

# The Impact of Population Aging on Pension Accounting and Asset Allocation

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## Abstract

Population aging has become a global challenge with profound implications for pension systems. This study systematically examines the multidimensional impacts of population aging on pension accounting and asset allocation. In terms of accounting, aging has driven the ongoing evolution of pension accounting standards, exemplified by the International Accounting Standards Board's (IASB) revision of IAS 19, requiring more precise liability measurement and information disclosure. Extended life expectancy and low-interest-rate environments have increased the present value of pension liabilities, resulting in significant deficits in many corporate pension plans. Regarding asset allocation, the traditional "60/40" model faces challenges, prompting pension institutions to increase allocations to alternative assets, adopt more dynamic approaches, and enhance global diversification strategies. Technological applications, such as artificial intelligence and big data analytics, are revolutionizing asset allocation methods, improving investment efficiency and risk management capabilities. However, these changes also introduce new challenges, including algorithmic biases and data security issues. This study also explores coping strategies, encompassing pension system reforms, accounting standard adjustments, and asset allocation innovations. Future pension management may require further innovation and adaptation to accommodate evolving demographic structures and financial market environments.

## Keywords

Pension Accounting Standards, Asset Allocation Adjustment, Technological Innovation Application, Pension Liability Measurement, Global Investment Strategies

## 1. Introduction

Population aging has become one of the major challenges facing the world,

profoundly impacting various aspects of society and economy. According to United Nations data, the global proportion of population aged 65 and above increased from 6% in 1990 to 9% in 2019, and is projected to reach 16% by 2050. This trend is particularly pronounced in developed countries, with Japan's elderly population (65+) reaching 28.4%, while Italy and Germany stand at 23.1% and 21.7% respectively. As birth rates decline and life expectancy increases, many countries are experiencing significant changes in their demographic structure, with a rising proportion of elderly population. This trend poses a severe test to the sustainability of pension systems, while also bringing new challenges and opportunities for pension accounting and asset allocation.

Recent academic research on this issue has deepened. Bloom et al. (2010) pointed out that population aging will lead to a reduction in labor supply, thereby affecting economic growth and the financial balance of pension systems. Baruch et al. (2021) emphasized that in the context of population aging, pension accounting standards need to be adjusted accordingly to more accurately reflect pension liabilities. In terms of asset allocation, Merton proposed the life-cycle investment theory, arguing that as age increases, individual investment portfolios should gradually shift towards more conservative asset allocation strategies. However, in the face of a low interest rate environment and extended retirement periods, traditional asset allocation strategies may struggle to meet pension needs. Addressing this challenge, Cocco and Gomes suggested introducing more risk assets into pension investments to enhance long-term returns. Simultaneously, with technological advancements, Broeders et al. (2020) explored the application prospects of artificial intelligence and big data in optimizing pension asset allocation. Population aging has also driven pension system reforms, such as the trend of transitioning from pay-as-you-go to partial accumulation systems, as analyzed by Holzmann.

This study has both theoretical and practical significance. From a theoretical perspective, it examines the mechanisms through which population aging affects pension systems through the dual lenses of accounting and asset allocation. From a practical standpoint, it provides strategic adjustment recommendations for pension fund managers and policymakers in response to demographic changes. The main contributions of this study are: first, it systematically analyzes the impact of population aging on pension accounting standards and practices, particularly in liability measurement and information disclosure; second, it identifies new trends in pension asset allocation strategies against the backdrop of demographic changes; third, it explores the role of technological innovation in addressing pension management challenges; and finally, it offers practical recommendations for policymakers and pension fund managers. This study employs a combination of literature review and data analysis methods, utilizing information from multiple sources including academic literature, international organization reports, industry research, and government statistics. However, this study has several limitations: the research primarily draws on developed market experiences, relies mainly on existing literature and secondary data, and due to the rapid pace of technological change, some findings may

have limited temporal validity.

The remainder of this paper is structured as follows: Section 2 reviews existing literature, Section 3 analyzes the current status and trends of population aging, Section 4 examines the impact of population aging on pension accounting, Section 5 investigates the influence of population aging on pension asset allocation, and Section 6 concludes with findings and policy recommendations.

## **2. Literature Review**

### **2.1. Current Research on Population Aging**

Research on population aging has yielded rich theoretical results. From a macroeconomic perspective, Bloom et al. (2010) found that population aging affects economic growth through channels such as labor supply, savings rates, and productivity. Their long-term data analysis shows that for every percentage point increase in the elderly dependency ratio, GDP growth rate decreases by an average of 0.15 percentage points. Harper focused on the social impact of population aging, finding that aging exacerbates intergenerational income inequality and strains social security systems. In the Chinese context, Wang and Chen found that the challenges of rapid aging combined with economic transformation are particularly prominent, projecting that China's elderly dependency ratio will exceed 70% by 2050.

### **2.2. Progress in Pension Accounting Research**

Pension accounting research has primarily focused on measurement standards, disclosure requirements, and risk management. Baruch et al. (2021) conducted a systematic review of pension accounting research from 1990-2020, finding that the evolution of accounting standards has been mainly driven by demographic changes and financial market fluctuations. They pointed out that traditional pension liability measurement methods may underestimate longevity risk. Brown and Liu studied the impact of different discount rate choices on pension liability valuation, finding that using market rates as discount rates may lead to excessive volatility in liability valuations.

### **2.3. Development of Pension Asset Allocation Research**

Pension asset allocation research has evolved from static to dynamic approaches, and from single-market to global perspectives. Merton's life-cycle investment theory provided a theoretical foundation for personal pension investment, recommending risk asset proportion adjustments based on age. Campbell and Viceira extended this theory, proposing optimal asset allocation strategies considering inflation and labor income risks. At the institutional investor level, Broeders et al. (2020) found that large pension institutions increasingly adopt factor investing and alternative investment strategies to address low-interest-rate environment challenges. Particularly in ESG investing, recent studies indicate that sustainable investment strategies help improve long-term risk-adjusted returns.

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### 3. Current Status and Trends of Population Aging

#### 3.1. Global Overview of Population Aging

Population aging has become one of the most significant demographic trends of the 21<sup>st</sup> century, profoundly impacting global socio-economic development. According to United Nations data, the global population aged 60 and above reached 1 billion in 2019 and is projected to double to 2.1 billion by 2050 (United Nations, 2019). This trend is particularly pronounced in developed countries, but the pace of aging is accelerating in developing countries as well. Japan, as the country with the highest degree of aging globally, has over 28% of its population aged 65 and above. Many European countries such as Italy, Germany, and Greece also have elderly populations exceeding 22%. China, as the country with the largest elderly population in the world, faces the challenge of “getting old before getting rich.” The main driving factors of population aging include declining birth rates and increased life expectancy. Advances in medical technology, improved living conditions, and heightened health awareness have collectively led to a significant increase in average life expectancy. Simultaneously, factors such as rising education levels and increased female employment have caused a continuous decline in fertility rates. This change in population structure has profound impacts on various fields including the labor market, healthcare, and social security, with particularly significant effects on pension systems.

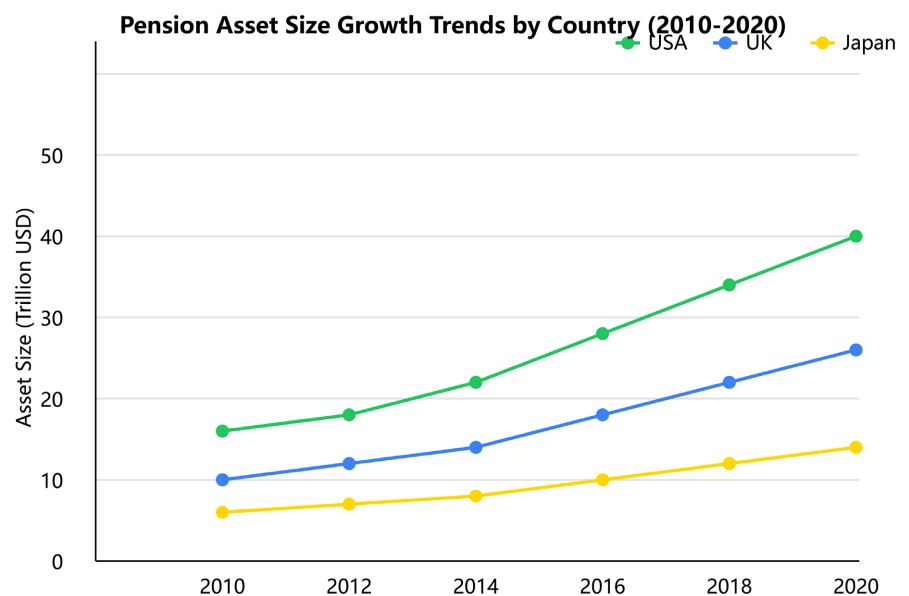
#### 3.2. The Impact of Population Aging on Pension Systems

The impact of population aging on pension systems is multifaceted, mainly manifesting in the following aspects: The rising proportion of elderly population leads to increased pension expenditures, while the declining proportion of working-age population reduces the contribution base for pensions. This “scissors effect” severely threatens the financial sustainability of pension systems (Holzmann, 2013). Secondly, increased life expectancy means a longer pension payment period after retirement, which increases the long-term liabilities of pension systems. Thirdly, population aging changes societal risk preferences, posing new requirements for pension investment strategies. Fourthly, the low interest rate environment in aging societies makes it difficult for traditional fixed-income investments to meet the appreciation needs of pension funds. Fifthly, the issue of intergenerational wealth transfer becomes more complex, and balancing the interests of current working population and retired population becomes a thorny social problem. Faced with these challenges, many countries have begun to implement pension system reforms, including raising retirement ages, increasing contribution rates, and introducing multi-pillar pension systems. However, the effects of these reform measures still need further observation and evaluation.

#### 3.3. Changes in Pension Asset Scale and Structure

As population aging deepens, the global scale of pension assets shows a continuous growth trend. According to data from the Organisation for Economic Co-operation and Development (OECD), the total pension assets of OECD countries

reached 56.3 trillion US dollars in 2020, an increase of nearly 80% compared to 2010 (OECD, 2021). This growth not only reflects the increased pension needs brought about by population aging but also demonstrates the importance attached to pension savings by governments and individuals. In terms of asset structure, the traditional “60/40” allocation model (i.e., 60% stocks, 40% bonds) is changing. The low interest rate environment is pushing pension institutions to increase allocations to alternative assets, such as private equity, real estate, and infrastructure investments. At the same time, the rise of ESG (Environmental, Social, and Governance) investment concepts is reshaping pension investment strategies. Furthermore, as pension fund sizes expand, their influence in capital markets is increasing, becoming an important force in promoting corporate governance improvement and sustainable development. **Figure 1** shows the trends in pension asset size changes of major global economies from 2010 to 2020.



Source: OECD Pension Markets in Focus 2021.

**Figure 1.** Trends in Pension Asset Size Changes of Major Global Economies from 2010 to 2020.

As shown in **Figure 1**, pension asset sizes in the United States, United Kingdom, and Japan all showed upward trends from 2010 to 2020, albeit with different growth rates. The United States, as the world’s largest pension market, saw the most significant growth in asset size, increasing from about 20 trillion US dollars in 2010 to nearly 35 trillion US dollars in 2020. The growth in the UK and Japan was relatively moderate but still maintained a steady upward trend. This growth reflects the importance of pension asset accumulation in the context of population aging, while also highlighting the challenges of effectively managing and allocating these enormous assets. The differences in pension asset sizes among countries also reflect variations in their pension systems, economic development levels, and demographic structures. For example, the prevalence of individual pension

accounts such as 401(k) plans in the United States has driven the rapid growth of its pension assets. Japan, despite facing severe population aging issues, has seen relatively slow growth in pension assets, partly because its pension system is still dominated by public pensions. These differences suggest that when addressing the challenges of population aging, it is necessary to consider the specific national conditions of each country and formulate pension policies and asset management strategies that suit their actual situations.

## **4. The Impact of Population Aging on Pension Accounting**

### **4.1. Evolution of Pension Accounting Standards**

As the trend of population aging intensifies, pension accounting standards are continuously evolving to adapt to new economic realities. Institutions such as the International Accounting Standards Board (IASB) and the Financial Accounting Standards Board (FASB) have been striving to improve pension accounting standards to more accurately reflect the financial status and risks of pension plans. In recent years, key changes in pension accounting standards include a greater emphasis on the market value measurement of pension liabilities, requirements for more detailed disclosures, and improvements in accounting treatments for multi-employer pension plans (Baruch et al., 2021). For example, the revision of International Accounting Standard 19 (IAS 19) requires companies to recognize the net liability or net asset of defined benefit plans on the balance sheet and to recognize actuarial gains and losses directly in other comprehensive income. These changes aim to enhance the transparency and comparability of pension accounting information but also increase the complexity of accounting treatments.

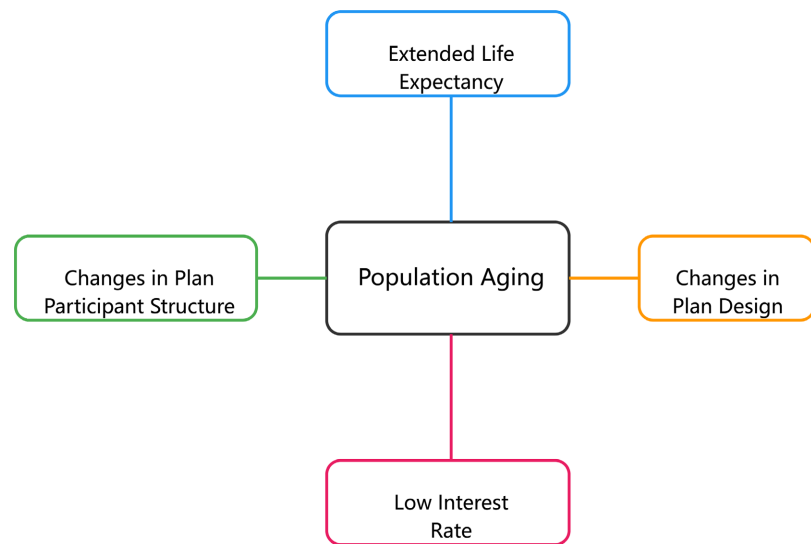
In the context of population aging, the long-term nature and uncertainty of pension liabilities further increase the difficulty of accounting estimates, especially in aspects such as the selection of discount rates and the prediction of future salary growth rates. Additionally, the international convergence of pension accounting standards is an important trend, although differences in implementation details still exist among countries. This convergence helps improve the comparability of financial statements of multinational companies but also brings challenges in implementation costs and local adaptation. As population aging deepens and financial markets evolve, pension accounting standards may need further adjustments to better reflect the economic substance and risks of pension plans.

### **4.2. The Impact of Population Aging on Pension Liability Measurement**

Population aging has had a profound impact on pension liability measurement. The extension of life expectancy directly increases the expected payment period of pension plans, leading to an increase in liability valuation. At the same time, in a low-interest-rate environment, the lowered discount rates used for discounting future pension benefits further push up the present value of liabilities. These factors have collectively resulted in significant deficits in many corporate pension

plans. According to OECD data, the average pension gap in OECD countries reached 20% of GDP in 2020 (OECD, 2021). To more accurately reflect these changes, pension accounting standards have adjusted liability measurement methods. For example, requiring the use of high-quality corporate bond yields as discount rates have, to some extent, increased the volatility of liability valuations.

Another significant impact is that population aging has altered the participant structure of pension plans, with an increasing proportion of retirees, requiring accounting treatments to focus more on the liabilities of retired participants. Furthermore, population aging has driven changes in pension plan designs, such as the shift from Defined Benefit (DB) to Defined Contribution (DC) plans, which also poses new requirements for accounting treatments.



Source: Author's analysis based on IASB and FASB guidelines.

**Figure 2.** Impact factors of population aging on pension liability measurement.

As shown in **Figure 2**, population aging affects pension liability measurement through multiple pathways. Extended life expectancy directly increases the expected payment period of pension plans, while the low interest rate environment affects the discounted value of liabilities. At the same time, population aging also leads to changes in the participant structure of pension plans and drives changes in plan design. These factors interact, ultimately resulting in an increase in pension liability valuation. This complex impact mechanism requires accounting standard setters and practitioners to adopt a more comprehensive and dynamic perspective in assessing and measuring pension liabilities.

#### **4.3. New Requirements for Pension Accounting Information Disclosure in the Context of Population Aging**

In the context of population aging, pension accounting information disclosure faces new challenges and requirements. Investors and regulators are increasingly concerned about the long-term sustainability and risk management capabilities of

pension plans, driving more comprehensive and transparent information disclosure requirements. In recent years, the International Accounting Standards Board (IASB) and national regulatory bodies have continuously strengthened disclosure requirements for pension-related information, including more detailed actuarial assumptions, sensitivity analyses, and risk management strategies (Baruch et al., 2021). For example, companies need to disclose the impact of changes in demographic assumptions on pension liabilities, as well as strategies for matching pension assets and liabilities.

With the diversification of pension plan types, such as the emergence of hybrid plans, accounting information disclosure also needs to adapt to this complexity. Another important trend is that more and more stakeholders are requiring companies to disclose the potential impact of pension plans on the company's overall financial position and cash flows, necessitating more forward-looking and comprehensive information. At the same time, the increasing importance of ESG (Environmental, Social, and Governance) factors in pension investments has driven the demand for related information disclosure. However, increased disclosure requirements also bring about rising costs and complexity. Finding a balance between information usefulness and cost-effectiveness is an important challenge faced by regulators and companies. In the future, with the development of big data and artificial intelligence technologies, the methods of collecting, analyzing, and disclosing pension accounting information may undergo revolutionary changes, providing new opportunities to address the challenges brought by population aging.

## **5. The Impact of Population Aging on Pension Asset Allocation**

### **5.1. Asset Allocation Strategy Adjustments in the Context of Population Aging**

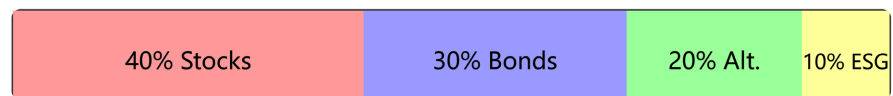
Population aging has had a profound impact on pension asset allocation strategies, driving the transformation of traditional investment concepts and methods. Faced with extended retirement periods and a low interest rate environment, pension management institutions have had to reassess their asset allocation strategies to balance long-term returns and risk management needs. The traditional "60/40" portfolio (i.e., 60% stocks, 40% bonds) faces challenges in the current environment, and many institutions have begun to increase allocations to alternative assets, such as private equity, real estate, and infrastructure investments (Cocco & Gomes, 2012). This shift aims to increase portfolio diversification and seek higher risk-adjusted returns. At the same time, the extension of long-term investment horizons has also enabled pension institutions to better bear investments with lower liquidity but potentially higher returns. Another significant trend is the popularization of life-cycle funds, which automatically adjust asset allocation based on the investor's age, gradually reducing the proportion of risk assets as age increases. However, in the current low interest rate environment, overly conservative allocations may not meet retirement income needs, so some institutions have

begun to explore more dynamic and flexible life-cycle strategies. Population aging has also pushed pension institutions to pay more attention to long-term sustainable development and ESG factors, reflected in the increase in sustainable investments and socially responsible investments. **Figure 3** illustrates the main adjustment directions of pension asset allocation strategies in the context of population aging.

### Traditional Model



### Emerging Model



Source: Analysis based on Willis Towers Watson Global Pension Asset Study 2021.

**Figure 3.** Pension Asset Allocation Strategy Adjustments in the Context of Population Aging.

As shown in **Figure 3**, pension asset allocation strategies are undergoing significant adjustments in the context of population aging. The traditional “60/40” allocation model is gradually shifting towards more diversified asset portfolios. In emerging allocation strategies, the proportions of stocks and bonds have decreased, while the proportions of alternative assets and ESG investments have significantly increased. This transformation reflects pension institutions’ pursuit of long-term returns and sustainable development, as well as their need for risk diversification. It is worth noting that these adjustments are not one-size-fits-all; different types of pension plans (such as public pensions, corporate pensions, individual pensions, etc.) may adopt different adjustment strategies based on their specific circumstances. For example, more mature pension plans may tend to increase allocations to fixed-income assets to match their liability structure. Emerging individual pension plans, on the other hand, may adopt more life-cycle strategies, dynamically adjusting asset allocation based on participants’ ages. Overall, these asset allocation strategy adjustments aim to address the long-term challenges brought by population aging, balance returns, risks, and liquidity needs, while considering social responsibility and sustainable development requirements.

## 5.2. Global Trends in Pension Asset Allocation

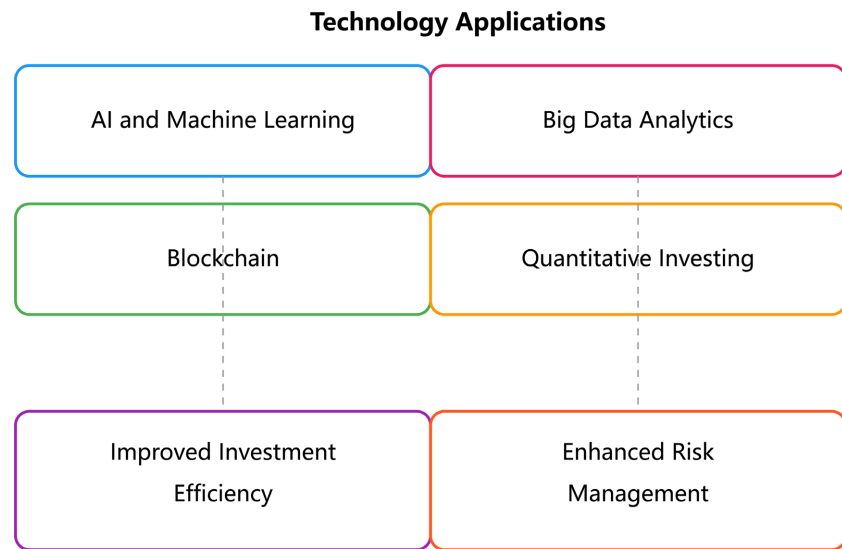
In the context of population aging, the globalization trend of pension asset allocation is becoming increasingly evident, serving both as a strategy to address domestic market limitations and as a means to pursue higher returns and risk diversification. In recent years, pension institutions in developed countries have

continuously increased their investments in emerging markets to capture potential high-growth opportunities. Meanwhile, pension funds in emerging market countries have also begun to seek overseas investments to diversify risks and obtain more stable returns (Merton, 2014). This globalization trend is reflected not only in geographic diversification but also in the internationalization of asset classes. For example, more and more pension funds are investing in global infrastructure projects, international real estate markets, and multinational private equity funds. However, global allocation also brings new challenges, such as currency risks, political risks, and the complexities of cross-border regulation. To address these challenges, some large pension institutions have begun to establish overseas investment teams or cooperate with local asset management companies to gain localized expertise. Furthermore, the globalization trend has also driven changes in pension governance structures, requiring decision-makers to possess broader international perspectives and cross-cultural management capabilities. It is worth noting that although globalization is a major trend, there are significant differences in the degree of globalization among pension funds in different countries and regions. For example, Canadian and Dutch pension funds have always been at the forefront of globalization, while Japanese pension funds are relatively conservative, with a lower proportion of overseas asset allocation. In the future, as global financial markets further integrate and emerging markets continue to develop, the globalization trend of pension asset allocation may further strengthen, but at the same time, it will require more prudent assessment and management of related risks.

### 5.3. Application of Technology in Pension Asset Allocation

As population aging intensifies and financial market complexity increases, the application of technology in pension asset allocation is becoming increasingly widespread, serving as an important means to improve investment efficiency and risk management capabilities. Artificial Intelligence (AI) and machine learning technologies are revolutionizing traditional asset allocation methods, capable of processing massive data and identifying complex market patterns, thereby optimizing investment decisions (Broeders et al., 2020). For example, some pension institutions have begun to use AI algorithms for dynamic asset allocation, automatically adjusting investment portfolios based on real-time market data and economic indicators. Big data analysis technology allows pension managers to more comprehensively assess investment risks, including traditional financial risks and emerging ESG risks. The application of blockchain technology is expected to improve the efficiency and transparency of pension asset transactions, especially in cross-border investments and alternative asset management. Additionally, the popularization of quantitative investment strategies has enabled pension funds to more systematically implement advanced asset allocation methods such as factor investing and risk parity. However, technology applications also bring new challenges, such as algorithmic bias, data security, and privacy protection issues. Therefore, many pension institutions are exploring “human-machine collaboration” models,

combining human expert judgment with machine computational capabilities. The degree of technology application varies among different types and sizes of pension institutions. Large public pensions and corporate pensions often lead in technology application, while small and medium-sized pensions may face limitations in technology and talent. In the future, as technology advances and costs decrease, the application of technology in pension asset allocation may become more widespread, but at the same time, corresponding regulatory frameworks will be needed to ensure its safety and effectiveness.



Source: Author's compilation based on industry reports and academic literature.

**Figure 4.** Application of technology in pension asset allocation.

As shown in **Figure 4**, the application of technology in pension asset allocation covers multiple areas, from artificial intelligence and big data analytics to blockchain and quantitative investing. These technologies play a crucial role in optimizing asset allocation and risk management. For example, machine learning algorithms can enable dynamic asset allocation, while big data analytics can provide real-time risk monitoring. The potential impacts of these applications include improved investment efficiency, enhanced risk management capabilities, personalized solutions, and increased overall transparency. However, it is worth noting that the application of technology also introduces new challenges, such as data security, algorithmic biases, and the risks of over-reliance on technology. Therefore, pension institutions need to carefully assess these technologies and establish appropriate governance frameworks to manage related risks. In the future, as technology continues to advance and mature, its application in pension asset allocation may become more profound and widespread, but regulatory frameworks will also need to be adjusted accordingly to ensure safety and effectiveness.

## 6. Conclusion

The impact of population aging on pension accounting and asset allocation is

profound and complex, necessitating a collaborative response from pension managers, accounting standard setters, and policymakers. In accounting, aging has driven the ongoing evolution of pension accounting standards, which require more precise and transparent liability measurement and information disclosure. This not only enhances the reliability of financial reporting but also provides stakeholders with more valuable decision-making information. In the context of asset allocation, the low-interest-rate environment and extended investment horizons associated with aging have prompted significant adjustments in allocation strategies, including increased investments in alternative assets, the adoption of more dynamic allocation methods, and a strengthened global diversification approach. The application of technology offers new tools and methodologies to address these challenges but also introduces new risks and regulatory challenges.

As population structures continue to change and financial markets evolve, pension accounting and asset allocation may require further innovation and adjustment in the future. This demands that all relevant parties maintain an open and flexible attitude, continually learning and adapting to new environments. Additionally, while this study focuses on the impact of population aging, pension management also faces other long-term challenges, such as climate change and technological disruption, which need to be thoroughly considered in future research and practice.

Regarding policy recommendations, firstly, policymakers should promote pension system reforms, such as gradually increasing the retirement age and optimizing contribution mechanisms to address the financial pressure brought by population aging. Secondly, pension management institutions should be encouraged to adopt diversified asset allocation strategies, particularly considering increasing allocations to alternative assets in a low-interest-rate environment. Finally, the rational application of technology can improve investment management efficiency, but an appropriate regulatory framework must be established to ensure data security and privacy. Only through the combined efforts of governments, businesses, and individuals can the impact of population aging on pension systems be effectively addressed, ensuring the sustainable development of society.

## Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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