economic growth. I also find that the proportion of employment payments transferred to personal accounts positively influences economic growth. The theoretical model and simulation indicate that the reform of social health insurance causes an increase in economic growth.

Keywords: Social Health Insurance Reform, Physical Capital, Human Capital, Economic Growth

1. Introduction

China has implemented drastic reforms in social health insurance within the past decade. The country has established the largest social medical security network in the world, consisting of Urban Residents Basic Medical Insurance and Urban and Rural Residents Basic Medical Insurance (URRBM). China's social health insurance system covers all groups, with 1.336 billion residents (97% of the population) insured in 2015. The social insurance fund contained total insurance premium revenue of 1.603 trillion and medical expenditure of 1.354 trillion yuan in 2015. As medical insurance coverage expands, government financial subsidies have come to play an important role in URRBM social insurance premiums; 80% of the population receives government subsidies for medical insurance. These subsidies accounted for 82.09% of social insurance fund income in 2011.

Social health insurance plays a central role in China's social security system and carries substantial implications for residents' medical needs and public health. The country now faces an important stage in the reform of social health insurance due to population aging, various diseases, changes in the ecological environment, and challenges related to life and health. The proportion of total medical expenses to GDP rose from 4.89% in 2010 to 6% in 2015, an increase of 1.11%. The proportion of government health expenditure to total health expenditure in China is high among the world. China's government expenditure on health accounts for 54.3% of all health expenditure; as such, China ranks 36th out of 195 member countries according to 2015 World Health Statistics data.

On the other hand, economic development remains a top priority for China. China's economy has shown signs of deceleration following years of rapid growth; the economic growth rate was 6.7% in 2016, the lowest since 1991. Exploring the underlying causes of economic growth has long been a popular topic in economic research. Since the mid-1980s, studies on economic growth have ballooned, beginning with the work of Romer (1986). Medical insurance is closely tied to economic development. Social health insurance can provide financial accessibility for people in the event of illness [1]; it also influences family constraints and economic incentives, which in turn affect consumption, savings, and other microeconomic decision factors [2-4]. These factors influence the accumulation of physical capital and human capital, which shape the overall economy. Therefore, the relationship between social health insurance and economic growth warrants close attention.

Social health insurance is designed to maintain fairness and social welfare as a major public policy and exerts a profound influence on all aspects of social life. This form of insurance informs personal savings, consumption, and investment in microeconomic decisions by changing insured individuals' budgetary constraints (and thus welfare and status), which also influences economic operations via the accumulation of physical capital and human capital, inevitably affecting economic growth.

This study intends to answer the following questions: Does social health insurance promote economic growth? What is the path of social health insurance on economic growth? How can China's social health insurance reform promote economic growth? In this paper, I study the interdependence of social health insurance, consumption, medical expenditure, health capital, physical capital, and economic development using an overlapping generation's model of two-period lived agents. In contrast to the conventional model, I assume that the contribution rates of personal accounts to social health insurance are conducive to physical and human capital accumulation, generating a multiplier effect on economic growth. In addition, a simulation details steady-state output, health capital, and physical capital. These patterns imply that social health insurance is a potential growth-promoting factor. My simulation results further suggest that the proportion of employment payments transferred to personal accounts exerts a positive effect on economic growth. My research provides a theoretical basis for accelerating reform of the social health insurance system in China and provides empirical support for developing empirical and feasible social health insurance policy.

In this paper, I evaluate the intergenerational effects of social health insurance, physical capital, human capital, and economic growth via a multi-period overlapping generation's model within a general equilibrium framework. Analyses of the relationships between model variables provide a new perspective to explain economic growth. I also simulate a theoretical model through parameter calibration and evaluate policy on the basis of my simulation results.

The remainder of this paper is organized as follows. Section 2 presents a review of relevant literature. Section 3 provides an introduction to China's social health insurance system. I outline the general model and discuss equilibrium conditions in Section 4. In Section 5, for illustration purposes, I study how health care is related to growth using an explicit parametric example and simulation of empirical observations of social health insurance in China. Finally, conclusions and policy suggestions are offered in Section 6.

2. Prior Research

Research on the relationship between physical capital, human capital, and economic growth began with North [5]. Studies on the impact of social insurance on economic growth have tended to focus on two areas, the first of which encompasses social insurance, physical capital, and economic growth. The neoclassical model has been used to examine the effect of social security on economic growth by studying the impact of social security on savings and accumulation of physical capital. Solow (1956) [6] suggested that social insurance can alter spending and saving behavior by changing families' budgetary constraints. Modigliani's (1954) [7] life cycle hypothesis and Samuelson's (1958) [8] overlapping generation's model have been applied to examine the effect of social security on savings rates. Feldstein (1974) [9] suggested that the substitution effect of social insurance led to a decline in total savings, which resulted in slow economic growth in the United States in the 1960s and 1970s. Kotlikoff (1989) [10] found that numerous types of insurance (e.g., unemployment, pension, disability benefits, and health insurance) continued to increase along with a declining savings rate in the United States after World War II; thus, Kotlikoff concluded that medical insurance payments could reduce savings by 12% compared with self-pay arrangements. Chou et al. (2006) [11] indicated that the implementation of social health insurance in Taiwan reduced savings by an average of 8.6% to 13.7%. Neoclassical growth theory holds that the pay-as-you-go system will have a 'crowding out' effect on savings, but the fund system will increase the savings rate, thereby promoting economic growth. Growth theorists of the 1950s and 1960s recognized this modeling deficiency and tended to explain it by assuming that technological progress occurred in an unexplained (exogenous) manner.

The second area encompasses social insurance, human capital, and economic growth [12]. Following classic research from Romer (1986) [13] and Lucas (1988) [14] on the role of human capital on economic growth, scholars began to explore the impact of social insurance on economic growth from the perspective of human capital accumulation. Recent work on endogenous growth theory has sought to explain long-term growth. The new growth theory implies that human capital accumulation is the sole source of long-term economic growth, elucidating the impact of social security in light of human capital formation on economic growth. Martin (1995) [15] explained that social security is conducive to economic growth from the externalities of human capital. Kemnita and Wigger (2000) [16] found that the social insurance system can encourage families to increase human capital investment, thereby promoting economic growth. Shen (2012) [17] discovered that an improved social security level can promote accumulation of human capital and stimulate economic development under the pay-as-you-go system.

Several empirical studies have attempted to explain the relationship between social security expenditure and economic growth. Barro and Sala-I-Martin (1995) [18] pointed out that only social insurance expenditure is positively correlated with economic growth among all forms of public expenditure. Perotti (1996) [19] noted a positive association between social insurance expenditure and economic growth on the basis of cross-sectional data. Cuyvers and Rayp (1998) [20] argued that a positive correlation exists between social security expenditure and economic growth in newly industrialized countries in East Asia. Bellettini and Ceroni (2000) [21] found a significant positive role of social security expenditure on economic growth, adding that this effect was more significant in less developed countries. Their results also indicated that social security expenditure is conducive to the formation of human capital based on data from 61 countries. Zhang and Zhang (2004) [22] examined the relationship between social security expenditure and determinants of economic growth using data from countries with a market economy. Their findings revealed social insurance expenditure to be positively correlated with economic growth. Lee and Chang (2006) [23] found that social security expenditure exerts a positive effect on GDP using panel data from 12 Asian countries between 1972 and 2000; although no causal relationship emerged between the two in the short term, a two-way causal relationship manifested between economic growth and social security spending in the long term. Wang et al. (2008) [24] found that the growth rate of health human capital is always positively related to economic growth.

Research on social security and economic growth has important implications for my research. In this article, I studies on the interaction between social health insurance and economic growth and use data from China. In particular, I examine mechanism of social health insurance on economic growth.

3. China's Social Health Insurance System

China has undergone one of the most drastic public health insurance reforms in the world. China has transitioned from an initially free medical service with labor-protection medical care to social health insurance that combines social mutual accounts with personal accounts. China established a reform plan and invested about 850 billion CNY within 3 years since April 2009 and investment is still increasing. China's current social health insurance system consists of social health insurance for urban employers and social health insurance for urban and rural residents.

Social health insurance for urban employers: The basic medical insurance system for employees grew out of free medical service, which was established by the Chinese State Council in late 1998. As the planned economy transformed into market economy, government-sponsored free medical service and enterprise-sponsored employer insurance posed great burdens to the government and enterprises. Social medical reform needed to adapt to China's new economic and social environment. Because coverage under the original system design was mainly intended for employees, financing of UESM is now shared by three parties: the state, enterprises, and individuals. To reduce resistance to reform, China designed personal accounts to which employees and employers each contributed, resulting in personal accounts and pooled accounts. This scheme consists of a pooled fund for inpatient stays and personal accounts for outpatient visits to curb the excessive growth of medical expenses. Basic medical insurance is financed by payroll taxes paid by employers (6%) and employees (2%). About 160 million people (roughly 28% of the total urban population) Ire insured under this scheme in 2006. Premiums per capita increased from 1443 yuan in 2008 to 2840 yuan in 2016; the rate of people insured increased from 80.7% to 95% during the same period.

Social health insurance for urban and rural residents: China reformed the basic medical insurance system for urban residents and new rural cooperative medical insurance to establish a unified basic medical insurance system for urban and rural residents in 2016. Basic medical insurance for urban residents was extended to the rest of the urban population; this initiative began in 2007 and targeted residents not covered by other schemes (e.g., children, students, and migrants), financed by urban residents and local government authorities. The rural cooperative medical system launched in 2003, and 720 million agricultural households (85.9% of the rural population) Ire insured by the end of 2007. In the Istern and middle regions of China, central and local governments contribute 40 Renminbi (roughly £3) for each participant per year; participants contribute the remaining 20 Renminbi.

Combining these two systems, the total premiums for social health insurance reimbursement are increasing; per capita premiums for urban residents increased from 131 yuan in 2008 to 450 yuan, and the participation rate increased from 63.8% to 95%. The total premiums from social health insurance reimbursement for rural residents increased from 96 yuan in 2008 to 450 yuan in 2016, and the insured rate increased from 90% to 98.9%.

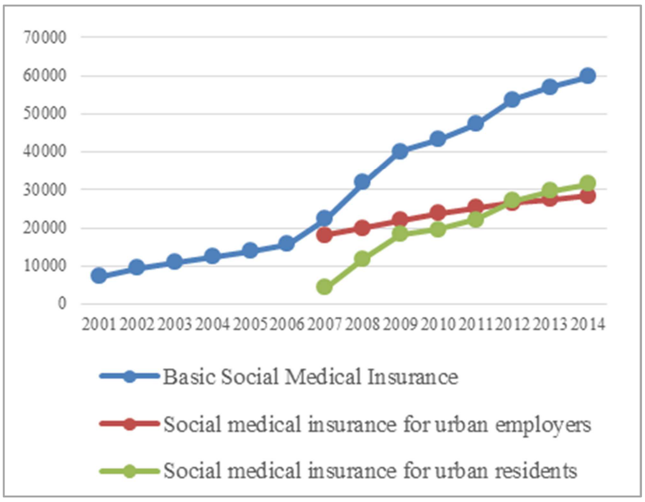

Figure 1. *Residents insured under social health insurance in China from 2001 to 2014.*

Figure 1 indicates that the number of residents insured under social health insurance has increased steadily each year. Given ongoing economic and social development, the coverage and level of insurance security will continue to increase in China.

Figure 2 presents basic income and expenditure information for China's social health insurance fund. The basic medical insurance fund income and expenditure is rising year by year; the growth of UEBMI is fastest, whereas the surplus of RCMS is lowest.

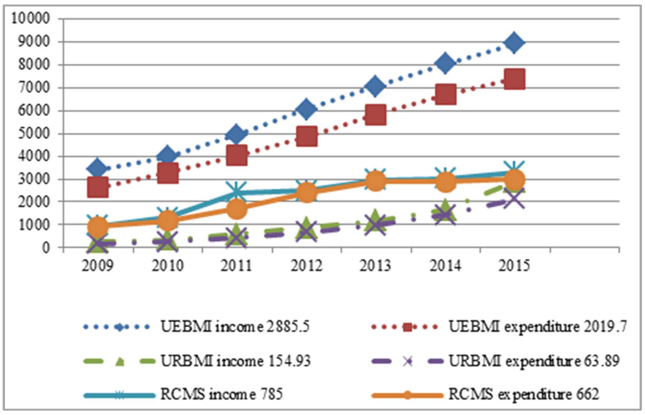

Figure 2. *Fund income and expenditure of social health insurance from 2009-2015.*

Financing social health insurance: China established pooled accounts and personal accounts from 1998. Basic medical insurance premiums paid by employees are included in personal accounts. Basic medical insurance premiums paid by employers are divided into two parts: one part has been used to set up a pooling fund, and other is putted in personal accounts. A proportion of individual accounts are paid by employers, although the standard has been determined by factors such as the length of employment corresponding to different provinces or cities. Pooling funds and personal accounts are considered separately according to their respective payment ranges, and medical expenses below the payment standard shall be paid from personal accounts. Interest earned on a personal account can be used throughout life and inherited.

The financial mechanism of pooled accounts combined with personal accounts is characteristic of China's social health insurance system. It can also alleviate the challenge of population aging regarding the sustainability of a medical insurance fund. There are two primary functions of personal accounts: to increase self-restraint and save for medical expenses; and to increase funds against the growing pressure of medical expenses associated with an aging population.

4. The Model

In this paper, I consider a multi-period overlapping generation's model [25, 8] within a general equilibrium framework in which social health insurance is determined endogenously. Social health insurance influences savings, physical capital, human capital and economic growth through changing budgetary constraints. My model consists of three parts: individuals, firms and the government.

Social health insurance affects economic growth in two major ways: one is through budgetary constraints that influence individuals' saving behavior and thus affect the formation of physical capital; other is through current and future welfare, which alter individuals' medical expenditure and human capital and therefore influence human capital accumulation.

4.1. Individuals

Individuals live for two periods. In the first period (0), they are healthy and can work; in the second period (1), they are retired and may become ill. Individuals born in period *t* live to old age (the second period) only with a probability *p*, which is determined by their health status.

In the first period, individuals who are healthy and earn income can pay social health insurance premiums according to the provisions of social health insurance. In the next period, the probability of representative individuals falling ill is *P*; if an individual is sick, he must pay medical expenses m_t representing some proportion of medical expenses according to social health insurance[1].

Individual preferences are identical for all generations. For an individual of generation *t*, his expected lifetime utility is given by consumption over two periods and medical services in the second period (I assume that the amount of medical services is represented by medical expenses). Preferences in the first period are given by a strictly increasing and concave utility function u (·), satisfying the Inada condition at zero. The utility function from second-period consumption and medical expenses satisfy similar conditions. Individuals live for two periods; thus, I assume that an individual's lifetime utility depends on utility c_t in the first period and c_{t+1} in the second period along with medical expenses m_t in the second period. I further assume there is no altruistic bequest motivation, and Ricardo equivalence does not hold. The utility function of the individual is thus assumed to be

$$u(c_t, c_{t+1}, m_t) = \ln c_t + \rho \ln c_{t+1} + p\varphi \ln m_t \quad (1)$$

where ρ and φ denote the time discount factor and discount rate of the utility of medical expenses, respectively.

Human health capital function: Following Grossman (1972), individuals are assumed to be able to produce health stock via purposeful health investment [2] according to a health production function. Suppose individuals of all generations are endowed ex ante with an initial health capital h_t in the

1 "China Social Insurance Law" (Article 27) states that individuals who participate in basic medical insurance reach statutory retirement age and total payment after 20 years; they do not need to pay basic medical insurance premiums after retirement and can enjoy basic medical benefits. Therefore, I assume individuals do not pay basic medical insurance premiums in the next period.

2 In our model, 'health investment' can be broadly defined as all spending and activities related to improving the health stock of an agent, which includes but is not limited to spending on medical products and services. For a concrete and reasonable approximation, I later use health care expenditure as the proxy for health investment in our discussion of calibration and simulation.

first period of their lives. I assume that an individual's health is mainly affected by medical expenses and the stock of human capital. Therefore, the health stock of a young individual in period t can be described by the following equation:

$$h_{t+1} = Dm_t^{\theta} h_t^{1-\theta} \tag{2}$$

where D measures the production technology of human capital and is constant, θ reflects the contribution rate of medical expenditure on human capital, h_t denotes the stock of human capital, and $1-\theta$ can be interpreted as transfer of the current stock of human capital to the next period.

Budgetary constraints: Individuals of all generations are endowed with one unit of labor when they are young, which is then supplied in elastically in the labor market. By supplying labor, an individual born in period t earns a market wage rate w_t in the first period of his life. Having earned w_t when young, the individual must decide on his first-period consumptionc_t; his amount of savings s_t; and the amount of health care he wishes to purchase m_t. Savings in period t, which become physical capital in period t+1, yield a real rate of return of r_{t+1}. A proportion τ_t of the wage must be used to finance social health insurance. The health status of those who become ill depends on the medical care they obtain. An ill individual can only provide the copay $(1-\sigma)m_t$ according to his social health insurance. Therefore, individual budgetary constraints are such that consumers' lifetime spending does not exceed their income. $(1-\tau_i-\tau_p)w_t$ represents an individual's net income that is used for c_t, s_t, c_{t+1}, and σm_t. The budgetary constraints of the two phases are as follows:

$$c_t = (1-\tau_i-\tau_p)(1-s_t)w_t \tag{3}$$

$$c_{t+1} = (1+r_{1+t})s_t(1-\tau_i-\tau_p)w_t - m_t + p(1-\sigma)m_t + (\tau_i+\eta\tau_p)w_t \tag{4}$$

Eqs. (3) and (4) can then be combined:

$$\left[(1+r_{1+t})(1-\tau_i-\tau_p)+(\tau_i+\eta\tau_p)\right]w_t - p\sigma m_t - c_{t+1} - (1+r_{1+t})c_t = 0 \tag{5}$$

4.2. Firms

Assuming the economy is completely competitive, the economy has only one enterprise and one product, and the output constantly returns to scale. Firms use physical capital k_t and human capital defined in h_t to produce homogeneous output y_t.

I assume that output is determined by physical capital and human capital as suggested in various studies (Bloom et al., 2004; Howitt; Kalemli-Ozcan et al., 2000; Strauss & Thomas, 1998; Weil). Healthy individuals tend to be more energetic and have a lower chance of illness, enabling them to be more effective and manage a higher intensity of work. Health can also improve an individual's learning ability and returns on education. Therefore, I can assume that individuals with higher health human capital will have a higher production capacity or more effective labor in the unit time.

Firms are assumed to maximize profits, taking the wage rate and interest rate as given. The wage rate and interest rate are determined in perfectly competitive markets in equilibrium. The production function is assumed to be of the Cobb-Douglas form:

$$Y_t = AK_t^{\alpha} L_t^{1-\alpha} = AK_t^{\alpha}(h_t N_t)^{1-\alpha} \tag{6}$$

Where A denotes the technology of firm production, Y_t represents aggregate output at time t, K_t denotes aggregate physical capital, and L_t denotes aggregate labor supply measured in the effective labor unit. Effective labor depends on the number of workers and healthy human capital; $A>0$, $0<\alpha<1$. Firms are maximizing profits $\pi_t = AK_t^{\alpha}(h_t N_t)^{1-\alpha} - \delta K_t - w_t L_t$, where δ represents the depreciation rate and w_t denotes the labor price per unit, which is the wage rate; $1+r_t$ applies to the capital price per unit, which is the interest rate. Assuming that each factor market is perfectly competitive with the above aggregate production function, output is fully distributed to labor and capital. Profit maximization and competition imply that factors are paid their marginal product. The first-order necessary conditions of the firm yield the following:

$$w_t = A(1-\alpha)k_t^{\alpha} h_t^{1-\alpha}, \quad 1+r_t = \alpha A(k/h)^{\alpha-1} \tag{7}$$

4.3. Government

The government sector consists of a general account and a personal insurance pooled account. The social health insurance account consists of a pooled account and personal account in accordance with China's social health insurance system. A personal account is mainly used to pay for outpatient medical expenses and can be carried forward; the pooled account is used to pay for hospitalization expenses. Personal payments account for τ_i proportion of wages, and employer payments account for τ_p [3] proportion of wages τ_p. η denotes an employer payment transfer to an individual account, and $1-\eta$ is an employer payment transfer to a pooled account. The payment from the pooled account is B_t, and the cumulative amount of personal accounts is A_t. The income of the social health insurance fund is given by

$$B_t + A_t = (1-\eta)\tau_p w_t + (\tau_i+\eta\tau_p)w_t \tag{8}$$

The expenditure of the social health insurance fund depends on the medical expenditure of the sick individual and the expenditure of the pooled account:

$$B_t + A_t = m_t p(1-\sigma) + (\tau_i+\eta\tau_p)w_t \tag{9}$$

As the goal of social health insurance is to hold the fund

3 Social medical insurance payments are divided into two parts, individual and employer payments; the employer payment would be included in the cost of labor.

balance, the equilibrium condition of the government in period t is given by

$$(1-\eta)\tau_p w_t = m_t p(1-\sigma) \tag{10}$$

4.4. The Model

Given human capital, wages, interest rates, medical insurance premium copayment from a representative individual, and medical insurance payment rate, an individual can maximize lifetime utility via consumption decisions and medical expenses on the basis of budgetary constraints. Therefore, the utility maximization problem can be stated as

$$\max_{c_t, c_{t+1}, m_t} u(c_t, c_{t+1}, m_t) \tag{11}$$

$$s.t.\left[(1+r_{1+t})(1-\tau_i-\tau_p)+(\tau_i+\eta\tau_p)\right]w_t - p\sigma m_t - c_{t+1} - (1+r_{1+t})c_t = 0 \tag{12}$$

I construct the following Lagrange function:

$$L = \ln c_t + \rho \ln c_{t+1} + p\varphi \ln m_t + \lambda\left\{\left[(1+r_{1+t})(1-\tau_i-\tau_p)+(\tau_i+\eta\tau_p)\right]w_t - p\sigma m_t - c_{t+1} - (1+r_{1+t})c_t\right\} \tag{13}$$

4.5. Social Health Insurance, Savings, and Physical Capital

Accordingly, I obtain the optimal consumption and optimal medical expenditure in different periods:

$$m_t = (1+r_{1+t})\varphi c_t / \sigma \tag{14}$$

$$\lambda = \frac{(1+\rho)(1-\sigma)}{\left[(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p)+(1-\sigma)(\tau_i+\eta\tau_p)-\sigma(1-\eta)\tau_p\right]w_t} \tag{15}$$

$$c_t = \frac{(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p)+(1-\sigma)(\tau_i+\eta\tau_p)-\sigma(1-\eta)\tau_p}{(1+\rho)(1+r_{1+t})(1-\sigma)} w_t \tag{16}$$

$$c_{t+1} = \frac{\left[(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p)+(1-\sigma)(\tau_i+\eta\tau_p)-\sigma(1-\eta)\tau_p\right]\rho}{(1+\rho)(1-\sigma)} w_t \tag{17}$$

The optimal savings rate is

$$s_t = 1-\frac{1}{1+\rho}-\frac{(1-\sigma)\tau_i+(\eta-\sigma)\tau_p}{(1+\rho)(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p)} \tag{18}$$

The total saving rate is an individual's optimal savings rate and the accumulation of individual accounts:

$$S_t = 1-\frac{1}{1+\rho}-\frac{(1-\sigma)\tau_i+(\eta-\sigma)\tau_p}{(1+\rho)(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p)}+(\tau_i+\eta\tau_p) \tag{19}$$

Proposition 1: Because $0<1-\sigma<1$, the higher the contribution rates of individual accounts to social health insurance, the lower the personal savings rate. The contribution rate to the pooled account payment rate depends on $\eta-\sigma$. With a high proportion of η and low proportion of self-pay of σ, then the value of $\eta-\sigma$ is positive and greater; as such, the pooled account rate τ_p is high, and the personal savings rate is low.

Contributions of personal accounts to the individual savings rate are reflected as follows: an optimal savings rate exists; when personal account contributions do not exceed the voluntary savings rate, and tax on a personal account equals the rate of return of the individual voluntary savings rate, then an individual will decrease savings to maintain the original optimum. If this effect is one-to-one, then when the personal account payment rate increases by 1%, the savings rate will decline by 1%. This pattern occurs because the representative individual predicts that the money in this account will be used when he is ill, leading to a decrease in private voluntary savings without changing his consumption plan. From a whole-society perspective, the total savings rate does not change, and there is an equivalent effect of voluntary savings and involuntary savings; thus, the collective impact of individual accounts on the total savings rate is neutral.

The contribution rate of the social pooled account represents the proportion transferred from the healthy population to those who are ill. The higher the transfer rate, the less saving resources are available for the healthy population, which reduces the optimal voluntary savings rate. Higher insurance payments following illness are also associated with higher transfer rates; thus, if a person anticipates this scenario, he will likely reduce his precautionary savings. The model also shows that the proportion of funds transferred to an individual account will affect the results along with copayment; a larger funds transfer from the social pooled account to an individual account and a lower copayment leads to a lower savings rate, which can also be compared with economic intuition as indicated in the classic literature.

Overall economic wealth is equal to the voluntary private savings of all individuals and the individual medical insurance fund. If no intergenerational loss, then the capital is fully depreciated in each period, and the total wealth of society is $W_t = N_t\left[s_t w_t + (\tau_i + \eta\tau_p) w_t\right]$. If the economy is self-enclosed, then equilibrium conditions of the capital market are $K_{t+1} = W_t = N_t\left[s_t w_t + (\tau_i + \eta\tau_p) w_t\right]$; in this case, the capital accumulation equation is $K_{t+1}/N_t = k_{t+1} = \left(s_t + \tau_i + \eta\tau_p\right) w_t$, such that

$$k_{t+1} = \left[\frac{\rho}{1+\rho} - \frac{(1-\sigma)\tau_i + (\eta-\sigma)\tau_p}{(1+\rho)(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p)} + \tau_i + \eta\tau_p\right] w_t \tag{20}$$

Because $w_t = A(1-\alpha)k_t^{\alpha} h_t^{1-\alpha}$, the capital accumulation equation is

$$k_{t+1} = A(1-\alpha)\left[\frac{\rho}{1+\rho} - \frac{(1-\sigma)\tau_i + (\eta-\sigma)\tau_p}{(1+\rho)(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p)} + \tau_i + \eta\tau_p\right] k_t^{\alpha} h_t^{1-\alpha} \tag{21}$$

$$\frac{k_{t+1}}{k_t} = A(1-\alpha)\left[\frac{\rho}{1+\rho} - \frac{(1-\sigma)\tau_i + (\eta-\sigma)\tau_p}{(1+\rho)(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p)} + \tau_i + \eta\tau_p\right] k_t^{\alpha-1} h_t^{1-\alpha} \tag{22}$$

Proposition 2: The contribution rates of personal accounts and pooled accounts of social health insurance to the accumulation of physical capital are ambiguous. On one hand, pooled accounts of social health insurance will reduce the personal savings rate; on the other hand, the fund for consumption can shift to an accumulation fund from the entire society, which increases capital accumulation. Accordingly, the overall effect is unclear.

4.6. Social Health Insurance and Medical Expenditure

To solve the optimization equation to obtain representative individual medical expenditure, I use

$$m_t = \frac{\varphi(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p) + (1-\sigma)(\tau_i + \eta\tau_p) - \sigma(1-\eta)\tau_p}{(1+\rho)(1-\sigma)\sigma} w_t \tag{23}$$

The proportion of medical expenditure to wages is

$$\frac{m_t}{w_t} = \frac{\varphi(1-\sigma)(1+r_{1+t}) + (1-\sigma)\left[1-(1+r_{1+t})\varphi\right]\tau_i + \left[\eta - \varphi(1-\sigma)(1+r_{1+t})\right]\tau_p}{(1+\rho)(1-\sigma)\sigma} \tag{24}$$

Proposition 3: The contribution rates of personal accounts of social health insurance to medical expenditure depend on the equation $1-(1+r_{1+t})\varphi$, if $\varphi < 1/(1+r_{1+t})$. With an increase in the personal account payment rate, the proportion of medical expenditures to wages will rise. In this case, individual accounts can deduct medical expenses; thus, an increase in the payment rate is associated with an increase in personal account funds, and the medical expenditure will increase in kind.

The overall account payment rate τ_p on medical expenditure depends on $\eta - \varphi(1-\sigma)(1+r_{1+t})$. Therefore, pooled account payments affect medical expenditure in two aspects: first, establishment of pooled accounts and the proportion of payment η provides ill individuals financial security, such that individuals tend to increase medical costs; second, $\varphi(1-\sigma)(1+r_{1+t})$, indicating that healthy individuals transfer funds to ill individuals. The higher the transfer rate, the fewer resources are available for health individuals. Therefore, the net effect of the pooled account payment rate on the proportion of medical expenditure depends on the model parameters.

4.7. Social Health Insurance and Health Human Capital

$$\frac{h_{t+1}}{h_t} = D m_t^{\theta} h_t^{1-\theta} = D\left\{A(1-\alpha)\frac{\varphi(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p) + (1-\sigma)(\tau_i+\eta\tau_p) - \sigma(1-\eta)\tau_p}{(1+\rho)(1-\sigma)\sigma} k_t^{\alpha} h_t^{1-\alpha}\right\}^{\theta} h_t^{-\theta} \tag{25}$$

Proposition 4: The contribution rates of personal accounts and pooled accounts to human health capital are ambiguous. The influence of individual account payment rate τ_i on health human capital depends on $1-(1+r_{1+t})\varphi$; if $\varphi < 1/(1+r_{1+t})$, then healthy human capital will rise with an increase in the personal account payment rate.

4.8. Social Health Insurance and Economic Growth

Next, I consider economic growth. In a steady state, $k_{t+1} = k_t = k^*$, such that

$$\overset{*}{k} = A^{-\frac{\theta}{\alpha}}(1-\alpha)^{-\frac{1+\theta}{\alpha}}\left[\frac{\rho}{1+\rho}-\frac{(1-\sigma)\tau_i+(\eta-\sigma)\tau_p}{(1+\rho)(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p)}+\tau_i+\eta\tau_p\right]^{\frac{1-\theta}{1+\theta\alpha-\alpha}} \left\{\frac{\varphi(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p)+(1-\sigma)(\tau_i+\eta\tau_p)-\sigma(1-\eta)\tau_p}{(1+\rho)(1-\sigma)\sigma}\right\}^{\frac{\theta}{\alpha^2-\alpha-\theta\alpha^2}} \tag{26}$$

Similarly, in steady state that $h_{t+1} = h_t = h^*$, I get

$$\overset{*}{h} = A^{\frac{\alpha\theta-\alpha\theta^2-1-\theta}{\alpha-\alpha^2+\theta\alpha^2}} D^{\frac{1}{1-\alpha+\theta\alpha}}(1-\alpha)^{-\frac{2}{1-\alpha+\theta\alpha}}\left[\frac{\rho}{1+\rho}-\frac{(1-\sigma)\tau_i+(\eta-\sigma)\tau_p}{(1+\rho)(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p)}+\tau_i+\eta\tau_p\right]^{\frac{-\theta}{1+\theta\alpha-\alpha}} \left\{\frac{\varphi(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p)+(1-\sigma)(\tau_i+\eta\tau_p)-\sigma(1-\eta)\tau_p}{(1+\rho)(1-\sigma)\sigma}\right\}^{\frac{\theta-\alpha\theta}{\alpha^2-\alpha-\theta\alpha^2}} \tag{27}$$

According to the theory of economic growth, when the economy is in the path of steady-state growth, then the per capita output, per capita physical capital, and per capita human capital will increase at the same rate, such that

$$\frac{y_{t+1}}{y_t} = \frac{k_{t+1}}{k_t} = \frac{h_{t+1}}{h_t} = 1+g_t = 1+g_{k,t} = 1+g_{h,t}$$

effectively, the growth path of the steady-state growth rate is 1+g.

The steady-state growth rate is obtained by simultaneous equations:

$$1+g = A^{\frac{\theta}{1-\alpha(1-\theta)}} D^{\frac{1-\alpha}{1-\alpha(1-\theta)}} (1-\alpha)^{\frac{2\alpha\theta-\alpha-\theta+1}{1-\alpha(1-\theta)}} \sigma^{\frac{\theta(\alpha-1)}{1-\alpha(1-\theta)}} \left[(1+r_{1+t})(1-\tau_i-\tau_p)\right]^{\frac{1+\theta-\alpha}{1-\alpha(1-\theta)}} \left[(1-\rho)(1-\sigma)\right]^{\frac{-\theta}{1-\alpha(1-\theta)}} \frac{\left\{(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p)\left[\rho+(1+\rho)(\tau_i+\eta\tau_p)\right]-(1-\sigma)\tau_i-(\eta-\sigma)\tau_p\right\}^{\frac{\alpha-1}{1-\alpha(1-\theta)}}}{\left[\varphi(1-\sigma)(1+r_{1+t})(1-\tau_i-\tau_p)+(1-\sigma)(\tau_i+\eta\tau_p)-\sigma(1-\eta)\tau_p\right]^{\frac{\theta(\alpha-1)}{1-\alpha(1-\theta)}}} \tag{28}$$

Proposition 5: The contribution rates of personal accounts to economic growth are reflected in two ways: the contribution rates of personal accounts can replace precautionary savings in the presence of insufficient effective demand, which produces a multiplier effect according to Keynes's theory. Increasing personal account payments means that the same demand will emerge; thus, demand will promote output, and increasing output will boost government financial revenue. The contribution of each monetary unit will eventually lead to more than one monetary unit of output, representing the multiplier effect of the personal account payment rate on economic growth.

The impacts of pooled account payments on economic growth take the following two forms. The first is the impact of the accumulation of physical capital. According to Proposition 1, pooled accounts affect the savings rate in two ways, and the net effect is negative; thus, a high pooling payment rate will reduce the accumulation of physical capital and thus reduce economic growth. Second, the social pooled account will affect the rate of medical expenditure. The net effect of all social pooled account rates is unclear according to Proposition 2, evoking an uncertain effect on economic growth.

5. Numerical Simulations

Individual accounts and pooled accounts of social health insurance both influence individual savings rates, accumulation of physical capital, accumulation of human capital, and economic growth according to the theoretical model. To explain and predict the influence of social health insurance on economic growth in China, I calibrate relevant parameters and analyze the numerical simulation results. The following assumptions apply to obtain a realistic benchmark model. To make my simulations as realistic as possible, available actual and projected data have been used together with estimated values of relevant parameters based on empirical research.

Based on estimates from the literature, I can obtain values for the benchmark model parameters. The base case value θ =0.646 was taken from Pan et al. (2013). The base case value α = 0.4 is based on a widely cited empirical estimate of the income share of capital, such as in Wand and Fan (2008). In My model, probability ρ measures the time discount factor, approximated as 0.78 per Liu and Lu (2008). Due to the high probability of illness during one's lifetime, it is assumed that the probability of illness is 1. I choose φ = 0.3 for My base case because the literature related to the medical cost utility discount rate is limited; thus, I considered the discount rate of medical cost utility as the replacement rate of future medical costs into preventive health care. In addition, the social health insurance premium accounts for 2–3% of employees' income, which is included in the personal account. Employers must pay 6–8% of the total salary, 1% of which is allocated to personal accounts; the remaining 5–7% is included in the pooled account according to China's social health insurance policy. Thus, I set the base rate of individual payment as 0.02, employer payment as 0.07 and the proportion of employer contributions to individual accounts as 0.01. According to the same source, the average copay of social health insurance is 71.4%; accordingly, I set the self-payment ratio to 0.286. r = 0.015 is the one-year deposit benchmark interest rate, which seems reasonable for an interest rate. Other parameter values were selected somewhat arbitrarily and calibrated only to the extent that the range of the resulting steady-state share of GDP in health care matches that observed in Table 1 ($A = D = 2.13$). I will also perform sensitivity checks for parameter values to ensure robustness.

Table 1. *Parameter Values.*

parameter	meaning	value
θ	Output elasticity of human capital production function	0.646
α	Output elasticity of physical capital in production function	0.4
ρ	Time preference factor	0.78
p	Probability of illness	1
φ	Discount rate of medical expenditure	0.3
r	Interest rate	0.015
τ_i	Social health insurance premium (individual)	0.02
τ_p	Social health insurance premium (employer)	0.07
η	Proportion of employer contribution to individual account	0.01
σ	Self-paid ratio	0.286
D	Technical parameters of health human capital	2.13
A	Technical parameters of production	2.13

I will primarily conduct two simulation exercises using model. First, I will evaluate whether my model, with endogenous insurance premium payments by employees and employers, leads to higher or lower steady-state economic growth. Second, I will examine how changes in the proportions of employer contributions to individual accounts will influence steady-state values of economic growth.

5.1. Benchmark Simulation

Given the above assumptions, the benchmark result is shown in Table 2 the pooling payment rate is higher, the individual savings rate is lower, and the social optimal savings rate is lower, leading to a lower rate of economic growth. An overall 15% increase in the pooling rate will reduce the rate of economic growth by about 0.796%, indicating that the government can improve medical security by boosting pooled account payments. Doing so will reduce household savings rate, thereby reducing accumulation of physical capital. Although increasing the pooled account rate exerts an incentive effect on human capital investment, the effect on physical capital has played a leading role; therefore, the net effect on economic growth will be negative. This finding is consistent with theoretical expectations and the previous simulation results.

Table 2. *Pooled account rate, savings rate, and economic growth rate.*

Pooled account rate (%)	Individual optimal savings rate (%)	Social optimal savings rate (%)	Economic growth rate (%)
0	0.46	0.49	10.958
2	0.45	0.47	10.850
4	0.44	0.46	10.643
6	0.44	0.46	10.541
8	0.44	0.45	10.344
10	0.43	0.45	10.251
15	0.42	0.45	10.162

Table 3 outlines the simulation of individual account payments, savings rates, and economic growth under the current parameters: a higher individual payment rate will lead to a lower savings rate, generating higher economic growth.

Individual account rates Ire found to increase by 15% per year, generating a 1.23% increase in the economic growth rate. This pattern is due to an increase in the personal account contribution rate, which helps increase physical capital and decreases individuals' preventive savings for illness. Healthy human capital will therefore rise, promoting economic growth.

Table 3. *Personal account rate, savings rate, and economic growth rate.*

Personal account rate (%)	Individual optimal savings rate (%)	Social optimal savings rate (%)	Economic growth rate (%)
0	0.427	0.427	8.199
2	0.426	0.447	8.277
4	0.426	0.467	8.885
6	0.426	0.487	8.929
8	0.426	0.506	9.214
10	0.425	0.526	9.346
15	0.424	0.575	9.429

5.2. Reform Simulations

I also carry out sensitivity analysis of the preceding simulation results. I change the policy parameters η because the proportion of employer payments transferred to individual accounts will affect economic growth; thus, I change the value of η to reveal corresponding impacts on economic growth.

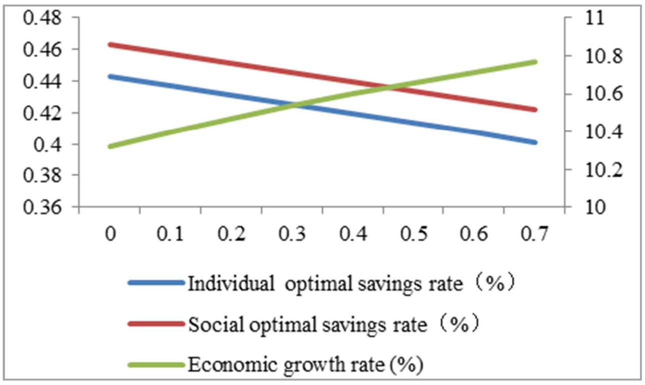

Figure 3. *Proportion of employer accounts allocated to individual accounts and economic growth.*

The proportion of employer payments transferred to individual accounts can promote economic growth, confirming the multiplier effect of the individual contribution rate to economic growth.

6. Conclusions

I analyze the impact of social health insurance on economic growth from the perspective of human capital and physical capital amidst population aging. My findings show that the contribution rates of personal accounts are conducive to physical and human capital accumulation, producing a multiplier effect on economic growth. The numerical simulation indicates that a lower rate of pooled account payments leads to a higher rate of personal account payments and greater economic growth. I also find that the proportion of employment payments transferred to personal accounts exert a positive effect on economic growth.

I can draw several conclusions from my study. Firstly, reforming the medical insurance system can improve residents' health status. Secondly, appropriate social health insurance can promote economic growth on the basis of various factors, so if China accelerates medical insurance system reform, which will exert a positive effect on China's economic development. Lastly, policies related to social health insurance should consider the relationships among social health insurance, physical capital, human capital, and economic growth along with the establishment of an incentive mechanism within the social health insurance system to promote economic growth.

The dilemma around social health insurance reform involves the question of how to balance fairness and efficiency. The medical insurance system can continue to be reformed as long as social health insurance can continuously improve physical capital and human capital and promote economic growth. My article tries to shed light on this important issue by providing evidence on the relationship between health insurance reform and economic growth.

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