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Analysis and Research on Home-based Care for the Aged Based on Insurance Policy under Government Leading

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Abstract

Government plays an important role in the formation and development of the home care model. In this paper, we study how the supervision of government in the pension service system based on insurance policy affects the members of the system. First of all, taking into account whether the government as the leader of the Steinberg Game, we establish a no government led model N and a government led model S to describe the characteristics of the pension service system under government supervision. Then, we analyze the impact of government participation in the pension system from the perspective of the elderly, insurance companies, pension companies, and the size of pension industry. The equilibrium results of the models show that the members of different role benefit different from the government's supervision. And the supervision of government is conducive to all elderly people's benefiting from the subsidy policy and expanding the scale of the pension industry. Both insurance companies and pension companies are the beneficiaries of the supervision of government.

Key words

Home-based Care; Supervision; Insurance; Industrial scale

1. Introduction

For the time being the trend of population aging is becoming increasingly serious. According to the 5th population census of our country in November 2000, the number of the elderly over the

age of 60 is 129.98 million, accounting for 10.46% of the country's total population, which symbols that our country has formally entered the aging society since 2000[1]. In the process of accelerated ageing of the population, home-based care for the aged gradually came into the vision of Chinese. In recent years, the pension model of our country has been turning to the home care model since its emergence in 2001 [2]. In 2012, the Standing Committee of National People's Congress revised the law on the protection of the rights and interests of the elderly, and specifically pointed out the "home-based care for the aged" model, combining China's national conditions with international experience. Some Suggestions on Accelerating the Development of Pension Services under the State Council, introduced in 2013, set forth the development goals for China's pension service, i.e. by the year 2020, depending on homes, communities, and institutions, the old-age service system that is perfect in function, modest in size, and covering both urban and rural areas shall be completely established. At present, the "home-based care for the aged" model is fundamental and dominant in the majority of the large and middle-sized cities across the country.

Of late years, to promote home-based care for the aged, provinces and cities nationwide successively published a series of policies and initiatives, forming patterns and experience of local characteristics, which worked pretty well [3]. However, some problems are coexisting. For instance, endowment resources and departments are comparatively dispersing and difficult to be integrated; with inadequate infrastructure, pension funds and staff in service are also in shortage; the form and content of service are still single and pension services are not complete in function; especially the division of responsibilities of the government and social organizations is not clear, nor the boundary between the government and market is reasonably divided [4-6]. For the reason, it can be found that due to the finiteness of the home-based care service resources and the low resource utilization, some local governments took things so seriously and personally that the elderly depended more and more on the government [7-9]. More importantly, the lag of markets' development led to that the home-based care services are lacking in a long-effect mechanism [10]. To a great extent, the existence of the above problems restraints the long-term, steady, and sustainable development of home-based care for the aged, and stops it from effectively playing a fundamental role [11].

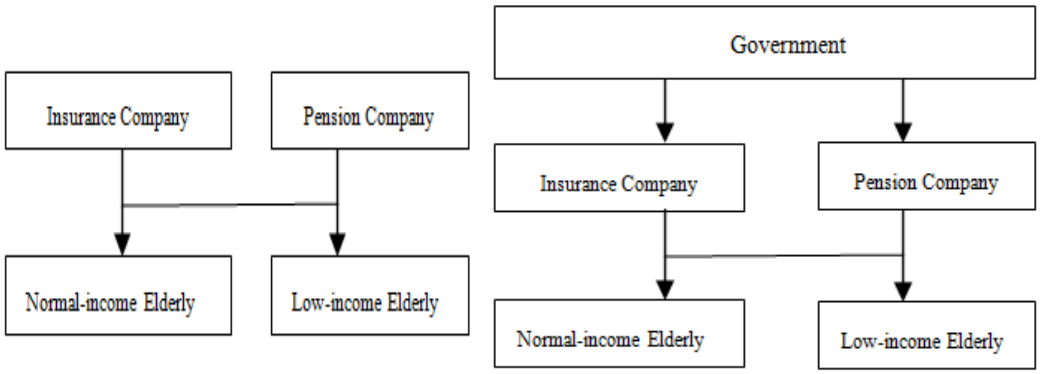
Home-based care for the aged is a social engineering which requires long-term and arduous efforts of all works of life, as well as a social welfare undertaking that serves the elderly people, thus requiring the government to improve and perfect laws and regulations, provide funding support, and make according plans [12-14]. Despite the current proposed "socialization of social

welfare" strategy, the scientific leading role of the government still holds vital importance [15-17].

The paper aims to study the influence of government's supervision on equilibrium results in the situation that the government together with insurance companies engages in Steinberg Game with the pension companies.

2. Symbol Set and Hypotheses

In this chapter, there is the pension model which is based on insurance service (Model N in Figure 1(a)). In the figure, both the normal-income and low-income elderly can have access to the insurance services provided by insurance companies and pension companies (hereinafter referred to as insurance services). Besides, the services provided are not differential. Taking into consideration the pension model based on insurance services and the influence of the supervision of the government, the pension model that is based on insurance services and dominated by the government is created (Model S in Figure 1(b))



(a) Model N (b) Model S

Fig.1. Pension Model Based on Insurance

Tab.1. The parameters in the model

Symbol	Denotation
w	The cost of government supervision
c_e	The service cost of insurance company
c_t	The service cost of pension company
p_e	The service price of insurance company
p_t	The service price of pension company
Φ	Market scale, i.e. the total number of the elderly

δ	The proportion of low-income elderly
θ^m	The will of normal-income elderly when they purchase services
θ^l	The will of low-income elderly when they purchase services
ρ	The ratio of the will of purchasing service from pension company and that of purchasing service from insurance company
q_i^k	The amount of services purchased. The value of superscript k can be m and l that represent respectively normal-income elderly and low-income elderly; the subscript i can be e and t that represent respectively insurance company and pension company. ($q^m = q_e^m + q_t^m, q^l = q_e^l + q_t^l, q_e = q_e^m + q_e^l, q_t = q_t^m + q_t^l$ $q = q^m + q^l = q_e + q_t$)
u_i^k	The acquired utility of the elderly k for purchasing service from the company i. The value of superscript k can be m and l that represent respectively normal-income elderly and low-income elderly; the subscript i can be e and t that represent respectively insurance company and pension company.
Π_i^k	The profit function in model k for the member i. The value of superscript k can be N and S that represent the two models in figure 3-1; the subscript i can be e and t that represent respectively insurance company and pension company.

For simplifying the analysis of the models in this chapter, we may just as well propose the following hypotheses:

Hypothesis 1: The services provided by both insurance companies and pension companies are standard and there is only one standard, and the services are provided for all the elderly without distinction.

In fact, the services that insurance companies and pension companies provide are diverse, but for the sake of simplicity here we suppose that they provide only one kind of standard service. Providing services without distinction reflects the sole standard.

Hypothesis 2: There are two types of elderly in the market, i.e. normal-income elderly (m) and low-income elderly(l) . They can purchase and have access to the insurance services. We make a hypothesis that the total number of the aged in the market is Φ, in which the proportion of low-income elderly is δ.

Hypothesis 3: The services provided by insurance companies and pension companies are supervised by the government. The supervision cost for each time of insurance service is w, which shall be undertaken by insurance companies and pension companies. As the elderly

purchase the services the additional utility of the governments' supervision is kw^b, and in it $0 < b < 1$.

On account of the externality of the services provided by insurance companies and pension companies, the government will supervise the business actions of those companies to guarantee the standard of the services and the benefits of the elderly. The supervision cost shall be undertaken by insurance companies and pension companies. For the convenience of calculation, the supervision cost of the government is directly proportional to the service times of the insurance companies and pension companies, and the supervision cost for each time of service is w. It can be inferred from the latter part of this hypothesis that the supervision of the government can promote the quality of the services, and thus the utility of the purchase for the elderly is increased.

Hypothesis 4: Assuming that all members (government, insurance companies, and pension companies) can share the information and there is no existence of asymmetric information, and the government possesses powerful enough control over other members, then the government plays the leading role in the Steinberg Game.

In the former part of this hypothesis, all members including the government, insurance companies, and pension companies sharing symmetric information is to control the inefficiency and risks that arise from the asymmetric information. And the latter part indicates that the government is able to utilize the reaction function of the insurance companies and pension companies and make decisions beneficial to achieve its goals. In such case, the government aims at maximizing the total of the elderly who purchase insurance services. In reality, the government is so dominant over other members as to play the leading role in the Steinberg Game.

Hypothesis 5: The will of normal-income elderly and that of low-income elderly to purchase services from insurance companies are respectively regarded as θ^m and θ^l , supposing t hey are uniformly distributed between 0 and 1.

In hypothesis 6, the will of normal-income elderly and that of low-income elderly to purchase services from insurance companies are uniformly distributed between 0 and 1, too. For the convenience of calculation, we also limit the service price that insurance companies and pension companies charge between 0 and 1.

Moreover, due to the advertising promotion of insurance companies, the elderly is more familiar with and places more confidence in insurance companies than pension companies. Therefore, the elderly is willing to pay more to purchase services from insurance companies,

which means that the willingness of the elderly to purchase services from insurance companies is higher than from pension companies, i.e. $\rho < 1$. Meanwhile, the advertising promotion of insurance companies needs higher cost, so the cost of insurance companies is higher than that of pension companies, i.e. $c_e > c_t$, so the service price of insurance companies is comparatively high. Then comes the result: $0 < p_t < p_e \leq 1$.

We can acquire the following conclusions from the above hypothesis:

(1) In Model N, the utility acquired by normal-income elderly for purchasing services from insurance companies can be expressed as $u_e^m = \theta^m - p_e$, and that from pension companies is $U_t^m = p\theta^m - p_t$. Similarly, the utility acquired by low-income elderly for purchasing services from insurance companies can be expressed as $U_e^l = \theta^l - \rho_e$, while that from pension companies is $U_t^l = \rho\theta^l - \rho_t$.

(2) In Model S, the utility acquired by normal-income elderly for purchasing services from insurance companies can be expressed as $U_e^m = \theta^m + kw^b - \rho_e$, and that from pension companies is $U_t^m = \rho\theta^m + kw^b - p_t$. Similarly, the utility acquired by low-income elderly for purchasing services from insurance companies can be expressed as $U_e^l = \theta^l + kw^b - p_e$, while that from pension companies is $U_t^l = \rho\theta^l + kw^b - p_t$.

If $U_e^m > U_t^m$ and $U_e^m > 0$, normal-income elderly would choose to purchase services from insurance companies; while if $U_t^m > U_e^m$ and $U_t^m > 0$, then they would choose to purchase services from pension companies. Similarly, if $U_e^l > U_t^l$ and $U_e^l > 0$, low-income elderly would choose to purchase services from insurance companies; while if $U_t^l > U_e^l$ and $U_t^l > 0$, then they would choose to purchase services from pension companies.

Hypothesis 6: $\frac{p_t}{p_e} < \rho < 1 - p_e + p_t$.

In Model N, $U_e^m - U_t^m = (1-\rho)\theta^m - p_e + p_t$ and $U_e^l - U_t^l = (1-\rho)\theta^l - p_e + p_t$. In order to ensure that insurance companies and pension companies can coexist, when$\theta^m \in [0,1]$, $U_e^m - U_t^m$ shall neither be permanently greater than or equal to 0, nor be permanently less than or

equal to 0, and when $\theta^l \in [0,1]$, $U_e^l - U_t^l$ shall neither be permanently greater than or equal to 0, nor be permanently less than or equal to 0. Furthermore, $U_e^m - U_t^m$ and $U_e^l - U_t^l$ are respectively the linear functions of θ^m and θ^l , which are monotonically increasing. To keep insurance companies and pension companies coexisting, based on the fact that the elderly is more willing to purchase the services of insurance companies, we can see that when the purchasing will of the old people is 1, they are certain to purchase services from insurance companies. In other words, for normal-income elderly, if $\theta^m = 1$, then $U_e^m - U_t^m > 0$ and $U_e^m > 0$; for low-income elderly, if $\theta^l = 1$, then $U_e^l - U_t^l > 0$ and $U_e^l > 0$. When the purchasing will of the old people decreases to the extent that $U_t^m = 0$ or $U_t^l = 0$, they are certain to choose the services of pension companies. That is to say, for normal-income elderly, if $\theta^m = \frac{p_t}{\rho}$, then$U_t^m - U_e^m > 0$ and $U_t^m > 0$; for low-income elderly, if $\theta^l = \frac{p_t-(1-\rho)kw^b}{p_e} <$, then $U_t^l - U_e^l > 0$ and $U_t^l > 0$, and the result is $\frac{p_t}{p_e} < \rho < 1 - p_e + p_t$.

Similarly, In Model S, $U_e^m - U_t^m = (1-\rho)\theta^m - p_e + p_t$ and $U_e^l - U_t^l = (1-\rho)\theta^l - p_e + p_t$. To keep insurance companies and pension companies coexisting, when the purchasing will of the old people is 1, they are certain to purchase services from insurance companies. And when the purchasing will of the old people is $\frac{p_t-kw^b}{\rho}$, they are certain to purchase services from pension companies. Therefore, we can get $\frac{p_t-(1-\rho)kw^b}{p_e} < \rho < 1 - p_e + p_t$.

Since $\frac{p_t-(1-\rho)kw^b}{p_e} < \frac{p_t}{p_e}$, we can make an assumption that $\frac{p_t}{p_e} < \rho < 1 - p_e + p_t$.

Hypothesis 7: The decisions of all members (government, insurance companies, and pension companies) depend on the total of the elderly in the market, and every elderly can make purchase of service only once.

Here we take no account of those who have made purchase and who are not qualified to make purchase (such as those who don't meet the age requirements) . That every elderly can

make purchase of service only once means that they can buy services from insurance companies or pension companies for only one time.

3. Model Structuring and Solution

In this section, the decisions of the government, insurance companies, and pension companies in the two different models will be discussed. Before analyzing the game model between members, the market demand function in different models have to be discussed in this chapter. Based on the hypotheses in the previous chapter, we can come to the following conclusions:

(1) In Model N, for normal-income elderly, when their purchasing will ranges in $\left[\frac{p_e-p_t}{1-\rho}, 1\right]$, then $U_e^m - U_t^m > 0$ and$U_e^m > 0$; when their purchasing will ranges in $\left[\frac{p_t}{\rho}, \frac{p_e-p_t}{1-\rho}\right]$, then $U_t^m - U_e^m$ and $U_t^m > 0$. For low-income elderly, when their purchasing will ranges in $\left[\frac{p_e-p_t}{1-\rho}, 1\right]$, then $U_e^l > U_t^l$ and $U_e^l > 0$; when their purchasing will ranges in$\left[\frac{p_t}{\rho}, \frac{p_e-p_t}{1-\rho}\right]$, then $U_t^l > U_e^l$ and $U_t^l > 0$. Therefore, $q_e^m = \Phi(1-\delta)\left[1 - \frac{p_e-p_t}{1-\rho}\right], q_t^m = \Phi(1-\delta)\left[\frac{p_e-p_t}{1-\rho} - \frac{p_t}{\rho}\right], q_t^l = \Phi\delta\left[\frac{p_e-p_t}{1-\rho} - \frac{p_t}{\rho}\right]$,.

(2) In Model S, for normal-income elderly, when their purchasing will ranges in$\left[\frac{p_e-p_t}{1-\rho}, 1\right]$, then $U_e^m > U_t^m$ and $U_e^m > 0$; when their purchasing will ranges in$\left[\frac{p_t-kw^b}{\rho}, \frac{p_e-p_t}{1-\rho}\right]$, then$U_t^m > U_e^m$ and $U_t^m > 0$. For low-income elderly, when their purchasing will ranges in$\left[\frac{p_e-p_t}{1-\rho}, 1\right]$, then $U_e^l > U_t^l$ and$U_e^l > 0$; when their purchasing will ranges in$\left[\frac{p_t-kw^b}{\rho}, \frac{p_e-p_t}{1-\rho}\right]$, then $U_t^l > U_e^l$ and $U_t^l > 0$. Therefore, $q_e^m = \Phi(1-\delta)\left[1 - \frac{p_e-p_t}{1-\rho}\right], q_t^m = \Phi(1-\delta)\left[\frac{p_e-p_t}{1-\rho} - \frac{p_t-kw^b}{\rho}\right]$,

$q_e^l = \Phi\delta\left[1 - \frac{p_e-p_t}{1-\rho}\right], q_t^l = \Phi\delta\left[\frac{p_e-p_t}{1-\rho} - \frac{p_t-kw^b}{\rho}\right]$.

3.1 Model N—Without Government Leading

In Model N, we assume that the government doesn't engage in supervision. On the basis of this model, what we study is just how the decisions of both insurance companies and pension companies interact with each other, without regard to the government's policy.

First of all, we determined the best response function of insurance companies and pension companies. The profit maximization function for insurance companies and pension companies is respectively:

$$\max_{p_e} \prod_e^N = q_e (p_e - c_e) = \Phi\left(1 - \frac{p_e - p_t}{1-\rho}\right)(p_e - c_e)$$

(1)

$$\max_{p_t} \prod_t^N = q_t (p_t - c_t) = \Phi\left(\frac{p_e - p_t}{1-\rho} - \frac{p_t}{\rho}\right)(p_t - c_t)$$

(2)

Based on the concavity of target function and the first order conditions of p_e and p_t, it is easy to define the respective response function for insurance companies and pension companies. In accordance with $\frac{d\Pi_e^N}{dq_e^*} = 0$and,$\frac{d\Pi_t^N}{dq_t^*} = 0$ we can find the solution:

$$-2p_e^* + p_t^* + c_e + 1 - \rho = 0$$

(3)

$$\rho p_e^* - 2p_t^* + c_t = 0$$

(4)

Turning the above equations into equation group, we can find the respective optimal pricing for insurance companies and pension companies:

$$p_e^* = \frac{1}{4-\rho}[2(1-\rho) + 2c_e + c_t] \quad (5)$$

$$p_t^* = \frac{1}{4-\rho}[\rho(1-\rho) + \rho c_e + 2c_t] \quad (6)$$

Subsequently, on the basis of the optimal pricing for insurance companies and pension companies, we can acquire their respective optimal profit and the amount of low-income elderly and the total of all elderly that have access to services in equilibrium state. The results of solution are listed in the following Table 2.

Tab.2. The Optimal Values of Some Parameters in Model N

Parameter	Optimal Value
p_e	$\frac{1}{4-\rho}[2(1-\rho) + 2c_e + c_t]$
p_t	$\frac{1}{4-\rho}[\rho(1-\rho) + \rho c_e + 2c_t]$
q^l	$\frac{\Phi\delta}{\rho(4-\rho)}(-\rho c_e - 2c_e + 3\rho)$
q	$\frac{\Phi}{\rho(4-\rho)}(-\rho c_e - 2c_t + 3\rho)$
Π_e	$\frac{\Phi}{(1-\rho)(4-\rho)^2}[-2(2-\rho)c_e + c_t + 2(1-\rho)]^2$
Π_t	$\frac{\Phi}{(1-\rho)(4-\rho)^2}[\rho c_e + (2-\rho)c_t + (1-\rho)\rho]^2$

3.2 Model S—Government Leading

In Model S, we assume that the government engages in supervision. Different from Model N, in this model the government acts as the leader in Steinberg Game and determines the supervision cost (w) which will be included in the cost of insurance companies and pension companies.

First of all, we set up the best response function of insurance companies and pension companies. With the specified W, the profit maximization function for insurance companies and pension companies is respectively:

$$\max_{p_e} \prod_e^S = q_e (p_e - w - c_e) = \Phi\left(1 - \frac{p_e - p_t}{1-\rho}\right)(p_e - w - c_e)$$

(7)

$$\max_{p_t} \prod_t^S = q_t (p_t - w - c_t) = \Phi\left(\frac{p_e - p_t}{1-\rho} - \frac{p_t - kw^b}{\rho}\right)(p_t - w - c_t)$$

(8)

Based on the concavity of target function and the first order conditions of p_e and p_e, it is easy to define the respective response function for insurance companies and pension companies. In accordance with $\frac{d\Pi_e^S}{dq_e^*} = 0$ and $\frac{d\Pi_t^S}{dq_t^*} = 0$, we can acquire respectively:

$$-2p_e^* + p_t^* + w + c_e + 1 - \rho = 0$$

(9)

$$\rho p_e^* - 2p_t^* + w + (1-\rho)kw^b = 0$$

(10)

Turning the above equations into equation group, we can find the respective optimal pricing for insurance companies and pension companies:

$$p_e^* = \frac{1}{4-\rho}[3w + 2c_e + c_t + (1-\rho)(2 + kw^b)] \quad (11)$$

$$p_t^* = \frac{1}{4-\rho}[(2+\rho)w + \rho c_e + 2c_t + (1-\rho)(2 + kw^b)]$$

(12)

Since the government's goal is to maximize the amount of the elderly who purchase services, according to the given response function of insurance companies and pension companies, we can obtain the target optimization function of the government:

$$\max_w q = \Phi\left(1 - \frac{p_t^* - kw^b}{\rho}\right) = \frac{\Phi}{\rho(4-\rho)}[3\rho - (2+\rho)w - \rho c_e - 2c_t + (2+\rho)kw^b]$$

(13)

Because $\frac{d_q^2}{dw^2} = \frac{(b-1)b\Phi(2+b)kw^{b-2}}{\rho(4-\rho)} < 0$,the target optimization function of the government is a concave function about W. Solving$\frac{dq}{dw} = 0$, we can obtain the optimal supervision cost of the government:

$$w^* = (bk)^{\frac{1}{1-b}}$$

(14)

Subsequently, on the basis of the optimal supervision cost of the government, we can acquire the optimal pricing for insurance companies and pension companies, the respective optimal profit of both kinds of companies, and the amount of low-income elderly and the total of all elderly that have access to services in equilibrium state. The results of solution are listed in the following Table 3.

Tab.3. The Optimal Values of Some Parameters in Model S

Parameter	Optimal Value
p_e	$\frac{1}{4-\rho}\left[3(bk)^{\frac{1}{1-b}} + 2c_e + c_t + (1-\rho)\left(2 + b^{\frac{b}{1-b}} \cdot k^{\frac{1}{1-b}}\right)\right]$
p_t	$\frac{1}{4-\rho}\left[(2+\rho)(bk)^{\frac{1}{1-b}} + \rho c_e + 2c_t + (1-\rho)\left(\rho + 2b^{\frac{b}{1-b}} \cdot k^{\frac{1}{1-b}}\right)\right]$
q^l	$\frac{\Phi\delta}{\rho(4-\rho)}\left[3\rho - (2+\rho)(bk)^{\frac{1}{1-b}} - \rho c_e - 2c_t + (2+\rho) \cdot b^{\frac{b}{1-b}} \cdot k^{\frac{1}{1-b}}\right]$
q	$\frac{\Phi}{\rho(4-\rho)}\left[3\rho - (2+\rho)(bk)^{\frac{1}{1-b}} - \rho c_e - 2c_t + (2+\rho) \cdot b^{\frac{b}{1-b}} \cdot k^{\frac{1}{1-b}}\right]$
Π_e	$\frac{1}{(1-\rho)(4-\rho)^2}\left[(1-\rho)(bk)^{\frac{1}{1-b}} + (2-\rho)c_e - c_t + (1-\rho) \cdot \left(2 - \rho - b^{\frac{b}{1-b}} \cdot k^{\frac{1}{1-b}}\right)\right]^2$
Π_t	$\frac{1}{\rho(1-\rho)(4-\rho)}\left[-2(1-\rho)(bk)^{\frac{1}{1-b}} + \rho c_e - (2-\rho)c_t + (1-\rho) \cdot \left(\rho + 2b^{\frac{b}{1-b}} \cdot k^{\frac{1}{1-b}}\right)\right]^2$

4. Analyses of the Influence of Subsidies

This chapter discusses the influence of the government's supervision from the perspectives of the elderly, the scale of pension demand, insurance companies, and pension companies, and forms a series of conclusions. For ease of comparison, superscripts are added to some parameters in the models to discriminate from each other. For instance,$p_e^N$and p_e^S represent respectively the service price of insurance companies in Model *N* and Model *S*.

4.1 From the Perspective of the Elderly

According to the hypotheses and the results of solution in the previous chapters, the following conclusions are drawn:

In Model *N*, if the purchasing will of all elderly (including normal-income and low-income elderly people) is within $\left[\frac{p_e^N-p_t^N}{1-\rho},1\right]$, they will purchase services from insurance companies; if that purchasing will range in $\left[\frac{p_t^N}{\rho},\frac{p_e^N-p_t^N}{1-\rho}\right]$, they will purchase services from pension companies.

In Model S, if the purchasing will of all elderly is within $\left[\frac{p_e^S-p_t^S}{1-\rho},1\right]$, they will purchase services from insurance companies; while if that purchasing will range in $\left[\frac{p_t^S-kw^{*b}}{\rho},\frac{p_e^S-p_t^S}{1-\rho}\right]$, they will purchase services from pension companies.

Figure 2 shows in different models the choices that the elderly make when they purchase services from insurance companies and pension companies, as well as the influence of the government leading.

Based on what stated above, we make a comparison between Model N and Model S. Considering that $\frac{p_e^N-p_t^N}{1-\rho}-\frac{p_e^S-p_t^S}{1-\rho}=\frac{(1-b)(bk)^{\frac{1}{1-b}}}{b(4-\rho)}>0$, $\frac{p_t^N}{\rho}-\frac{p_t^S-kw^{*b}}{\rho}=\frac{(1-b)(2+\rho)(bk)^{\frac{1}{1-b}}}{b\rho(4-\rho)}>0$, and the values of $\frac{p_t^N}{\rho}$and $\frac{p_e^N-p_t^N}{1-\rho}$are not definite,we can draw some conclusions as follow:

(1) For the elderly, whose purchasing will range in $\left[\frac{p_e^N-p_t^N}{1-\rho},1\right]$, their choice won't be affected by the subsidies of the government for low-income elderly. In this case, both normal-income and low-income elderly would still purchase services from insurance companies. Due to the government's supervision, these low-income elderlies could obtain additional utility $(\theta^l-p_e^S+kw^{*b})-(\theta^l-p_e^N)$, and normal-income elderly could obtain additional utility

$(\theta^m - p_e^S + kw^{*b}) - (\theta^m - p_e^N)$. Or rather, the two groups obtain the same additional utility that is equal to $\frac{3(1-b)(bk)^{\frac{1}{1-b}}}{b(4-\rho)}$.

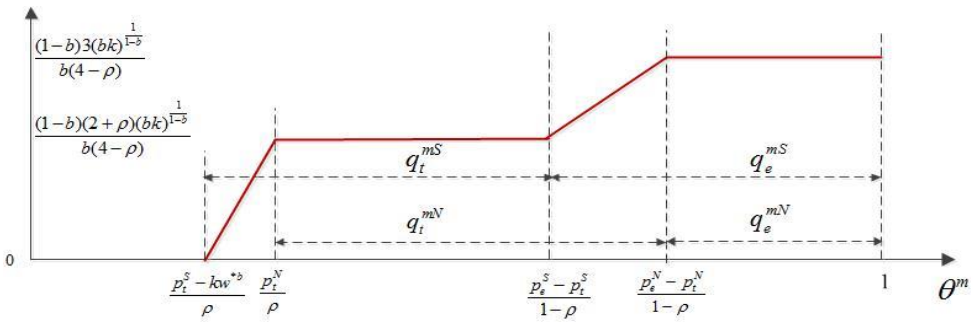
(2) If $\frac{p_t^N}{\rho} < \frac{p_e^S - p_t^S}{1-\rho}$, the choices of the elderly whose purchasing will ranges in $\left[\frac{p_e^S - p_t^S}{1-\rho}, \frac{p_e^N - p_t^N}{1-\rho}\right]$ will be affected by the consumption subsidy of the government. The elderly won't purchase services from pension companies but from insurance companies. Thanks to the government supervision, low-income elderly will obtain the additional utility $(\theta^m - p_e^S + kw^{*b}) - (\rho\theta^m - p_t^N)$, while normal-income elderly will obtain the additional utility $(\theta^l - p_e^S + kw^{*b}) - (\rho\theta^l - p_t^N)$. And if $\frac{p_t^N}{\rho} \geq \frac{p_e^S - p_t^S}{1-\rho}$, the choices of the elderly whose purchasing will ranges in $\left[\frac{p_t^N}{\rho}, \frac{p_e^N - p_t^N}{1-\rho}\right]$ will also be affected by the government supervision. Those elderlies who formerly purchased services from pension companies will instead turn to insurance companies. Thanks to the government supervision, low-income elderly will obtain the additional utility $(\theta^m - p_e^S + kw^{*b}) - (\rho\theta^m - p_t^N)$, while normal-income elderly will obtain the additional utility$(\theta^l - p_e^S + kw^{*b}) - (\rho\theta^l - p_t^N)$.

(3) If $\frac{p_t^N}{\rho} > \frac{p_e^S - p_t^S}{1-\rho}$, the choices of the elderly whose purchasing will ranges in $\left[\frac{p_t^N}{\rho}, \frac{p_e^S - p_t^S}{1-\rho}\right]$ are not affected by the government supervision. The elderly still purchase services from pension companies. Thanks to the government's supervision, low-income elderly could obtain additional utility $(\rho\theta^m - p_t^S + kw^{*b}) - (\rho\theta^m - p_t^N)$, and normal-income elderly could obtain additional utility $(\rho\theta^l - p_t^S + kw^{*b}) - (\rho\theta^l - p_t^N)$. Besides, all the elderly obtains the same additional utility that is equal to $\frac{(1-b)(2+b)(bk)^{\frac{1}{1-b}}}{b(4-\rho)}$.

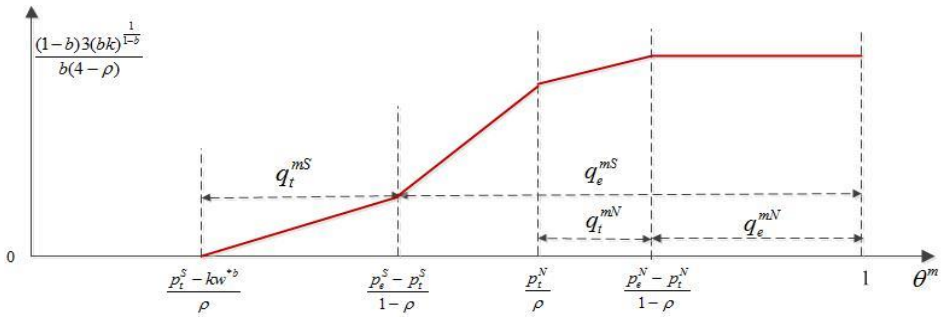
(4) If $\frac{p_t^N}{\rho} < \frac{p_e^S - p_t^S}{1-\rho}$, the choices of all the elderly whose purchasing will ranges in $\left[\frac{p_t^S - kw^{*b}}{\rho}, \frac{p_t^N}{\rho}\right]$ are obviously affected by the government supervision. Without the supervision of the government, these elderlies don't purchase any insurance service; yet when the government

engages in supervision, they would make purchase of services from pension companies. Benefiting from the government supervision, normal-income elderly could obtain additional utility $\rho\theta^m + kw^{*b} - p_t^S$, and low-income elderly could obtain additional utility $\rho\theta^l + kw^{*b} - p_t^S$. And if $\frac{p_t^N}{\rho} \geq \frac{p_e^S - p_t^S}{1-\rho}$, the choices of all the elderly whose purchasing will ranges in $\left[\frac{p_t^S - kw^{*b}}{\rho}, \frac{p_t^N}{\rho}\right]$are also affected by the government supervision. Without the supervision of the government, these elderly don't purchase any insurance service; yet when the government engages in supervision, all the elderly whose purchasing will ranges in $\left[\frac{p_e^S - p_t^S}{1-\rho}, \frac{p_t^N}{\rho}\right]$would make purchase of services from insurance companies, while those elderly whose purchasing will ranges in $\left[\frac{p_t^S - kw^{*b}}{\rho}, \frac{p_e^S - p_t^S}{1-\rho}\right]$ would purchase services from pension companies. On purchasing services from insurance companies, the additional utility obtained by normal-income elderly is $\theta^m + kw^{*b} - p_e^S$, and the additional utility obtained by low-income elderly is $\theta^l + kw^{*b} - p_e^S$; on purchasing services from pension companies, the additional utility obtained by normal-income elderly is $\rho\theta^m + kw^{*b} - p_t^S$, and the additional utility obtained by low-income elderly is $\rho\theta^l + kw^{*b} - p_t^S$.

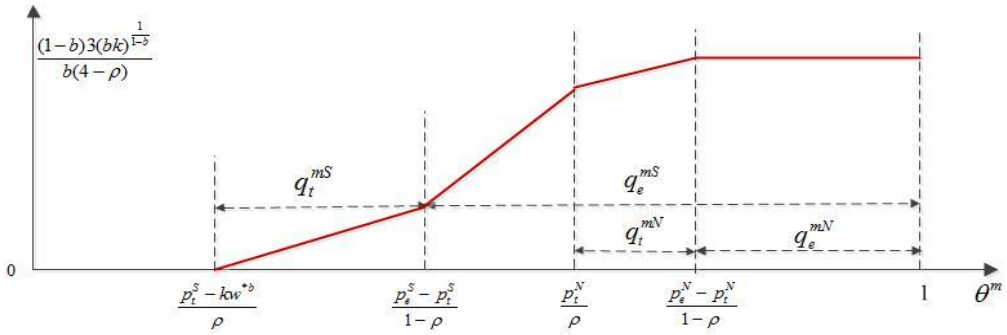
The above-mentioned changes can be apparently seen in the following Figure 2.



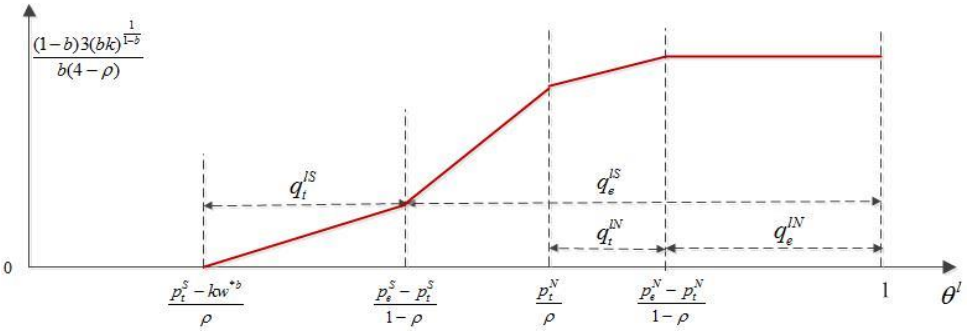
(a) Normal-Income Elderly ($\frac{p_t^N}{\rho} > \frac{p_e^S - p_t^S}{1-\rho}$)



(b) Low-Income Elderly ($\frac{p_t^N}{\rho} < \frac{p_e^S - p_t^S}{1-\rho}$)



(c) Normal-Income Elderly ($\frac{p_t^N}{\rho} \geq \frac{p_e^S - p_t^S}{1-\rho}$)



(d) Low-Income Elderly ($\frac{p_t^N}{\rho} < \frac{p_e^S - p_t^S}{1-\rho}$)

Fig .2. The Purchase Choices of the Elderly and Additional Utility Brought by Income Subsidies

4.2 Analysis on the Scale of Pension Service Industry

The scale of pension service industry refers to the amount of the elderly who are willing to purchase insurance services from related companies. The greater the number of the elderly purchasing insurance service is, the larger the scale of pension service industry will be. In this paper, the quantity of the elderly who purchase insurance services from insurance companies and pension companies is used as the scale of pension service industry.

Basing on the former hypotheses and analyses, we will conduct a comparison between the scale of pension service industry in Model N and that in Model S.

The low-income elderly whose purchasing will belongs to $\left[\frac{p_t^N}{\rho}, 1\right]$ in Model N and the low-income elderly whose purchasing will belongs to $\left[\frac{p_t^S - kw^{*b}}{\rho}, 1\right]$ in Model S will make purchase of services from insurance companies and pension companies. Calculating with the results of Table 2 and Table 3, we can know $\frac{p_t^N}{\rho} - -\frac{p_t^S - kw^{*b}}{\rho} = \frac{(1-b)(2+b)(bk)^{\frac{1}{1-b}}}{b(4-\rho)\rho}$, which means $q^{IS} > q^{IN}$, i.e. the government supervision will increase the number of low-income elderly who purchase insurance services. Here q^{mS} and q^{mN} refers to respectively the number of low-income elderly purchasing pension services in Model S and Model N, and $q^{lS} = q_e^{lS} + q_t^{lS}$, $q^{lN} = q_e^{lN} + q_t^{lN}$. It is obvious that the government supervision led the change in Figure 2 (b) and (d).

Then we take into consideration the number of normal-income elderly who purchase services.

The normal-income elderly whose purchasing will belongs to $\left[\frac{p_t^N}{\rho}, 1\right]$in Model N and the normal-income elderly whose purchasing will belongs to $\left[\frac{p_t^S - kw^{*b}}{\rho}, 1\right]$ in Model S will make purchase of services from insurance companies and pension companies. Obviously, the result is the same with that for low-income elderly. The government supervision will increase the number of normal-income elderly who purchase insurance services, so $q^{mS} > q^{mN}$. Here $q^{mS}$and q^{mN} refers to respectively the number of normal-income elderly purchasing pension services in Model S and Model N, and $q^{mS} = q_e^{mS} + q_t^{mS}, q^{mN} = q_e^{mN} + q_t^{mN}$. Similarly, it is obvious that the government supervision led the change in Figure 2 (a) and (c) .

The quantity of the elderly purchasing pension services is respectively $q^N$and q^Sin Model N and Model S, with $q^N = q^{IN} + q^{mN}, q^C = q^{IS} + q^{mS}$. Because $q^{IS} > q^{IN}, q^{mS} > q^{mN}$, so $q^S > q^N$, and therefore, the supervision of the government leads the scale of pension service industry to become larger.

4.3 From the Perspective of Companies

This section mainly analyzes the influences that the government supervision exerts on insurance companies and pension companies. To simplify the analysis, we have built basic models in which we only consider the decisions that the government, insurance companies, and pension companies make. The government invests supervision cost to increase the number of the elderly who purchase services, while insurance companies and pension companies earn profits by selling services to normal-income and low-income elderly.

On the basis of the former sections, we make a comparison between Model N and Model S and analyze the influences that the government supervision causes on insurance companies and pension companies:

(1) The profit function of insurance companies, $\Pi_e = q_e(p_e - w - c_e)$, shows that the profits of insurance companies relate to not only the sales of their services, but also the service price and the supervision cost of the government. According to the former analyses, no matter whether the government supervises the companies or not, the elderly whose purchasing will ranges in $\left[\frac{p_e^N - p_t^N}{1-\rho}, 1\right]$ will choose to purchase services only from insurance companies. Due to the government supervision, when $\frac{p_t^N}{\rho} < \frac{p_e^S - p_t^S}{1-\rho}$, the elderly whose purchasing will ranges in $\left[\frac{p_e^S - p_t^S}{1-\rho}, \frac{p_e^N - p_t^N}{1-\rho}\right]$ would not purchase services from pension companies but from insurance companies; when $\frac{p_t^N}{\rho} > \frac{p_e^S - p_t^S}{1-\rho}$, the elderly whose purchasing will ranges in $\left[\frac{p_t^N}{\rho}, \frac{p_e^N - p_t^N}{1-\rho}\right]$ would turn from pension companies and purchase the services of insurance companies. Therefore, the supervision of the government will motivate more elderly to make purchase of services from insurance companies. Furthermore, since $(p_e^S - w^* - c_e) - (p_e^N - c_e) = \frac{(1-b)(1-\rho)(bk)^{\frac{1}{1-b}}}{b(4-\rho)} > 0$, the profits which insurance companies earn from pension services get larger, even though the government supervision adds the cost of insurance companies. Based on the above analyses, we can draw a conclusion that insurance companies are the beneficiaries of the government's policy of consumption subsidy.

(2) The profit function of pension companies, $\Pi_t = q_t(p_t - w - c_t)$, shows that the profits of pension companies relate to not only the services they provided, but also the service price and the supervision cost of the government. According to the former analyses, due to the government

supervision, when $\frac{p_t^N}{\rho} < \frac{p_g^S - p_t^S}{1-\rho}$, the elderly whose purchasing will ranges in $\left[\frac{p_g^S - p_t^S}{1-\rho}, \frac{p_g^N - p_t^N}{1-\rho}\right]$would not purchase services from pension companies but from insurance companies, while the elderly whose purchasing will ranges in $\left[\frac{p_g^S - p_t^S}{1-\rho}, \frac{p_t^N}{\rho}\right]$would instead purchase services from pension companies, though they don't make any purchase of pension services in the first place. Then, the government supervision makes the increase or decrease of the service amount of pension companies depend on the relation between $\frac{p_g^N - p_t^N}{1-\rho} - \frac{p_g^S - p_t^S}{1-\rho}and\frac{p_t^N}{\rho} - \frac{p_t^S - kw^{*b}}{\rho}$. If$\frac{p_t^N}{\rho} > \frac{p_g^S - p_t^S}{1-\rho}$, the elderly whose purchasing will ranges in$\left[\frac{p_t^N}{\rho}, \frac{p_g^N - p_t^N}{1-\rho}\right]$would not purchase services from pension companies but from insurance companies, while the elderly whose purchasing will ranges in $\left[\frac{p_t^S - kw^*}{\rho}, \frac{p_g^S - p_t^S}{1-\rho}\right]$would instead purchase services from pension companies, though they don't make any purchase of services in the first place. Figure 2 shows clearly such changes. Then, we can know that the government's consumption subsidy policy makes the increase or decrease of the service amount of pension companies depend on the relation between $\frac{p_g^N - p_t^N}{1-\rho} - \frac{p_t^N}{\rho}and\frac{p_g^S - p_t^S}{1-\rho} - \frac{(1-\lambda)p_t^S - kw^{*b}}{\rho}$. Therefore, it is a problem whether pension companies can benefit from the government's consumption subsidy policy.

In this section, the influences that the government supervision has on the purchasing will of the elderly, the scale of pension service industry, insurance companies, and pension companies are respectively researched. After a series of analyses, we have obtained some conclusions that could provide theoretical supports for the management and decision-making of insurance companies and pension companies.

5. Conclusion

In order to promote the development of the model of home-based care for the aged, different countries have taken a series of different measures to improve and perfect the existing models. This paper mainly studies the influences of the government supervision on the companies.

The paper studies deep into the pension model that is based on insurance services. In the model that we construct the supervision of the government is introduced, that is, both insurance companies and pension companies provide services for the elderly under the government leading. On this basis, we propose a series of hypotheses to make a comprehensive interpretation of the

models. And after drawing a series of equilibrium solutions under the two models, the influences brought by the government supervision are analyzed respectively from the perspective of the elderly, the scale of pension service industry, insurance companies, and pension companies.

The following important conclusions are drawn from this paper:

(1) The supervision of the government will effectively increase the purchasing demands of both low-income and normal-income elderly;

(2) The supervision of the government is beneficial to the expansion of the pension service industry and fulfil the purposes of government regulation.

(3) Insurance companies benefit from the government supervision in terms of profits, yet whether they are the beneficiaries of the government supervision remains to be further discussed.

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