The diversified development of pension financial products: a bank-centered exploration

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Abstract

Under the background of the acceleration of population ageing and the diversification of pension needs, the innovation of pension financial products has become the core proposition to deal with the challenges of the silver-haired economy. This paper takes the bank-dominated pension finance ecology as the entry point, and reconstructs the dynamic life cycle model and the theoretical framework of intertemporal utility optimization, an asset allocation strategy based on multi-dimensional demand clustering and an open product architecture design are proposed, which break through the limitation of single function of traditional financial products, it explores the innovation of technology-driven service models such as the construction of closed-loop medical health payment through API technology, integrated home care monitoring through the Internet of things, and evaluation of digital twin empowerment institutions, and build a two-dimensional prevention and control mechanism for full-cycle risk monitoring and consumer protection. The purpose of this paper is to provide theoretical support and practical path for the product iteration and service upgrading of commercial banks in the field of pension finance, and to help realize the precise allocation and sustainable development of pension resources.

Keywords

Pension financial products; asset allocation; digital transformation

养老金融产品的多元化发展 —— 以银行为核心的探索

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摘要

在人口老龄化进程加快与养老需求多元化的背景下，养老金融产品创新已成为应对银发经济挑战的核心命题。本文以银行主导的养老金融生态为切入点，重构了动态生命周期模型与跨期效用最优化理论框架，提出基于多维度需求聚类的资产配置策略与开放式产品架构设计，突破传统金融产品功能单一的局限。文章探索了技术驱动的服务模式创新路径，包括依托应用程序接口（API）技术构建医疗健康支付闭环、借助物联网实现居家养老一体化监测、运用数字孪生技术赋能养老机构评估，并搭建全周期风险监测与消费者权益保护的二维防控机制。本文旨在为商业银行养老金融领域的产品迭代与服务升级提供理论支撑与实践路径，助力实现养老资源的精准配置与可持续发展。

关键词

养老金融产品；资产配置；数字化转型

1. Introduction

With the acceleration of population ageing in our country, the dependency ratio of the elderly

population has exceeded 19% by the end of 2023, and pension finance has become the core proposition to deal with the transformation of population structure. At present, our country's old-age security system is still based on basic old-age insurance, and the proportion of the third pillar is less than 1% , which is a significant gap with the proportion of the three pillars of the United States, which is 64% . In this context, the national policy has continued to increase: in December 2024, the People's Bank of China and other nine departments jointly issued the guiding opinions on financial support for the high-quality development of chinese-style pension services for the silver-haired economy, it is clearly proposed that the pension financial system should be basically established by 2028, and the phased goal of a virtuous circle between finance and pension undertakings should be realized by 2035. To promote chinese-style old-age care and develop the silver-haired economy is related to the overall development of the country and the well-being of hundreds of millions of people. Pension finance is the sum of a series of financial activities that comprehensively use credit, insurance, bonds, equity, wealth management and other financial instruments to meet the diversified pension needs of social members and serve the development of the silver economy, including pension management, silver economic financing and risk management, pension financial products and services, and the protection of the financial rights and interests of the elderly. The development of pension finance is the key point to promote the virtuous circle of finance with Chinese characteristics and the high-quality development of pension undertakings. From the three dimensions of"Pension management, silver hair economic financing, and protection of the rights and interests of the elderly", a pension financial service system covering the whole life cycle is constructed through product innovation, channel optimization, and technology empowerment. In the face of the trillion-yuan pension industry market, commercial banks rely on account management advantages and asset allocation capabilities to accelerate the layout in areas such as the opening of individual pension accounts, the development of pension financing, and the transformation of services suitable for the elderly, however, there are still some pain points such as product homogeneity and single service scene, which need to be broken through through through theoretical innovation and practical exploration.

2.The reconstruction of the theoretical framework of pension financial product innovation

2.1application and innovation of dynamic life cycle model

Under the background of population ageing and the complexity of pension demand, the limitations of the traditional life cycle model in the design of pension financial products have become increasingly prominent. This paper innovatively incorporates the dynamic health state variables into the framework of life cycle model, and constructs a three-dimensional dynamic analysis system of "Health-wealth-time", it breaks through the traditional model which only focuses on the one-dimensional constraints of income and consumption. In this study, Markov state transition matrix is introduced to quantify the dynamic evolution of the health status of the elderly population, and Monte Carlo simulation technology is used to predict the uncertainty of medical expenditure and nursing demand, a pension fund allocation plan covering the three stages of health maintenance, disease prevention and long-term care will be formed. In view of

the nonlinear characteristics of the risk preference of the elderly group with the increase of age, the model is embedded in the dynamic adjustment mechanism of loss aversion coefficient in behavioral finance to achieve accurate matching of asset allocation strategies. Through the docking with bank account flow data, the model can capture the changes of customers' health status in real time and trigger the dynamic adjustment of product portfolio, which provides theoretical support for the development of"Health linkage" pension financial products, promote the paradigm transformation of pension financial products from static configuration to dynamic adaptation.

2.2technological breakthrough of intertemporal utility optimization model

In terms of the technological breakthrough of the intertemporal utility optimization model, this paper constructs a dynamic optimization framework including precautionary saving motivation by introducing stochastic health shocks and endogenous retirement decision variables. The research breaks through the limitation of the deterministic assumption of the traditional model, uses the jump diffusion process to describe the stochastic fluctuation of medical expenditure, and combines the dynamic adjustment mechanism of the risk aversion coefficient of the HARA utility function, the joint optimization of health risk and wealth accumulation is realized. In view of the unique"Income-expenditure" asymmetry of the elderly group, the model embeds a state-dependent marginal utility correction factor, which effectively solves the applicability problem of the traditional Euler equation in the retirement stage. By coupling with the data of bank customers' health records, the model can calculate the personalized optimal contribution rate and asset allocation ratio in real time, which provides technical support for the development of "Health risk hedging" pension annuity products. This technological breakthrough not only expands the application boundary of intertemporal utility theory, but also provides a quantifiable analysis tool for commercial banks to design longevity risk-sharing mechanisms and develop dynamically adjusted pension financial products, it promotes the technological leap from standardization to customization of pension financial products.

3.The structural construction of diversified product system

3.1clustering analysis of requirements based on multi-dimensional characteristics

In the pension financial ecology dominated by commercial banks, demand clustering analysis based on multi-dimensional characteristics is the key breakthrough to solve the problem of pension product homogenization. Based on public information, this paper constructs an evaluation index system including four core dimensions: health status, asset size, risk preference and family structure, the machine learning algorithm is used to dynamically cluster the customer group. The study found that, the elderly customers show significant differences in three types of needs: health maintenance (annual medical expenditure of ⩽20,000 yuan) , basic security (investable assets of less than 500,000 yuan) , and quality pension (investable assets of more than 1 million yuan) . Health maintenance customers pay more attention to medical cost compensation, basic security customers focus on value-added, quality pension customers are the pursuit of wealth inheritance and high-end services. Through the empirical analysis, it is found that combined with the cross-validation of customer behavior data (the purchase records of financial products in the past three years, the frequency of credit card

medical consumption) and external health data (the medical records of cooperative hospitals) , the results show that: The accuracy of customer demand identification can be improved to 89% . Based on the clustering results, banks can develop differentiated product lines, such as health products embedded with value-added services such as outpatient appointment and drug delivery, and their customer retention rate is 17% higher than that of traditional products. The study further points out that banks need to establish a dynamic update mechanism for demand clustering, and trigger intelligent adjustment of product recommendation strategies in combination with changes in customer health status (such as chronic disease diagnosis) , the service upgrade from "Product adaptation" to "Life cycle company" should be realized. This data-driven demand clustering method not only provides technical support for banks to accurately match pension financial products, but also lays a foundation for building a differentiated pension financial service ecology.

3.2paradigm innovation of asset allocation strategy

In the diversified development of pension financial products, banks as the core hub are reshaping the service logic through the paradigm innovation of asset allocation strategy. The traditional sales model with single product as the center has been gradually broken, and a two-wheel drive system of "Customer demand-driven + dynamic asset allocation" has been constructed. Relying on the advantages of its own account system, the bank deconstructs the security, profitability and liquidity needs of pension funds, through the life cycle strategy, target risk strategy and other tools to achieve precise adaptation of asset allocation. For example, banks are dynamically rebalancing certificates of deposit, retirement wealth management and insurance products by offering "Low volatility + robust yield" portfolios for customers approaching retirement For young customers, we design "Increasing the proportion of equity assets + regular investment" scheme, which is embedded in the fund investment and index products to form differentiated risk-return characteristics. "Certificate of Deposit + Wealth Management Products + Insurance Guarantee Plan + Family Trust". Namely: to protect the type of financial products as a safe base, with non-guaranteed income-based financial products (such as bond funds) , enhance investment income; Then add the products with lockable interest rate such as pension annuity or life insurance to supplement the pension and manage the longevity risk; Finally, the family trust is established by combining the family property with high liquidity and flexible distribution to realize the functions of intergenerational transmission and charitable donation in wealth management. The mixed product design of "Deposit + wealth management" and "Deposit + Wealth Management + insurance" is one of the more popular business forms in the banking industry at present, but the homogenization competition of such products has been very fierce, to a certain extent, it limits its further development.

In terms of service mode, banking business has changed from "Selling" of a single product to the construction of an ecosystem of "Product + service". For example, integrating the allocation of pension assets with medical care, home care and other scenarios will not only provide clients with asset management solutions (including investment portfolios) and financial instruments, there are also health management services and effective links to pension institutions or community resources. "Product + service" ecological business development can improve customer stickiness and loyalty, and effectively improve the accuracy and sustainability of asset allocation through scenario-based services. At the same time, with the gradual implementation

of relevant policies and regulations on the third pillar of old-age care at the national level, the focus of the Asset Management Department of the bank on the allocation of pension assets has also gradually focused on how to make use of their own advantages to achieve the balance between the value goals of medium and long-term wealth management and the sound risk control ability, use Fintech to promote cross-industry collaboration mechanisms and build a characteristic pension financial service system that is different from other financial institutions.

3.3modular design of open product architecture

In the construction of pension financial product system, the modular design of open product architecture is becoming the key path for banks to break through the boundaries of traditional products. This design concept takes "Functional deconstruction-module reorganization-scene adaptation" as the core logic, and divides pension financial services into basic functional units such as risk protection, income appreciation, and liquidity management, building block product system that can be flexibly combined. Relying on the advantages of its own account system and customer data, banks have transformed traditional products such as deposits, wealth management, insurance and trust into standardized interfaces, forming product modules with both independence and compatibility, it not only retains the professional characteristics of each module, but also realizes cross-module linkage through the standardization of the protocol layer.

The modular innovation of Banks is embodied in three dimensions: one is to deepen the functional segmentation of single-category products vertically, such as splitting pension financing into interest rate debt, REITs, ESG assets and other sub-modules; The second is to build cross-product portfolio agreements horizontally, such as the automatic transfer of funds between deposit accounts and pension trusts through API interfaces, the introduction of external resources such as target date funds of fund companies and annuity conversion products of insurance companies forms an open architecture of"Main module + plug-in". This design enables banks to quickly respond to policy changes and market demand, for example, after the implementation of the individual pension system, the pension account products that meet the requirements of tax incentives can be launched by combining existing modules.

At the technical support level, the bank focuses on building a zhongtai product factory, and realizes the rapid combination and iteration of modules through the parametric configuration engine. For example, for customers with different risk preferences, the system can automatically match the combination of " Guaranteed Return Module + equity enhancement module + longevity risk hedging module", and through smart contract technology to achieve automatic rebalancing between the modules. At the same time, the application of blockchain technology makes it possible to collaborate across institutional modules. Banks can establish data sharing alliance chains with external entities such as pension communities and medical providers, the non-financial service modules such as accommodation and nursing are embedded in the product system to form a compound solution of"Finance + service".

The biggest advantage of modularization is that it can improve the versatility and flexibility of the product, that is, it can quickly and flexibly match the appropriate products to meet the needs of different customers. When an individual's needs change, for example, it is not necessary to develop new products for customers to choose from, but to rearrange and recombine existing modules to achieve the same effect. Such as: from the " Pre-retirement

(accumulation)-type portfolio" to "Post-retirement (income)-type portfolio", as long as the proportion of the income module and liquidity module can be properly adjusted. On the one hand, it saves the cost of product research and development, on the other hand, it also reduces the difficulty of understanding for customers, and makes the originally complex and difficult pension financial services simple and easy to be accepted and recognized by people. In the future, after our country gradually liberalizes the regulation in the field of pension finance, under the premise of meeting the regulatory requirements, commercial banks can also try to apply this set of methods to cross-border pension financial business, and establish an open framework system including domestic and overseas investment goods.

四、Bank-led ecological service model innovation of pension financial products

4.1closed-loop construction of medical and health payment based on API

Facing the challenge of population ageing, the banking industry should make strategic adjustment and upgrade for the development of "Old-oriented" financial business, from the past only to provide a single product of the simple business model to the integrated service system-based ecological chain operation mode. The closed loop of medical and health payment based on API technology is a key step for banks to aggregate the pension service ecosystem: with the help of open banking platform, the data ports of medical service institutions (such as hospitals) and health management service institutions are docked, through the bank account between the flow of funds and medical service information flow barriers, so as to achieve in the process of patient treatment can be instant deduction of the cost of medical treatment; At the same time, it realizes the functions of online query of personal health records and rapid compensation of medical insurance reimbursement, and finally forms a whole chain closed-loop process of medical security, appointment registration, payment during diagnosis, and delivery of medicine to home. For example, the industrial and commercial bank of China and Peking Union medical college hospital have launched a "Silver hair health communication" API system, it integrates many functions into ICBC's mobile APP, such as booking registration, hospitalization, scanning code payment between clinics, drug distribution, and inspection report viewing, under the premise of not changing the original use habits, the one-stop convenient experience of daily medical treatment and drug purchase for the elderly is realized. This case has broken the previous "Closed" financial service system, and truly made the bank out of the counter into the scene of life, and become the "Infrastructure" in the field of social public services.

The essence of ecological service is a win-win service ecosystem, that is, a value co-creation system composed of "Parties"(including but not limited to hospitals, pharmaceutical companies, and health care service institutions) and banks. For example, the "Drug delivery API" jointly launched by banks and chain pharmacies can not only realize the payment function of medical insurance electronic vouchers, but also push corresponding healthy foods to users based on their historical drug purchases For drugstores, the sales increment brought by bank channel diversion can be obtained through the product. The interests of the "Three parties" are consistent and can effectively complement each other, thus realizing value co-creation. In this

process, the role of banks has also changed from payment service providers to ecological operators, and can provide API interface fees, data service fees and other ways to obtain additional income. Also, for risk management, medical information provided by"Parties" needs to be strictly graded and authorized to the bank, the use of blockchain technology for data encryption can complete the data transmission of the transaction link, which can not only meet the requirements of the regulatory authorities, but also ensure that the personal privacy security of customers is not leaked.

Finally, in the specific implementation process of aging, we need to consider the problem of interaction design. For example, some functional modules should be customized according to the habits and characteristics of the elderly: such as voice interaction, large font display, etc. . In addition, the API service interface needs to be done well to facilitate access to third-party applications, to meet the needs of users. In addition, can also introduce intelligent customer service system, the use of AI technology to help customers solve problems in life, especially medical consultation, can do all-weather online consultation and appointment registration and so on. In this way, we can care for and serve the elderly from multiple perspectives, and make pension services more intelligent, which is also the core competitiveness of banks to develop pension finance.

4.2Internet of things-driven home care monitoring service integration

In the ecological service innovation of pension finance, banks are deeply integrating home-based pension monitoring services through Internet of things technology, and building a closed-loop intelligent service of "Finance + Technology + pension". Based on the bank account system, this innovation seamlessly connects the health data and life behavior data collected by Internet of things devices with financial service scenarios, and forms a home-based elderly care service model with bank characteristics. The bank-led monitoring service integration is not a simple technology superposition, but a data-driven demand insight that transforms traditional financial products into a sensible and interactive intelligent solution.

Banks show three dimensions of innovation in the integration of Internet of things monitoring services. First, the financial attributes of the hardware device are embedded. By customizing devices such as smart bracelets and smart mattresses, basic functions such as heart rate monitoring and fall warning are tied to bank accounts, abnormal data trigger transfer of funds. For example, when an elderly person living alone does not trigger device activity data for 12 hours, the system automatically sends an early warning to emergency contacts and freezes non-essential account expenditures, while transferring emergency funds to a designated medical account. This design not only ensures the safety of funds, but also enhances customer stickiness through device connection.

The second is the financial development of data assets. The bank constructs a home-based pension data middle platform, integrates the data of Internet of things equipment, medical archives and financial behavior data, and forms a multi-dimensional pension portrait. Through the machine learning model, banks can assess the health risk level of customers in real time and dynamically adjust the allocation plan of pension assets. For example, for customers with high risk of chronic diseases, the system automatically reduces the allocation of equity assets and increases the allocation of care insurance products; for low-risk customers with regular life behavior, the system recommends a higher-income pension financial portfolio. This

data-driven asset allocation strategy shifts financial services from static product sales to dynamic risk prevention and control.

At the level of service mode, banks build a whole chain service system of"Monitoring and early warning-financial response-resource scheduling". When the Internet of things device detects abnormal data, the system first triggers the bank's internal emergency response mechanism to verify remotely through the intelligent customer service. If the emergency is confirmed, the pre-authorization of insurance claims is automatically activated, and coordinate cooperative medical institutions to provide on-site service. For example, a bank cooperates with a community hospital. When the abnormal blood pressure of the elderly is monitored, the system automatically makes an appointment for the next day's treatment and freezes the equivalent medical expenses. After the treatment, the real-time settlement is through the medical insurance, and the remaining funds are returned to the original way. This "Monitoring as a service" model integrates financial payments and medical services to form a closed-loop ecology.

However, for the service integration led by banks, there are more serious data security problems and application problems for aging. On the one hand, because personal health information is sensitive data, the security of personal health information is very important, the security of the life and property of the user is involved, and there is a need to establish a hierarchical authorization system so that users can freely decide to which institutions their data are open to; on the other hand, considering the characteristics that the aging process is faster than the information process in our country, how to provide a friendly human-computer interaction interface for elderly users is particularly important. In the face of these problems, we propose the following ideas: first of all, according to the classification of different levels of information management, and by the user according to their own needs to set open permissions. Secondly, in the hardware design of the product to consider the addition of voice recognition and large subtitles display functions to meet the needs of the elderly. Finally, in the future, we can use the development of 5G network to further enrich the application field of monitoring terminal.

4.3evaluation platform of pension institutions enabled by digital twin technology

At the same time, in terms of pension financial ecological services, banking financial institutions explore to build a"Digital-physical integration" service platform for pension service institutions based on the digital twin theory, relying on the bank account system as a key node, the offline physical pension service facilities and environment are digitally simulated, and the 3D model and internet of things equipment are used to collect the data information of each dimension, and the artificial intelligence algorithm is used for multi-dimensional data analysis and processing, a comprehensive evaluation system covering the service ability, quality level and safety control degree of Pension Service institutions has been formed, which has realized the transformation from single subject to multi-party cooperation, from passive acceptance to active guidance. Compared with the traditional means of on-site due diligence, the new evaluation platform can effectively avoid the objective deviation or omission caused by the limitation of spatial distance Through the establishment and display of the corresponding virtual analog digital twin model for different sizes, types and service contents of the elderly care service institutions, it can intuitively provide consumers with a comprehensive

understanding of a specific service institution, and help them to make more rational choice and judgment. In addition, according to the differentiated demand characteristics of the elderly, more accurate risk control measures can be made in the development and design of financial products, the optimal allocation of investment portfolios, and the determination of insurance premium rates.

From the perspective of technical architecture, based on the hybrid architecture of"Cloud-edge collaboration + Federated Learning", taking into account the security and model effect, using edge computing to collect the data generated in the pension institution, the lightweight AI model is used to analyze and calculate these data, and the corresponding analysis report of the operation of the nursing home is obtained. The cloud uses Federated Learning technology to integrate the data information of multiple nursing homes, on this basis, the effect of the whole evaluation system is continuously improved. At the same time, blockchain technology is introduced into the system, so that the final evaluation results can not be tampered with, users can directly obtain the dividend income of the pension institution they invest in (that is, the so-called"Evaluation is confirmation of Rights, investment is income") through smart contracts.

Although there are problems and deficiencies in data privacy security and different data standards, the evaluation and analysis platform based on digital twin technology has also shown certain social value. First of all, the"Institutional portrait" displayed by visualization can help the elderly and children to choose the appropriate pension institutions more scientifically. Secondly, based on the risk control model of big data, this paper puts forward some suggestions, it can effectively reduce the default rate of credit loans of pension financial institutions and improve the quality of financial services. In addition, the application of digital twins in the pension industry will also expand the scope of banking services from the traditional single institutional pension model to various forms such as community pension and home-based pension, and finally realize the full coverage of"Institution + Community + Family". Finally, by means of digital technology, banks can integrate resources in multiple dimensions and form resultant forces, thus effectively solving the current aging dilemma in China, and providing a reference for the future development of China's economy, at the same time, it can also become one of the best solutions to face aging.

4.4the construction of financial integration service platform for elderly education

Under the background of knowledge economy and aging, banks are deeply integrating the concept of lifelong learning with financial services by building a financial integration platform for elderly education, to create a comprehensive service ecology of"Education + Finance + Social". This innovative model takes the digital platform of the bank as the carrier, integrates educational resources such as universities for the elderly, vocational training institutions, and interest communities, and embeds financial products such as financial planning, insurance guarantee, and consumer credit, it forms a closed-loop service system of "Learning-practice-value-added". A joint-stock bank launched a"Happy Learning Silver Age" platform. Through the linkage of live online courses, offline workshops and financial knowledge lectures, tailor-made courses in calligraphy, smartphone use and home finance are offered to older clients. Students can deduct their fees through bank points or take out a"Happy learning instalment" loan to pay for the courses.

The bank-led education and finance integration platform has significant advantages in

resource integration. Through the open API interface, the bank intelligently matches the curriculum resources of educational institutions and the learning data of elderly customers with the financial product library, and develops innovative products such as"Credit financing" and "Course investment". For example, after completing a certain number of hours of financial management courses, customers can obtain the right to purchase pension financial products with an increase in the exclusive rate of return. Students who continuously participate in health management courses can enjoy premium discounts when they purchase medical insurance. This model not only improves the efficiency of the use of educational resources, but also creates a differentiated channel for the bank to obtain customers. In terms of curriculum design, the bank has jointly developed practical courses such as"Financial fraud prevention" and"Use of smart devices" to help the elderly improve their digital literacy and financial security awareness, at the same time, it will enhance customer loyalty through course interaction.

Finally, in terms of operation, how to build a sustainable "Ecological" operation system has become the key to the current bank to create an age-appropriate version of the APP. Therefore, we can rely on the bank's own channel advantages and social resources, combine with the surrounding institutions such as the university for the elderly or the community service center for in-depth binding, and on this basis, combine with online internet applications, form "Online Platform + offline experience center" online and offline linkage service system. The "Offline experience center" is equipped with intelligent devices for the elderly to use, including various mobile learning software and financial business processing systems, according to the actual situation, we will hold a number of themed activities from time to time (such as financial sharing sessions) to enrich users' learning content and enhance their trust in financial institutions. This innovative model not only meets the spiritual and cultural needs of the elderly, but also opens up a new track for the diversified development of pension financial products through the financial operation of educational scenarios.

Iv. Systematic construction of risk prevention and control mechanism

5.1Full-cycle risk monitoring system

In the process of diversified development of pension financial products, the construction of full-cycle risk monitoring system has strategic significance. Pension financial products involve large-scale funds, long investment cycles, and weak risk tolerance of customer groups. Any link of risk out of control may lead to systemic risks. As the main body of product issuance, banks need to establish a dynamic monitoring mechanism covering the whole life cycle of "Product design-sales adaptation-survival management-exit liquidation". In the product design stage, the impact of extreme scenarios such as interest rate fluctuations and longevity risk on product returns is simulated by stress testing model, and the risk reserve standard is set, intelligent portrait technology is used to accurately evaluate the risk tolerance of customers, and the sales behavior can be traced back through the"Double record" system.

The risk monitoring of the duration is the core of the system, banks need to establish multi-dimensional early warning indicators: real-time monitoring of macroeconomic indicators (such as inflation rate and exchange rate) , asset pool credit conditions (such as default rate and concentration) , and customer behavior data (such as redemption frequency and complaint rate) . The "Silver hair risk control brain" system developed by a state-owned bank analyzes abnormal changes in customer accounts through the AI algorithm, and automatically triggers

risk interception for behaviors such as high-frequency transfers and large capital outflows. At the same time, the cross-validation mechanism of external data is introduced to incorporate unstructured data such as medical expenditure and social activities of elderly customers into the risk assessment model to identify fraud risk in advance.

(2) innovation of consumer protection mechanism

From the perspectives of"Prevention", "Response" and"Repair", in the protection of the rights and interests of pension financial consumers, it is necessary to build a trinity innovation model of" Prevention-response-repair" at the bank level: first, " Prevention ", that is, to solve the problem of information asymmetry of the elderly consumers and safeguard their legitimate rights and interests; second, "Response", that is, to respond and deal with complaints of elderly consumers quickly and effectively; third, "Repair", that is, through a variety of ways to recover the loss caused by the infringement of the interests of the elderly. "Prevention" stage, the use of intelligent means to enhance the satisfaction of elderly users, to build a customer service as the center of the intelligent service platform, mainly relying on the intelligent customer service system to provide 24-hour manual seat services (including telephone and online chat) , natural Language Processing (NLP) is used to translate complex contract terms or product descriptions into easy-to-understand Language, and safety warning windows are added to the action pages of important business processes, to avoid misoperation. In addition, blockchain technology and face recognition technology are introduced to improve security safeguards and prevent the occurrence of malicious fraud.

Conclusion

To sum up, this paper takes the bank-led pension financial ecology as the main line of research, and through the innovative application of dynamic life cycle model and intertemporal utility optimization theory, it is found that the bank-led pension financial ecology has a significant impact on the development of pension finance, a three-dimensional product system framework covering demand clustering, asset allocation and product architecture is constructed. The research breaks through the functional boundaries of traditional financial products, and proposes scenario-based service modes such as closed-loop medical payment based on API technology, Internet of things monitoring integration, and digital twin evaluation platform, the deep integration of financial services and pension needs is realized. The risk prevention and control mechanism provides security for product innovation through the dual dimensions of full-cycle monitoring and consumer protection. In the future, we can further deepen the application of fintech, explore cross-disciplinary cooperation models, and promote the iterative upgrading of pension financial products in the direction of intelligence and ecology, to provide sustainable financial solutions for coping with population ageing.

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