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# Research on the Impact of User Profiling and AI Security on Service Innovation in the Silver Economy

**Chen Xingran***
**Xiamen No.2 Middle School of Fujian, Fujian, China**
***Corresponding auhtor, E-mail:207522801@qq.com**

**Abstract:**
*In response to the socio-economic challenges posed by the aging population, the Chinese government is actively laying out and promoting the high-quality development of the silver-haired economy. This article deeply explores the impact of user portraits and AI security on the high-quality development of the silver economy from the perspectives of the market and technology. From a view of market, the user portraits of the elderly can not only accurately explore the demand of the elderly but also facilitate enterprises to carry out digital and intelligent innovative service models. Besides, AI security can not only ensure the security of the multi-dimensional elderly population stratification label system (data such as health, consumption, and social interaction), but also serves as the foundation for accurately identifying pension needs and customizing services from the perspective of technology. The combination of the two gives rise to a new "precision + security" ecosystem. However, issues such as the technological gap, the risk of privacy leakage, and cost control still need to be addressed through policy support, technological innovation, and community collaboration. User portraits and AI security promote the evolution of the silver economy towards efficiency, security, and humanization through precise demand reach and controllable risks, providing a "technology for good" solution to address the challenges of aging. In the future, it is necessary to strengthen the inclusiveness of technology and ethical governance to build a smart pension ecosystem for the elderly.*

**Keyword:**
*User portraits, AI Security, Service Innovation, Silver-haired Economy, High Quality Development*

## 1.Introduction

China's population aging trend is deepening, and in 2021 it will have entered a deeply aging society, so it is inevitable to develop the silver-hair economy and improve the quality of silver-hair economic development.

### *1.1 The degree of aging is intensifying*

The aging of China's population is currently progressing at a remarkably rapid pace. As shown in Figure 1, the proportion of China's elderly population aged 65 and above in the total national population has surged from 9.7% in 2013 to 15.4% in 2023.

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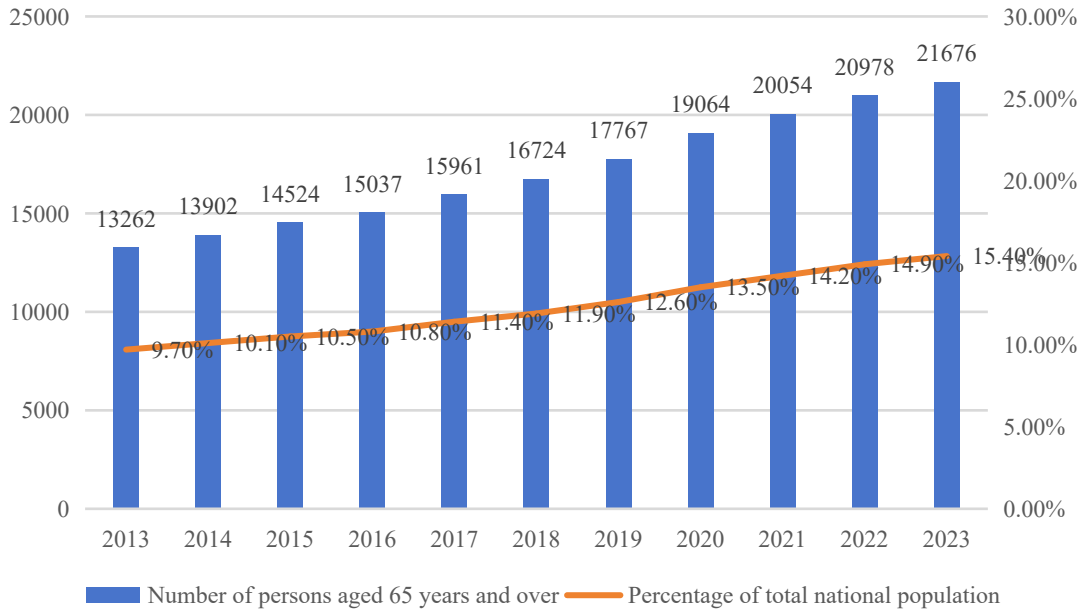



*Figure 1: The number of elderly people aged 65 and above in China and their proportion to the total population from 2013 to 2023*

*Data source: Mi Civil Affairs https://www.mca.gov.cn*

## *1.2 "Data+AI" is the key to breaking the game*

As the aging population continues to intensify, traditional elderly care models face dual challenges of resource shortages and inefficient service delivery. Meanwhile, with the rapid expansion of the artificial intelligence technology market, the deep integration of "data + AI" technologies provides a critical pathway to addressing these systemic challenges.

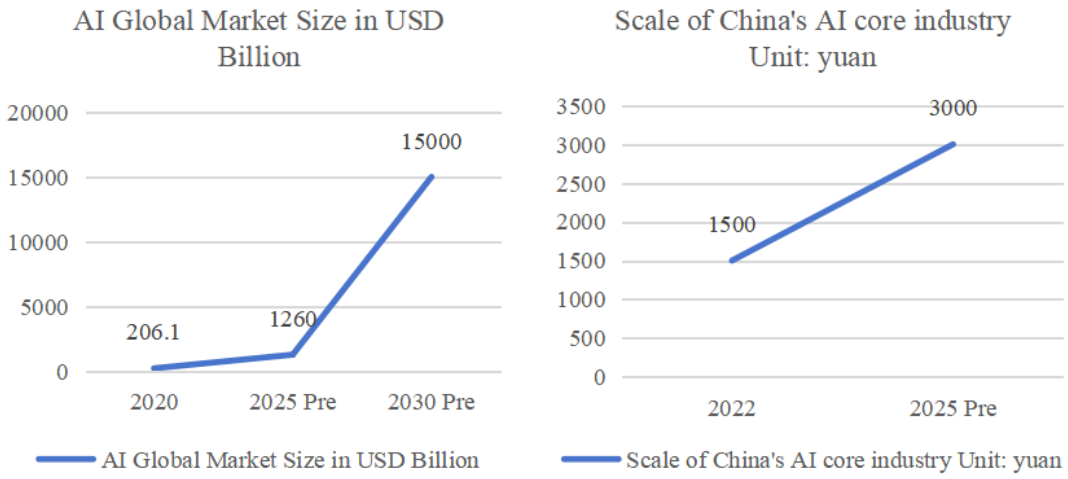



*Figure 2: Scale of global of AI market and China's AI Industry*

*Data sources: Statista https://www.statista.com, https://www.docin.com*

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### *1.3 The integration of the digital economy and real economy unlocks the blue ocean market in the silver economy.*

As the global aging process accelerates and the size of the elderly population continues to expand, their consumption needs, service demands and technological adaptability are undergoing profound changes. The digital economy is reshaping the supply mode and market pattern of the silver-haired economy through technological empowerment, model innovation and efficiency enhancement, forming new growth points. Science and technology innovation, as the first driving force for development, plays a key role in the rapid development of the silver-haired economy.

In order to actively cope with the trend of population aging, the high-quality development of silver-hair economy should not be delayed. Based on this, this paper discusses the impact of user profiling and AI security on the high-quality development of silver-haired economy by studying the current development status and drivers of silver-haired economy, comparing market data, and understanding the market environment. In-depth exploration from the market and technical perspectives - analyzing from the market perspective, user profiling can not only accurately tap the needs of the elderly, but also facilitate enterprises to carry out the innovation of the digital intelligence service model; analyzing from the technical perspective, AI security not only guarantees the security of the multi-dimensional elderly group hierarchical labeling (health, consumption, social, etc. data) system, but also is a key factor in achieving the goal of AI security not only ensures the safety of the multi-dimensional senior group hierarchical labeling (health, consumption, social and other data) system, but also is the basis for achieving accurate identification of senior needs and service customization.

## 2. Literature Review and Prospect

### *2.1 Research on Silver Economy*

The silver economy, an emerging industry serving aging populations, holds significant potential when being continuously reshaped by technological innovation and market dynamics. It includes customized economic activities tailored to the unique needs of the elderly. Key conceptual dimensions from the literature are summarized in Table 1.

*Table 1 Concepts and Dimensions of Important Literature on Silver Economy*

| Authors | Time | Concepts | Dimensions |
|---|---|---|---|
| Rahimi P et al. [1] | 2025 | Meeting the psychological and emotional needs of patients enhances service quality | Service quality |

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| | | | |
|---|---|---|---|
| Zhang [2] | 2024 | New quality productive forces are catalyzing innovative models, shaping emerging industries, and accumulating fresh momentum for the high-quality development of the silver economy | Economic Performance |
| Yuan et al. [3] | 2024 | How to maximize the transformation of potential markets into effective markets and build a high-quality product and service supply system in advancing the high-quality development of the silver economy | |
| Yue & Lin [4] | 2019 | Service quality is the essential foundation for the survival and development of elderly care institutions | Service Quality |
| Zhou & He [5] | 2017 | Service quality has a positive and direct impact on customer loyalty | |

Data sources: https://www.cnki.net

The silver economy, a system focused on enhancing elderly well-being, leverages adaptive services and market mechanisms to address older populations' diverse needs. It simultaneously fosters economies of scale, innovation, and social value through the synergistic integration of "service refinement" and "economic value creation".

## *2.2 Research on User profile*

In the big data era, user profiles are constructed by aggregating ubiquitous user data into an archetypal representation of target audience, which serves as a core analytical tool to decode customer needs. When applied to the silver economy, this approach focuses on three dimensions: "user value", "behavioral profiles", and "needs stratification". Key conceptual frameworks from the literature are synthesized in Table 2.

*Table 2: Concepts and Dimensions of Important Literature on User Profile*

| Authors | Time | Concepts | Dimensions |
|---|---|---|---|
| Yin & Guo [6] | 2023 | In the application mode of user analysis, based on the similar characteristics of target users and the correlation of tag information, target user groups with homogeneous resource demands are generated to provide accurate resource delivery services for these similar user groups | User Profiles |
| Yao et al. [7] | 2022 | Service quality can be significantly improved only when the service construction is demand-oriented | Needs Profiles |

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|---|---|---|---|
| He & Bai [8] | 2021 | The higher the user value, the more the platform should prioritize and allocate resources to them | User Value |
| Yang et al. [9] | 2006 | Value is generally considered as the result of the cost performance of products or services or a comparison with the acquisition cost | |

Data sources: https://www.cnki.net

User analysis, as a strategic tool, empowers platforms to maximize benefits through precise resource allocation by categorizing user value. Requirement analysis sharpens the accuracy of product/service positioning and elevates service quality. Ultimately, user profiling drives superior marketing outcomes through granular user group analysis, positioning it as a critical driver for sustainable growth in the silver economy.

## *2.3 Research on AI Security*

As an internet data-driven tool, user profiling inherently faces the common AI security challenges of intelligent systems. Therefore, when evaluating its impact on the development of the silver economy, it is imperative to integrate artificial intelligence security considerations, particularly algorithm, data, and system security. Key conceptual frameworks from the literature are summarized in Table 3.

*Table 3: Concepts and Dimensions of Important AI Security Literature*

| Authors | Time | Concepts | Dimensions |
|---|---|---|---|
| Zhang [10] | 2024 | The security of algorithm technology itself is merely a superficial aspect, the deeper issue lies in the security risks arising from embedding algorithms into personal and social processes | Algorithm Security |
| Cheng et al. [11] | 2024 | It is crucial to integrate with practical application scenarios to solve data, model, and application related problems generated by intelligent algorithms, and to prioritize the fundamental theoretical research and disciplinary development of intelligent algorithm security | |
| Hou [12] | 2024 | The prevention and institutionalization of risks in AI data necessitate adherence to the governance concept of development and adaptability throughout the entire process | Data Security |
| Zhou & Guo [13] | 2024 | Implicit data security risks possess existential state characteristics of concealment and randomness, movement patterns of transferability and diffusivity, and demonstrate scenario-based and accumulative features in spatiotemporal environments | |

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| Authors | Time | Concepts | Dimensions |
|---|---|---|---|
| Wu & Luo [14] | 2018 | The intricate system architecture amplifies risks through highly interconnected dependencies, where any single node or component failure may lead to systemic infiltration, disruption, or compromise | System Security |

Data sources: https://www.cnki.net

AI security, a dynamic and multidimensional field, ensures the safety and reliability of artificial intelligence systems. Reducing risks, especially in AI driven tools such as user analytics, is crucial when deploying artificial intelligence to promote high-quality development of the silver economy. This requires strong security measures in three areas: "algorithm security," "data security," and "system security," to ensure that artificial intelligence serves as a safeguard rather than a vulnerability.

## *2.4 Research on Service Innovation*

The previous text mentioned the roles of user profiling and AI security technologies in the silver economy. However, in order to better understand how these two technologies affect the silver economy, it is essential to know that the application of user analysis and AI security aims to promote service innovation in the silver economy. The service industry is the core of the silver economy. Service industry enterprises must provide unique service experiences in order to stand out in fierce market competition, and service innovation is one way to provide this unique experience. When exploring service innovation, we usually examine it from the aspects of innovation in service concepts, service efficiency, service technologies, and service methods. The concepts and dimensions in relevant literature are shown in Table 4.

*Table 4: Concepts and Dimensions of Important Literature on Service Innovation*

| Authors | Time | Concepts | Dimensions |
|---|---|---|---|
| Zhang et al. [15] | 2024 | Establish a user centered intelligent service concept and model, utilize big data technology to visualize and analyze user behavior data, and consistently provide services centered on user needs | Service Concepts |
| Ma & Gao [16] | 2024 | From the perspective of input-output, the enhancement of efficiency in labor, capital, and resource efficiency is a key manifestation of the high-quality development of elderly care institutions | Service Efficiency |
| Xu [17] | 2023 | The rapid development of digital technologies has boosted productivity across industries and partially alleviated the "Baumol's cost disease" in the service sector | Service Technologies |
| Liang [18] | 2011 | Service enterprises apply new technologies to improve and enhance service processes and products, elevate service quality and efficiency, create new value for customers, and ultimately establish competitive advantages | Service Methods |

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As discussed earlier, user analysis and AI security technologies play pivotal roles in the silver economy. Their application aims to drive service innovation, which is the cornerstone of the industry. For service-oriented enterprises to thrive in a fiercely competitive market, it is crucial to deliver distinctive experiences through innovation. Service innovation typically encompasses four dimensions: "conceptual"(ideas), "efficiency"(process optimization),"technological" (tools), and "methodological" (delivery modes).

## *2.5 Conclusions and recommendations*

### *2.5.1 Concepts and Dimensions*

The concepts and dimensions of important literature on silver economy, user profiling, AI security, and service innovation are shown in Table 5.

*Table 5: Concepts and Dimensions of Important Literature on Silver Economy, User Profile, AI Security, and Service Innovation*

| Concepts | Interpret | Dimensions |
|---|---|---|
| Silver Economy | Service quality serves as the core driving force for the development of the silver economy, while economic benefits are the fundamental guarantee. The integration of both facilitates the high-quality development of the silver economy | Service Quality<br>Economic Performance |
| User Profile | Requirement analysis enhances the accuracy of user profiles by refining user behavior and preference labels, while user value analysis optimizes the priority of profiles through economic dimension tags. These two approaches synergistically improve user portrait systems, facilitating precision marketing and product optimization for enterprises. | Needs Profiles<br>User Value |
| AI Security | Data security, algorithm security, and system security collectively constitute AI security. Data security serves as the foundation; algorithm security represents the core; and system security provides the safeguard. | Algorithm Security<br>Data Security<br>System Security |
| Service Innovation | Concepts drive technology and efficiency; technology empowers efficiency and concept implementation; efficiency innovations reinforce both technology and concepts. Service philosophy, efficiency, and technology form a closed loop of "concept-driven initiatives, technology-supported execution, and efficiency-ensured outcomes" that collectively propel the in-depth development of service innovation. | Service Concepts<br>Service Efficiency<br>Service Technologies |

Data sources: https://www.cnki.net

### *2.5.2 Role Relationships*

The role relationship between user profiling, AI security, service innovation and silver hair economy is shown in Figure 3.

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(1) User Profiling

By analyzing the characteristics, needs, and behaviors of aging populations, user analysis enables organizations to refine service quality. A deeper understanding of elderly users drives proactive service innovation and industrial upgrading, ensuring that products/services align precisely with target needs and generate greater economic value.

(2) AI Security Challenges

Although AI applications such as intelligent health monitoring and voice assistants are expanding in the silver economy, security risks (e.g., data breaches, algorithmic bias) erode trust among elderly users. Enterprises must prioritize the reliability of AI and robust privacy safeguards to foster confidence in adopting intelligent technologies.

(3) Service Innovation

Tailored services enhance convenience and precision in preventive healthcare and telemedicine. Innovations such as smart devices empower the elderly with autonomy, while digital platforms enrich their social engagement. These advancements also catalyze new business models, fueling sustainable growth in the silver economy.

(4) Synergistic Impact

User profiling and AI security are dual pillars of high-quality development of the silver economy: analysis ensures demand-driven customization, while AI guarantees the establishment of trust. Their integration fosters innovation, scalability, and long-term resilience in serving aging populations.

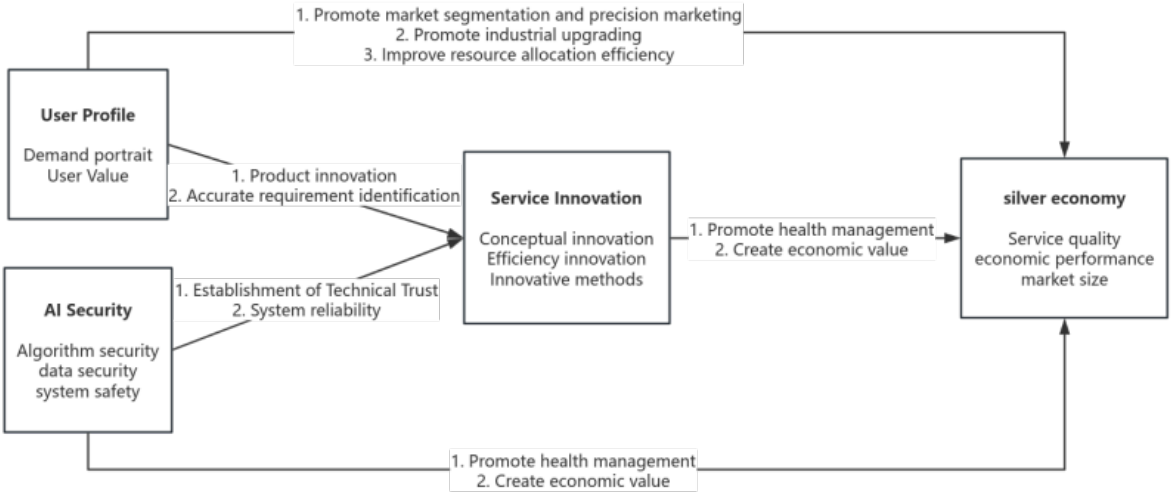



*Figure 3 The role of user profiling, AI security, service innovation and the silver-haired economy*

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# 3.Current Situation and Motivation Analysis

## *3.1 The current situation of silver economy*

(1) Rapid Growth in Scale

China is experiencing severe population aging, and it is expected that the proportion of elderly population will increase in the coming decades. By 2024, the silver economy had expanded to ¥7 trillion, accounting for 6% of GDP (Source: Blue Book of the Silver Economy: China's Silver Economy Development Report, 2024). This growth reflects the accelerating demographic shift and its economic implications.

(2) Diverse Demand & Untapped Potential

Aging populations are driving surging demand for elderly care (home-based, community-based, and institutional), particularly for disabled and semi-disabled seniors. Concurrently, the demand for chronic disease management, rehabilitation, and preventive healthcare is on the rise. Cultural and leisure consumption (e.g., tourism, education) and smart elderly care products (e.g., wearables, telemedicine) are also gaining traction, signaling vast market opportunities.

(3) Supply-Demand Imbalance

Despite the large elderly population, high-quality services in healthcare and elderly care remain scarce, failing to meet escalating demands. Regional disparities further exacerbate this gap, with rural and underdeveloped areas lagging in infrastructure and service provision. Additionally, shortages of skilled professionals in caregiving and rehabilitation hinder industry growth.

(4) Policy-Driven Momentum

To address aging challenges, China has launched initiatives like the "14th Five-Year National Plan for Aging Development and Elderly Care Systems", incentivizing private investment and industry standardization. Technologies such as AI and big data are poised to revolutionize service delivery, driving industrial upgrading and sustainable growth of the silver economy.

## *3.2 Analysis of the motivation of silver economy*

(1) Demographic Shift: Accelerated Aging

Driven by low fertility rates and increased life expectancy, China's aging population is expanding rapidly. Its aging rate surpasses that of developed nations at similar historical stages (National Bureau of Statistics). What is unique to China is the "aging before affluence" paradox: profound demographic aging coincides with middle-income status, straining traditional family-based care models and driving demand for market-driven elderly services.

(2) Economic Upgrade: Rising Senior Consumption

Higher incomes and a shift in attitudes are unlocking the purchasing power of the elderly. The demand for quality-driven, personalized services, particularly in healthcare, tourism and education, is propelling the up-

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grading of the "silver consumption" sector.

(3) Policy Catalysts: Strategic Prioritization

Top-down policies position the silver economy as a "new growth engine," incentivizing private investment through fiscal subsidies, tax breaks, and land policies. Concurrently, aging-induced fiscal pressures on pension systems necessitate job creation and industry diversification to alleviate public burdens.

(4) Tech-Driven Transformation: Smart Integration

Digital innovation has driven industry growth: smart wearable devices, telemedicine, and AI assisted nursing robots have improved efficiency while reducing costs. Cross industry convergence (e.g., "medical-care integration," "tourism-based elderly residences") and expansions into senior education, finance, and re-employment programs drive diversified growth.

(5) Socio-Cultural Evolution: Redefining Aging

Shrinking household sizes and over 130 million seniors living alone ("empty nesters") are rendering child-dependent care obsolete, spurring demand for institutionalized services. Seniors are now actively pursuing a "second life," igniting demand for cultural, recreational, and lifelong learning opportunities, which are key accelerators for silver economy expansion.

In summary, the silver economy is not merely a response to aging but an inevitable outcome of intersecting demographic, economic, and cultural shifts. Its momentum stems from aging-driven demand, policy incentives, tech innovation, and seniors' growing economic agency.

# 4.Implementation Path and Innovation Strategy

With the accelerated arrival of the aging society, the potential of the silver-haired economy continues to be released, and user image and AI security, as an important tool driven by technology, can accurately match the needs of the elderly, guarantee the safety of services, and become a key hand in promoting the high-quality development of the silver-haired economy. Specifically from the following aspects to analyze the realization of the path and innovation strategy, the path mechanism is shown in Figure 4.

## *4.1 Implementation Path: User Profiling in the Silver Economy*

(1) Multidimensional Elderly User Profiling

The profiling system addresses three dimensions:

·Data Integration: Aggregate health, consumption, social, and interest data from wearables, community services, and medical records into a dynamic database. Prioritize resource allocation based on user value assessments.

·Demand Stratification: Segment seniors into subgroups (e.g., active, disabled, empty-nest) to identify core requirements such as health management, social engagement, and financial planning.

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·Scenario Adaptation: Optimize services for home-based care, community activities, and medical support. Examples include personalized health plans for chronic disease patients and AI safety monitoring for elderly people living alone.

(2) Service Innovation via Profiling

·Product Development: Design age-friendly solutions like simplified smart home interfaces and AI-driven health monitors for chronic conditions.

·Personalized Recommendations: Deploy AI algorithms to match seniors with tailored services (e.g., senior education programs, customized travel plans).

·Demand Forecasting: Predict evolving needs through behavioral data analysis, enabling proactive service adjustments.

### *4.2 Implementation Path: AI Security Safeguards*

(1) Data Security & Privacy Protection

·Technical Measures: Implement differential privacy, federated learning, and anonymization. Develop senior-friendly authorization (e.g., voice/fingerprint verification).

·Policy Frameworks: Strengthen regulations to define data boundaries, usage standards, and penalties for misuse.

(2) Algorithmic Ethics & Transparency

·Design interpretable AI systems (e.g., explainable health risk assessments) to build trust.

·Combat scams (e.g., fraudulent health ads) and age-based biases (e.g., financial product restrictions) through algorithmic audits.

(3) Age-Friendly Safety Integration

·Embed fall detection, emergency alerts, and scam prevention functions in the devices.

·Combine AI with human support (e.g., community volunteers) to ensure service continuity during technical disruptions.

### *4.3 Innovation Strategy: Tech Integration & Ecosystem Development*

(1) Collaborative Ecosystem

·Establish cross-sector data platforms (healthcare, finance, community) to break silos while ensuring security.

(2) Tech Innovation Priorities

·Affective AI: Develop emotion-aware companion robots using profiling insights.

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·Blockchain Solutions: Ensure tamper-proof care service records (e.g., nursing logs).

(3) Policy Support

·Create government funds to advance privacy computing, anti-fraud algorithms, and AI security R&D for the silver economy.

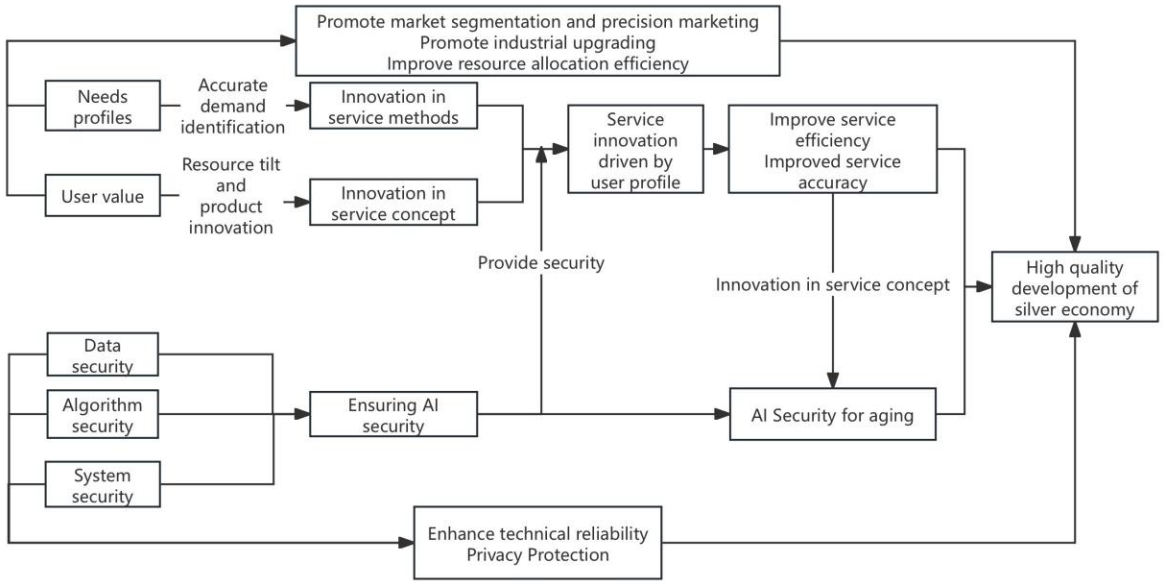



*Figure 4 Path mechanism diagram*

## 5. Conclusion

This paper discusses in depth the impact of user profiling, AI security and service innovation on the high-quality development of the silver economy, and draws the following conclusions:

First, user profiling and AI security constitute a "double-wheel drive" mechanism for the high-quality development of the silver-haired economy. User profiling helps enterprises realize service innovation and precise marketing through accurate insight into the needs of the elderly, and improves service efficiency and economic benefits, while AI security builds a foundation of trust and ensures the reliability and privacy protection of technology applications by guaranteeing data security, algorithm transparency and system stability. The combination of the two promotes the development of silver-haired economy in the direction of efficiency, safety and humanization.

Second, the path of user profiling to empower the silver-haired economy is clear. By building a multi-dimensional elderly user image system, integrating multi-dimensional data on health, consumption and socialization of the elderly, segmenting the needs of elderly groups, accurately identifying their core needs, and optimizing the service design with different scenarios. At the same time, user profile-driven service innovation, including accurate product development, personalized service recommendation and dynamic demand prediction, can better meet the diverse needs of the elderly.

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Third, the path of AI security escorting the silver-haired economy is clear. In terms of data security, the privacy of the elderly is protected through technical means such as differential privacy and federated learning, as well as data authorization mechanisms; in terms of algorithmic transparency and ethical governance, comprehensible AI decision-making logic is developed to identify senior citizen fraud and eliminate age discrimination; and in terms of the application of safe and age-appropriate technology, the sense of security and trust of the elderly is enhanced through intelligent security protection and human-machine collaborative services.

Fourth, innovative strategies help build the silver-haired economy ecosystem. We will build a collaborative ecosystem of "user profiling + AI security" to break the data silos and realize the precise reach of the needs of the elderly. The direction of technological innovation includes the research and development of emotional computing and companion robots, as well as the adoption of blockchain technology to ensure that the quality of senior care services can be traced. In terms of government guidance, it is recommended that a special fund be set up to support the research and development of key technologies and promote the sustainable development of the silver-haired economy.

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