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Research on the Application Value of Blockchain to For-Profit Pension Institutions: Focus on Blockchain's Impacts on Service Mode Upgrading Process

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ABSTRACT
Compared to public pension institutions, for-profit pension institutions are less accepted by consumers in China, which causes a lot of deficits to these private institutions. For dealing with this problem, we made this research. In this paper, we firstly found out why public institutions are much more popular, how for-profit pension institutions tackled the issue and revealed the defects of existing service mode updating schemes they applied. Then we analysed the features of blockchain and proposed schemes based on blockchain, in this part we explained why blockchain is worthy to for-profit pension institutions. At last we construct a two-market model, with the help of it we demonstrated the importance of the blockchain, it showed that blockchain's features can make great impacts on service modes upgrading process of for-profit pension institutions.
Keywords: *For-profit pension institutions, blockchain, credibility*

1. INTRODUCTION

Nowadays the general poor management of for-profit pension institutions has become a structural problem in China. According to data from the press conference held by the Joint Prevention and Control Mechanism of the State Council in March 2020, the occupancy rate of beds in pension institutions in China is only 50% and the remaining beds are most in for-profit pension institutions. While aging is becoming serious, this problem needs to be solved properly.

Many scholars have explored the reasons of this structural problem. Zuo [1] pointed out that this is a manifestation of the obvious mismatch between effective demand and the service supply market. Due to the defects of marketization of welfare facilities, it's not fair for for-profit pension institutions to compete with public pension institutions. The government is responsible for the cost of public pension institutions, therefore these institutions are not profit-oriented and their service prices can be lower, result in difficulties for for-profit institutions to attract consumers' eyes as their service content and quality are comparable to those of public institutions. Wang [2] pointed out that most old people are influenced by traditional concepts and have more trust in public pension institutions, so they are more willing to choose the services supplied by this kind of pension institutions. Qiao [3] displayed the prices of elderly care services in three types of pension institutions in Beijing, including public institutions, non-enterprise institutions, and enterprise institutions, and calculated the income of the elderly in this region. He pointed out that the prices of elderly care services promoted by non-enterprise and enterprises institutions exceeded most people's affordability and that's why demand is difficult to transform into effective demand. In summary, the reasons can ultimately be attributed to two aspects: price and credibility. Due to generally higher cost, the service price of for-profit pension institutions is generally higher than that of public pension institutions. For credibility, public institutions are more easily accepted by the public. Considering these two reasons, the competitiveness of public pension institutions is obviously higher than that of most for-profit pension institutions.

But there are few effective ideas promoted in papers to solve this problem. Wang [4] emphasized that to weaken the policies for supporting public pension institutions is a choice, however this measure might causing public pension institutions into deficits. Wu [5] considered that increasing the support for the innovation of financial products of pension industries is a good idea yet this measure can only help the institutions to improve the quality of services but not profits. Considering the existing views are not good enough, we think it's necessary to propose a novel idea from the perspective of for-profit institutions to solve the problem and avoid the weakness of these measures.

2. EXISTING SERVICE MODES UPGRADING SCHEMES AND THEIR DEFECTS

At the beginning of the research, we need to make an investigation about how the for-profit institutions update their service in order to save themselves. By analysing the services information of for-profit pension institutions in

Anhui, Zhejiang and Jiangsu, collected from www.yanglaocn.com, we summarize the existing service mode upgrading schemes of these institutions, which can be divided into three related categories presented in Figure 1.

Figure 1 Three existing service mode upgrading schemes

(1) Service specialization (S_1). Service specialization is the most common upgrading scheme and almost all for-profit pension institutions have made adjustment of their services based on this idea. This idea focuses on improving the quality of services. The content of improving service quality mainly includes improving the quality of equipment, the quality of personnel, and the environmental quality of infrastructure. Improving the quality of equipment mainly includes applying various intelligent detection equipment, better beds and other hardware facilities. Improving the quality of personnel mainly means improving the quality of nursing staff. Improving the environmental quality of infrastructure includes improving the environment of institutional buildings and optimizing spatial layout.

(2) Business diversification (S_2). Business diversification refers to the transformation from the previous single service mode to a diversified service mode, and this scheme was always considered after medium-sized and above scale pension institutions have realized their service specialization scheme. The single service mode refers to the typical traditional service mode that pension institutions limit their services within the institution buildings and only provide maintenance services to customers who reserve beds. The diversified service mode refers to the expansion of the types and methods of services on the basis of traditional services. For example, besides providing in-door maintenance services, institution in this mode also provides door-to-door maintenance services; In addition to maintenance services, services such as traveling, entertainments, and investment consulting are also covered in this service mode. Business diversification scheme provides more profit approaches for pension institutions and meets the multi-dimensional needs of customers.

(3) Cooperative operation (S_3). Cooperative operation is an attempt by for-profit pension institutions to utilize information technology to carry out service mode innovation, and is generally a service mode upgrading measure considered by large pension institutions. Considering that the government is now promoting "integration of medical care and elderly care" and "home-community-institution coordinated elderly care", how to accurately grasp needs and provide precise services in combination with social environment has become a key issue for many for-profit pension institutions. One of the ideas to solve this problem is to change the independent operation mode of the pension institutions themselves. The cooperation between pension institutions and medical institutions makes pension institutions providing professional medical services more easily. The cooperation between pension institutions and the community makes pension institutions grasping the needs for services of the elderly more accurately and easily to promote their brand as well as enhance their reputation.

In summary, due to cost constraints, for-profit pension institutions almost try to improve service experience instead of lowering service prices, and they look forward that relevant efforts can help lift the credibility of the institution and attract customers. However this approach has two shortcomings: Firstly, this approach cannot help pension institutions gaining the trust of customers in the short term as people who are originally unwilling to purchase services cannot obtain enough information about the improvement of the service quality through corresponding channels, and relying on insufficient customers to drive related groups to consume is inefficient; secondly, this approach fails to provide appropriate technical methods to convince potential customers that the improvement of its service quality is not exaggerated. To overcome these two shortcomings, we think taking the advantage of blockchain is an excellent choice.

3. CHARACTERISTICS OF BLOCKCHAIN AND SERVICE MODE UPGRADING SCHEMES BASED ON BLOCKCHAIN

Blockchain has the following characteristics that are worthy for for-profit pension institutions improving reputation:

(1) Data in blockchains cannot be manipulated. Excluding a few newly proposed conceptual blockchains [6], generally people cannot modify the data in blockchains, which is very important for customers who want to obtain real data. The reason why customers have more trust in public pension institutions is basically because they believe that public pension institutions are not profit-making. Therefore, they believe that government-established institutions have no reason to deceive customers and cut corners in their services, and the service personnel here are also professional. Even if public pension institutions do not provide service data, they will not question it. Regarding the purpose of for-profit pension institutions, they would have doubts from the beginning, which derives their preference in choice. However, if the service data is opened to customers in a proper way, such doubts can be eliminated. The good news is that blockchain can play a great role in this circumstance. Institutions can put the information that users care about on the blockchain in a traceable and verifiable way, which can not only gain customers' trust, but also provide more comprehensive and structured information than public pension institutions. It has great value in enhancing the credibility of for-profit pension institutions.

(2) Smart contracts change the transaction process. Smart contracts refer to "computer transaction protocols without intermediaries, being able to self-verify and automatic executing contract terms" [7]. By setting up smart contracts, transactions can be executed in a much more efficient way and easier to be accepted by both parties involved. The purchase processes of traditional pension institutions are commonly same. Costumers buy the service first, pay the fee, and then enjoy the service. However, this purchasing method is essentially guaranteed by the credibility of the institution. Due to the natural weakness of for-profit pension institutions compared to public pension institutions on credibility, some potential customers are not at ease to accept this purchasing method. However, a reasonable set of smart contracts for elderly care service transactions can solve this problem. Smart contracts can be set to be executed after customers enjoy services, and even linked to service satisfaction, quality data, etc. Absolutely, smart contracts can dispel worries, and they can also urge for-profit pension institutions to have a rigorous attitude towards service quality.

(3) Blockchain has value characteristics. Value characteristics are the fundamental reason why blockchain is called a value network [8]. Virtualizing services or physical objects to give virtual existence value is an important manifestation of the value characteristics of blockchain [9]. In traditional online sales, it is impossible to bundle service goods with real services, because in fact online services have no value, but based on the existence of a third-party transaction system to complete the transaction process. However, virtual goods on blockchains are unique, so virtual service goods on blockchains can be regarded as offline services with the same value. Therefore, for-profit pension institutions can deploy services goods on blockchains, which can ensure that customers have a real understanding on the service of these pension institutions in a trusted environment, so as to enhance the customers' confidence in the service of for-profit pension institutions.

Blockchain can provide the same value for different for-profit pension institutions, but due to the difference on scales and services, the application of blockchain in each institution would be different. Since the existing service mode upgrading schemes of various institutions have been targeted to solving the structural market problem, blockchain can be used by modifying existing schemes to overcome the shortcomings and avoid redesign novel schemes.

The specific features of the improved schemes are as follows:

(1) Service specialization scheme based on blockchain (S_4). Small-scale for-profit pension institutions can build their service transaction platform based on the public chain to reduce costs. The public chain is relatively ecologically complete, that can effectively reduce the difficulty of developing work and make the management information system more convenient to use. Institutions can easily migrate some of the original business modules to the new platform.

(2) Business diversification scheme based on blockchain (S_5). In this scheme, we can construct a multi-chain structure to meet the demand of varies applications, storing various service-related data in private chains and putting smart contracts on the public chain. This design is to ensure both security and efficiency.

(3) Cooperative operation scheme based on blockchain (S_6). It is appropriate to establish a consortium chain to meet the demands from large institutions because we can realise customization in this way and large institutions can afford the cost. Building projects based on a consortium chain is also a good idea to eliminate trust issues between partners.

Absolutely advertising is also necessary to all institutions. Yet it's not the key point so we won't talk about it in detail and just assume it's satisfying.

4. A TWO-MARKET MODEL AND DEMONSTRATIONS ABOUT THE APPLICATION VALUE OF BLOCKCHAIN

4.1. A Two-market Model

In order to reveal the application value of blockchain to the for-profit pension institutions, we now establish a model according to the real market environment.

Assuming two multi-oligopoly competition markets, regardless of the fixed cost of the blockchain and the cost of the service, there are 1 public pension institution (I_1) and 3 for-profit pension institutions (I_2, I_3, I_4) participating the competition. In market 1, I_2, I_3, I_4 adopts scheme S_1, S_2, S_3. In market 2, I_2, I_3, I_4 adopts scheme S_4, S_5, S_6. In addition, we assume that consumers were classified into 3 groups (g_1, g_2, g_3) by income from low to high and the proportions of them are p_1, p_2, p_3. In market 1, due to the influence of high credibility, some consumers prefer the services provided by the public pension institution and we mark the preference coefficients of each group as $\lambda_1, \lambda_2, \lambda_3$. Considering the low-income group is more concerned about the service price, while the high-income group is more concerned about the service quality, the high-income group has lower preference for public pension institutions than the low-income group, so it exits $0 < \lambda_3 < \lambda_2 < \lambda_1 < 1$. In market 2, the application of blockchain eliminates the influence of the credibility, so customers have no preference to the public pension institution and we can mark the preference coefficient 0. And we assume all institutions provide only 1 kind of service. The same institution's service has the same price in different markets, respectively marked as P_1, P_2, P_3, P_4. According to the different on cost, it exists $P_1 < P_2 < P_3 < P_4$. The demands in 2 markets were marked as $D_1, D_2, D_3, D_4, D_1^B, D_2^B, D_3^B, D_4^B$. Even for the same service, pension institutions with better supporting facilities can provide better experience. Therefore, the utility loss coefficient can be proposed to represent this phenomenon. In market 1, the utility loss coefficient of the service

provided by I_2, I_3, I_4 can be marked as $\alpha_2, \alpha_3, \alpha_4$. In market 2, they are $\alpha_2^B, \alpha_3^B, \alpha_4^B$. For the only public pension institution, the utility loss coefficient of its service is α_1. Absolutely in this model the service experience is related to the price and the service quality of the institutions, so it exists $0 < \alpha_1 < \alpha_2 < \alpha_2^B < \alpha_3 < \alpha_3^B < \alpha_4 < \alpha_4^B < 1$. Obviously, we also need to use the corresponding formula to express the nature that blockchain has the same value for different institutions, considering the utility loss coefficients, it exists $\alpha_3 - \alpha_2 = \alpha_3^B - \alpha_2^B, \alpha_4 - \alpha_3 = \alpha_4^B - \alpha_3^B$.

Referring to the model promoted by Guo [10], we also mark total utility of users as V (0 < V < 1) and the service price is P (0 < P < 1), the utility obtained by users is U = V-P. Obviously, when V = P, the utility obtained by the user is 0, which is defined as the utility indifference point. Taking this point as the boundary, rational users choose to consume the service whose utility is greater than 0, so the service demand can be expressed as D = 1- P.

In market 1:

In this market, competitors haven't taken blockchain into consideration. We can express the utility costumers gained after purchasing the service from different institutions as $U_i = \alpha_i v - P_i (i = 1,2,3,4)$. Assume $U_i = U_{i-1} (i = 2,3,4)$,we can find the utility indifference points $v_i = \frac{P_i - P_{i-1}}{\alpha_i - \alpha_{i-1}} (i = 2,3,4)$. Since a rational consumer always prefers better service if they can afford the price, it exists $v_2 < v_3 < v_4$, therefore $\frac{P_2 - P_1}{\alpha_2 - \alpha_1} < \frac{P_3 - P_2}{\alpha_3 - \alpha_2} < \frac{P_4 - P_3}{\alpha_4 - \alpha_3}$.

We can express the demands of the institutions as following:

$$D_1 = p_1\lambda_1(1 - P_1) + p_1(1 - \lambda_1)(\frac{P_2 - P_1}{\alpha_2 - \alpha_1}) + p_2\lambda_2(1 - P_1) + p_2(1 - \lambda_2)(\frac{P_2 - P_1}{\alpha_2 - \alpha_1}) + p_3\lambda_3(1 - P_1) + p_3(1 - \lambda_3)\left(\frac{P_2 - P_1}{\alpha_2 - \alpha_1}\right) \quad (1)$$

$$D_2 = p_1(1 - \lambda_1)\left(\frac{P_3 - P_2}{\alpha_3 - \alpha_2} - \frac{P_2 - P_1}{\alpha_2 - \alpha_1}\right) + p_2(1 - \lambda_2)\left(\frac{P_3 - P_2}{\alpha_3 - \alpha_2} - \frac{P_2 - P_1}{\alpha_2 - \alpha_1}\right) + p_3(1 - \lambda_3)\left(\frac{P_3 - P_2}{\alpha_3 - \alpha_2} - \frac{P_2 - P_1}{\alpha_2 - \alpha_1}\right) \quad (2)$$

$$D_3 = p_1(1 - \lambda_1)\left(\frac{P_4 - P_3}{\alpha_4 - \alpha_3} - \frac{P_3 - P_2}{\alpha_3 - \alpha_2}\right) + p_2(1 - \lambda_2)\left(\frac{P_4 - P_3}{\alpha_4 - \alpha_3} - \frac{P_3 - P_2}{\alpha_3 - \alpha_2}\right) + p_3(1 - \lambda_3)\left(\frac{P_4 - P_3}{\alpha_4 - \alpha_3} - \frac{P_3 - P_2}{\alpha_3 - \alpha_2}\right) \quad (3)$$

$$D_4 = p_1(1 - \lambda_1)\left(1 - \frac{P_4 - P_3}{\alpha_4 - \alpha_3}\right) + p_2(1 - \lambda_2)\left(1 - \frac{P_4 - P_3}{\alpha_4 - \alpha_3}\right) + p_3(1 - \lambda_3)\left(1 - \frac{P_4 - P_3}{\alpha_4 - \alpha_3}\right) \quad (4)$$

In market 2:

In this market, the schemes adopted by institutions are based on blockchain. We can express the utility costumers gained after purchasing the service from different institutions as $U_i = \alpha_i^B v - P_i (i = 2,3,4)$. When $i = 1, U_1 = \alpha_1 v - P_1$. We can also find the utility indifference points as above $v_i = \frac{P_i - P_{i-1}}{\alpha_i^B - \alpha_{i-1}^B} (i = 3,4)$. When $i = 2$, $v_2 = \frac{P_2 - P_1}{\alpha_2^B - \alpha_1}$. And the utility indifference points also meet $v_2 < v_3 < v_4$, therefore $\frac{P_2 - P_1}{\alpha_2^B - \alpha_1} < \frac{P_3 - P_2}{\alpha_3^B - \alpha_2^B} < \frac{P_4 - P_3}{\alpha_4^B - \alpha_3^B}$.

Due to the application of blockchain, customers don't have preference to the service from the public pension institution. We can express the demands of the institutions more concise:

$$D_1^B = \frac{P_2 - P_1}{\alpha_2^B - \alpha_1} \quad (5)$$

$$D_2^B = \frac{P_3 - P_2}{\alpha_3^B - \alpha_2^B} - \frac{P_2 - P_1}{\alpha_2^B - \alpha_1} \quad (6)$$

$$D_3^B = \frac{P_4 - P_3}{\alpha_4^B - \alpha_3^B} - \frac{P_3 - P_2}{\alpha_3^B - \alpha_2^B} \quad (7)$$

$$D_4^B = 1 - \frac{P_4 - P_3}{\alpha_4^B - \alpha_3^B} \quad (8)$$

4.2. Demonstrations about the Application Value of Blockchain

4.2.1. The impact of blockchain on the service demand of the for-profit institutions

According to the two-market model we can get the changes of service demand in two markets:

$$\Delta D_2 = D_2^B - D_2 = \frac{P_3 - P_2}{\alpha_3^B - \alpha_2^B} - \frac{P_2 - P_1}{\alpha_2^B - \alpha_1} - [p_1(1 - \lambda_1) + p_2(1 - \lambda_2) + p_3(1 - \lambda_3)]\left(\frac{P_3 - P_2}{\alpha_3 - \alpha_2} - \frac{P_2 - P_1}{\alpha_2 - \alpha_1}\right) \quad (9)$$

$$\Delta D_3 = D_3^B - D_3 = \frac{P_4 - P_3}{\alpha_4^B - \alpha_3^B} - \frac{P_3 - P_2}{\alpha_3^B - \alpha_2^B} - [p_1(1 - \lambda_1) + p_2(1 - \lambda_2) + p_3(1 - \lambda_3)]\left(\frac{P_4 - P_3}{\alpha_4 - \alpha_3} - \frac{P_3 - P_2}{\alpha_3 - \alpha_2}\right) \quad (10)$$

$$\Delta D_4 = D_4^B - D_4 = 1 - \frac{P_4 - P_3}{\alpha_4^B - \alpha_3^B} - [p_1(1 - \lambda_1) + p_2(1 - \lambda_2) + p_3(1 - \lambda_3)]\left(1 - \frac{P_4 - P_3}{\alpha_4 - \alpha_3}\right) \quad (11)$$

Based on this, the first lemma can be proposed:

Lemma 1. While not adjusting the price of the service, the demand of the service from the for-profit pension institutions would go up after applying blockchain and there is a positive correlation between the demand increment and customers' preference for public pension institutions.

Proof. Firstly because $\frac{P_2 - P_1}{\alpha_2^B - \alpha_1} < \frac{P_3 - P_2}{\alpha_3^B - \alpha_2^B}$, it exists $\frac{\alpha_2^B - \alpha_1}{\alpha_3^B - \alpha_2^B} < \frac{P_3 - P_2}{P_2 - P_1}$. So we can find that $\Delta D_2 = D_2^B - D_2 > \frac{P_3 - P_2}{\alpha_3^B - \alpha_2^B} - \frac{P_2 - P_1}{\alpha_2^B - \alpha_1} - (1 - \lambda_3)(\frac{P_3 - P_2}{\alpha_3 - \alpha_2} - \frac{P_2 - P_1}{\alpha_2 - \alpha_1}) = \frac{P_3 - P_2}{P_2 - P_1}(P_2 - P_1)(\frac{1}{\alpha_3^B - \alpha_2^B} - \frac{1 - \lambda_3}{\alpha_3 - \alpha_2}) - (P_2 - P_1)(\frac{1}{\alpha_2^B - \alpha_1} - \frac{1 - \lambda_3}{\alpha_2 - \alpha_1}) > \frac{\alpha_2^B - \alpha_1}{\alpha_3^B - \alpha_2^B}(P_2 - P_1)(\frac{1}{\alpha_3^B - \alpha_2^B} - \frac{1 - \lambda_3}{\alpha_3 - \alpha_2}) - (P_2 - P_1)(\frac{1}{\alpha_2^B - \alpha_1} - \frac{1 - \lambda_3}{\alpha_2 - \alpha_1}) = (P_1 - P_2)(1 - \lambda_3)(\frac{1}{\alpha_{2-}\alpha_1} - \frac{\alpha_3^B - \alpha_2^B}{(\alpha_2^B - \alpha_1)(\alpha_3 - \alpha_2)})$.

While $\frac{\alpha_3^B - \alpha_2^B}{\alpha_3 - \alpha_2} = 1$ and $\alpha_2 < \alpha_2^B$, it exists $\Delta D_2 > 0$.

To ΔD_3 and ΔD_4 , $\Delta D_3 = (\frac{P_4 - P_3}{\alpha_4^B - \alpha_3^B} - \frac{P_3 - P_2}{\alpha_3^B - \alpha_2^B})[1 - (p_1(1 - \lambda_1) + p_2(1 - \lambda_2) + p_3(1 - \lambda_3))]$, it exists $1 - (p_1(1 - \lambda_1) + p_2(1 - \lambda_2) + p_3(1 - \lambda_3)) > 0$, so $\Delta D_3 > 0$. And we can prove $\Delta D_4 > 0$ in the same way, therefore that the service demand from the for-profit pension institutions would go up after applying blockchain was proved.

And as it exists $\frac{\partial \Delta D_2}{\partial \lambda_1} = p_1(\frac{P_3 - P_2}{\alpha_3 - \alpha_2} - \frac{P_2 - P_1}{\alpha_2 - \alpha_1}) > 0, \frac{\partial \Delta D_2}{\partial \lambda_2} > 0, \frac{\partial \Delta D_2}{\partial \lambda_3} > 0, \frac{\partial \Delta D_3}{\partial \lambda_1} => 0, \frac{\partial \Delta D_3}{\partial \lambda_2} > 0, \frac{\partial \Delta D_3}{\partial \lambda_3} > 0, \frac{\partial \Delta D_4}{\partial \lambda_1} >$

$0, \frac{\partial \Delta D_4}{\partial \lambda_2} > 0, \frac{\partial \Delta D_4}{\partial \lambda_3} > 0$, we can know that when customers prefer the service from the public pension institution very much, applying blockchain can produce a better effect, then that there is a positive correlation between the demand increment and customers' preference for public pension institutions can be proved.
Lemma 1 has been proved.

4.2.2. The impact of blockchain on the service demand of the competitor

The government's purpose for establishing public pension institutions is to provide the cheap services for the low-income group. However, the existence of public pension institutions poses a threat to the operation of for-profit pension institutions, which is not conducive to the development of the elderly care service market, therefore we should ensure that applying blockchain by for-profit pension institutions is also good for realizing the government's original goal.
Then we propose the second lemma:
Lemma 2. In the case of for-profit pension institutions adopting the schemes based on blockchain, public institutions can play a better role in driving the healthy development of elderly care service market.
Proof. According to the two-market model, we can get $\Delta D_1 = D_1^B - D_1 = \frac{P_2 - P_1}{\alpha_2^B - \alpha_1} - [p_1\lambda_1 + p_2\lambda_2 + p_3\lambda_3](1 - p_1) - [p_1(1-\lambda_1) + p_2(1-\lambda_2) + p_3(1-\lambda_3)](\frac{P_2 - P_1}{\alpha_2 - \alpha_1}) < \frac{P_2 - P_1}{\alpha_2 - \alpha_1} - [p_1\lambda_1 + p_2\lambda_2 + p_3\lambda_3](1 - p_1) - [p_1(1-\lambda_1) + p_2(1-\lambda_2) + p_3(1-\lambda_3)](\frac{P_2 - P_1}{\alpha_2 - \alpha_1}) = [\frac{P_2 - P_1}{\alpha_2 - \alpha_1} - (1 - P_1)](p_1\lambda_1 + p_2\lambda_2 + p_3\lambda_3)$. While $1 - P_1$ is the total demand when the price of the service is P_1, $\frac{P_2 - P_1}{\alpha_2^B - \alpha_1}$ is the total demand of rational customers when the price of the service is P_1, therefore $\frac{P_2 - P_1}{\alpha_2 - \alpha_1} < 1 - P_1$, $\Delta D_1 < 0$.
In addition, $\frac{\partial \Delta D_1}{\partial p_3} < \frac{\partial \Delta D_1}{\partial p_2} < \frac{\partial \Delta D_1}{\partial p_1} < 0$. So we can know that after the schemes based on blockchain were adopted in for-profit pension institutions, the impact on the high-income group is greater and the impact on the low-income group is smaller. When the social income generally increases, the high-income elderly people are more likely to change their preference for public institutions and choose for-profit pension institutions, while the low-income people are more difficult to change their decisions, therefore the competitiveness of for-profit pension institutions has increased.
Lemma 2 has been proved.

5. CONCLUSION

Obviously, blockchain has great potential, which needs to be further explored in the field of pension. This study only shows a small part of it. From the perspective of for-profit pension institutions, this study not only puts forward the method of applying blockchain to solve the structural problem of the elderly care service market, but also reveals the application value of blockchain in the service mode upgrading process of for-profit pension institutions by establishing a two-market model. Specifically, blockchain can not only enhance the credibility of for-profit pension institutions, thus improving their operating conditions, but also drive the of elderly care service market developing healthily, which has a good enlightenment for the transformation of for-profit pension institutions.

REFERENCES

[1] Zuo Jing. Research on the legal issues of the development of the for-profit elderly service industry in China, Legal Expo, (07) (2020)1-5.

[2] Wang Lili. A Study on the development of China's nursing home services in urban area, Population Journal, 36(04) (2014) 83-92.

[3] Qiao Xiaochun. How to satisfy the unmet needs of elderly care—consideration to construction of elderly care system, Social Policy Research, (01) (2020)19-36.

[4] Wang Wenjuan, Zhang Shiqing. Strengthening or weakening: what should we do with supporting policies of pension institutions, Shandong Social Sciences, (12) (2019) 101-106.

[5] Wu Chanjun. Study on the development dilemma and countermeasures of Shaoxing pension Institutions ,China Market, (17) (2020) 34-35.

[6] Yuan Yong, Wang Feiyue. Editable blockchain: models, techniques and methods, Acta Automatica Sinica, 46(05) (2020) 831-846.

[7] Ouyang Liwei, Wang Shuai, Yuan Yong, Ni Xiaochun, Wang Feiyue. Smart contracts: architecture and research progresses, Acta Automatica Sinica, 45(03) (2019) 445-457.

[8]Wu Zhifeng. Blockchain: infrastructure of the internet of value[C] IMI research trends, Collection Institute of International Monetary Studies, Renmin University of China, (2016) 494-500.

[9]Chen Sijie, Wang Haoran, Yan Zheng, Shen Zeyu, Ping Jian, Zhang Ning, Kang Chongqing. Rethinking the value of blockchain: direction and boundary of blockchain applications, Proceedings of the CSEE, 40(07) (2020) 2123-2132+ 2392.

[10] Guo Qiang, Yao Xiaoling. Research on the pricing strategy of competitive music products considering the network externality, Soft Science, 30(06) (2016) 104-108+113.