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Green finance and the silver economy: catalyzing China's low-carbon development

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1 Introduction: China's emerging silver economy

As global population ageing accelerates (Harper, 2014), the Anthropocene is increasingly becoming a world dominated by older adults. Addressing the nuanced needs of various age groups becomes crucial in understanding the intricate link between human activities and environmental shifts (Lindsey et al., 2022). China's adoption of the silver economy emerges as a pivotal response to ageing challenges, as the same time China also has the need for low-carbon transformation of social-economic development. Therefore, China's silver economy can present an opportunity for green finance committed to low-carbon transformation. This opinion article builds upon an understanding of green finance and the silver economy's concepts and scopes, discussing how the changing needs and preferences of older adults affect the transformation of green consumer behaviour and purchasing habits within the silver economy. We summarized the potential and feasibility for targeted green finance to engage with the silver economy, and offered strategies at the green-product, household, and community levels. We point that green finance as a crucial driver for the ecological transformation of the silver economy, promoting innovation and providing greener options for an ageing society.

Human activities are disturbing the Earth's natural cycles, propelling it into the Anthropocene with more uncertainty (Steffen et al., 2011; Steffen et al., 2018). This era is characterized by urbanization and globalization, highlights two significant challenges, climate change and ecological crisis. In this context, social equity becomes crucial, particularly in protecting marginalised groups from climate adversities (Heyd, 2021). The era also underscores the need for integrated approaches that combine climate action with economic growth and human wellbeing (Pincetl, 2017; Angeler et al., 2020; Cork et al., 2023). While the 'Silvering Anthropocene' describe a new phase where increased ageing demographic intensifies challenges for sustainable development. According to the UN, the global population aged 65 and above is expected to grow from 10% in 2022 to 16% by 2050 (Gerland et al., 2022), impacting labour, industry, and consumer patterns, and highlighting ageing's potential to drive economic opportunities (Laperche et al., 2019). The silver economy, which includes public and consumer spending related to ageing, and industrial opportunities aimed to older adults (Lipp and Peine, 2022), reframes concerns around rising healthcare and pension costs, and a shrinking workforce and tax base, by highlighting the economic opportunities of this demographic shift. China, the largest developing economy, the rapidly ageing population is seen as vital to future consumption-oriented economy (Smith et al., 2014; Feng et al., 2020; Han et al., 2020; Xu and Liu, 2023). At the first China State Council executive meeting of 2024, China's government prioritized

the silver economy to a key part of the national socio-economic strategy (CGTN, 2024), recognising its potential to fuel growth across various sectors.

To align the goals set at the 20th National Congress of the CPC, promoting a green ecology and harmonious human-nature coexistence becomes paramount (Xue et al., 2023). Within the framework of whole nationwide climate action and pursuit of a green lifestyle, integrating the silver economy with low-carbon innovation emerges as a key sustainable development strategy in the Silvering Anthropocene. This approach not only addresses the needs and potential of an ageing population but also meets with China's broader environmental goals.

2 Convergence of the silver economy and green finance: exploring possibilities and feasibility

Green finance is recognized as an approach to mitigate the negative environmental effects of human actions since the Industrial Revolution, it underscores the importance of harmonizing economic progress with environmental conservation (Vitousek, 1994; Steffen et al., 2011; Udeagha and Ngepah, 2023). Developed nations, especially the European Union with its pioneering carbon emissions trading, have led green finance initiatives (Berrou et al., 2019; Zhang, 2023). In recent years, China has acknowledged green finance's role in sustainable development and launched initiatives supporting environmental improvement and efficient resource use (Hu J. et al., 2021; Lv et al., 2021; Gu et al., 2023). Green finance transcends being merely an economic instrument; it signifies China's dedication to embedding environmental awareness within its financial and development policies. The Chinese government supports green finance through regulatory measures, fiscal incentives, and public-private partnerships. Including green bonds, loans, and eco-friendly project investments (Tolliver et al., 2019; Bei and Wang, 2023; Sun et al., 2023). Empirical studies have demonstrated that China's green finance policies have indeed fostered the performance of green operations and corporate environmental responsibility, contributing broadly to the green transformation of the economy (Hu J. et al., 2021; Irfan et al., 2022; Huang et al., 2023; Zhang, 2023). Amidst the accelerating ageing, the emerging silver economy, aligned with China's low-carbon and ecological sustainability goals, could offer new domains for green finance.

When green finance intersects with the silver economy, there are many inherent interactions between these two concepts. The expansion of older population introduces new market demands, especially in healthcare, leisure, and housing modifications (Brink, 2023), spurring innovation and the emergence of markets like health management and smart home technologies (Selim, 2020). Their consumption patterns are significantly shaped by health, environmental awareness, and socioeconomic status (Menz and Welsch, 2012; Pais-Magalhães et al., 2022). For example, energy use typically increases during retirement compared to middle age, and in high-income countries, the elderly may prefer energy-intensive goods (Bardazzi and Pazienza, 2017). Their dependence on climate control systems like air conditioning and heating for comfortable living highlights the intersection of their needs with environmental concerns (Rhoades et al., 2017; Chang et al., 2022). One study suggests that retirement could lead to an annual increase of 1.71 billion kilowatt-hours in electricity use of China, representing 0.17% of national residential consumption (Zhu and Lin, 2022). Also, the essential need for accessible modifications is arising, such as in the U.S., where the lack of accessible facilities in bathrooms, has led to older adults incurring costs in the billions due to falls (Cisneros et al., 2016).

But from another point, older adults tend to prefer environmentally friendly and energy-efficient products and services, significantly contributing to the promotion of green consumption (Pillemer et al., 2021; Yin and Shi, 2021; Pais-Magalhães et al., 2022). Their preference for eco-friendly products and services, such as investment in solar energy equipment and household renovation, also older adults value the social prestige associated with their environmentally friendly actions, such as driving hybrid cars (Hur et al., 2015; Bardazzi and Pazienza, 2017). It is indicating a shift towards low-carbon development in related industries (as energy-efficient household products, healthy food, and green transportation) (Wrapson and Devine-Wright, 2014; Papadopoulos et al., 2016; Kim et al., 2018; Shahsavar et al., 2020; Li et al., 2024). Therefore, older adults possesses vast potential in promoting green production and lifestyles, their life experiences, combined with an acknowledgment of sustainable living and the need for a healthy environment, position them as active proponents of green lifestyles (Rhoades et al., 2017; Kriebel-Gasparro, 2022; Hampton and Whitmarsh, 2023). Their preference for green products can drive market demand towards more sustainable offerings, encouraging industries to innovate and adapt.

The growth of the silver economy in China is prompting the development of products and services tailored to older adults, which not only meet their unique needs but also drive market diversification and technological advancement. These emerging needs are where green finance can play a role. Moreover, China's modern urban and town development, guided by the principles of 'green, low-carbon, and ecological liveability' (Qiu et al., 2021; Chen et al., 2022), also including green construction and renewable energy use. The age-friendly modifications of infrastructure and housing must concurrently address eco-liveability (Frederick, 2022). Green finance can serve a key function in fostering these sectors, blending the silver economy's evolution with environmental sustainability.

3 Low-carbon innovation in the silver age: strategies and prospects

In the Silvering Anthropocene, integrating the silver economy and green finance is key to constructing an eco-friendly system in China. This integration uses the strengths to create a cohesive framework that addresses both the environmental and socio-economic aspects of ageing. China's first policy document on the silver economy clearly defines its key areas, including pension finance, geron-product innovation, smart elderly care industries, and age-friendly infrastructure modifications (General Office of the State Council Operation, 2024). While, pension finance is a key driver of China's silver economy (valued at approximately one trillion US dollars)

development, and both pension and green finance are focal points of financial initiatives under close government scrutiny (XinhuaPress, 2023). So, the integration of the silver economy with green finance is not only possible but also highly feasible. By deeply exploring the potential of green finance in contributing to the silver economy, combined with policy support and industrial innovation, new approaches can be developed to address the challenges of an ageing population. This exploration of integrated development models can also provide robust support for promoting the green and low-carbon transformation of the economy and society. Green finance as the enabler, can play a crucial role in funding these initiatives, providing the necessary capital for green technology development and incentivizing businesses to create eco-friendly solutions for older adults. Those green finance measures were concentrated on that can be utilized to boost the silver economy:

A. Investment in eco-friendly healthcare technologies: China's silver economy is large, with a significant need for innovative products. However, it is not well developed now, such as current internet-based caregiving platforms have not fully resolved caregiver market flaws (Hu Y. et al., 2021). Investments in geron-products, like accessible transport, would promote a low-carbon silver economy.
B. Funding energy-efficient housing for older adults: Ageing in place offers clear benefits, with U.S. data indicating that its integration with the sharing economy could halve the costs of elderly care (Miller et al., 2020). Yet, this requires accessible modifications. Green finance, potentially in combination with pension finance like reverse mortgages, can fund modifications in elderly-oriented housing, including sustainable heating and cooling systems that both meet seniors' comfort needs and help reduce energy use.
C. Promoting green lifestyle among older adults: China's policy framework advocates for dedicated zones for silver economy, including smart healthcare and elderly-oriented travel services. Also according to expert from the Asian Development Bank, developing age-friendly cities should be a key direction of China's green urbanisation (Rau, 2021). Thus, green finance should target sectors important to elderly lifestyles, such as investments in emerging retirement communities and the creation of carbon-neutral living spaces, promoting eco-friendly practices among seniors.

4 Conclusion

Investigating how to integrate the silver economy and green finance is vital for achieving the goals of sustainable development, especially to highlight the crucial role of ageing in fostering green transitions. We underscore the necessity of a multidimensional approach that blends economic, social, and policy innovations to align the welfare of older adults with environmental sustainability, amidst the challenges of the Silvering Anthropocene. Grounded in sustainable development and low-carbon transition theories, existed research have acknowledged the health benefits of the silver economy for older adults and their ability to influence communities through green lifestyles, but also overlooked the potential of green finance to drive the silver economy's low-carbon transformation (Kweon et al., 1998; Hong et al., 2018; Mason and Rigg, 2019; Ayalon et al., 2022). The integration of green finance into the silver economy could encounter social equity challenges, such as disparities between older adults' purchasing power and their willingness to buy specific products, alongside questions about the cost-effectiveness of these initiatives, necessitating further empirical exploration. Also, seniors might face difficulties using eco-friendly digital products, while elderly-oriented technology training could mitigate these risks (Zhang et al., 2023). As global challenges like ageing and climate action intersect more with the expanding silver economy, proactive strategies enhancing green finance's efficiency are crucial. If China could expand its application of green finance within the silver economy, it might provide valuable insights for the Global South, supporting the low-carbon transformation of the global ageing industry. This paper innovatively links green finance and the silver economy, emphasizing how demographic shifts can merge with eco-oriented green finance. By investing in green ageing product innovations, supporting environmentally oriented local elderly care, and building green communities, this approach could support low-carbon goals at the product-household-community level.

Author contributions

CZ: Conceptualization, Funding acquisition, Writing–original draft. SL: Writing–original draft. GC: Conceptualization, Funding acquisition, Supervision, Writing–review and editing. SH: Supervision, Writing–review and editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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