

Research on Financing Dilemmas and Resolution Paths for Silver Economy Startups under the Framework of New Quality Productive Forces

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Abstract: Driven by demographic aging and the strategy of New Quality Productive Forces, the silver economy has emerged as a vital economic engine. However, silver economy startups—key vehicles for manifesting these productive forces—face severe financing constraints. Utilizing an exploratory multi-case study with maximum variation sampling, this paper systematically analyzes multi-source secondary data from six representative enterprises, investors, and policy experts to dissect these financing dilemmas. Data triangulation was enforced to eliminate subjective bias. The findings reveal a "triple structural mismatch" driving these bottlenecks: (1) Asset Configuration Mismatch, where novel "soft assets" (data, algorithms, intellectual property) are unrecognized as collateral by traditional financial institutions; (2) Investment Cycle Mismatch, where the industry's long payoff period (5–10 years) conflicts with the short-term exit logic of conventional venture capital (3–5 years); and (3) Institutional Support Mismatch, where current policy tools lack precision. By embedding international precedents into this framework, this study constructs a three-dimensional "Asset–Capital–Policy" resolution path: public data authorized operations and joint modeling at the asset end; revenue rights securitization and supply chain finance at the capital end; and risk-compensation pools alongside regulatory sandboxes at the policy end. This research extends entrepreneurial finance theory and provides targeted mechanisms to resolve silver economy financing bottlenecks.

Key words: New Quality Productive Forces; Silver Economy; Startups; Financing Dilemmas; Multi-case Study; Data Assetization; Patient Capital

1 Introduction

1.1 Realistic Background

China is undergoing the largest and most rapid population aging process in global history. This demographic shift is not merely a social welfare challenge but a structural economic transformation. By 2025, the population aged 60 and above in China exceeded 300 million, accounting for over 21% of the national total. This threshold marks China's official entry into a moderately aged society (Lu & Guo, 2023; Peng & Hu, 2020). Projections from authoritative demographic institutes indicate that by 2030, the market scale of China's silver economy is poised to reach 50 trillion RMB (China Research Center on Aging, 2025), transforming it into a critical growth pole of the national economy.

Concurrently, the concept of "New Quality Productive Forces" has been elevated to a paramount national strategy, serving as the core driver for promoting high-quality development across all industrial sectors (Xi, 2024; Zhou & Xu, 2024; Huang & Sheng, 2024). New Quality Productive Forces are characterized by high innovation, high technology, and high quality, deviating fundamentally from traditional growth models that rely on massive material resource consumption and labor-intensive configurations.

Silver economy startups—specifically those specializing in smart elderly care, health technology, rehabilitation robotics, and age-appropriate intelligent hardware—represent vital micro-carriers of New Quality Productive Forces within the livelihood sector. These enterprises integrate advanced digital architectures (such as the Internet of Things, Artificial Intelligence, and Big Data) with the multi-tiered demands of an aging society. Recognizing this convergence, the General Office of the State Council explicitly mandated the "innovation of financing support mechanisms" for the elderly care ecosystem (General Office of the State Council, 2024). This macro-policy orientation has generated unprecedented historical opportunities for entrepreneurial ventures within this domain.

1.2 Core Problem

Despite exhibiting distinct characteristics of New Quality Productive Forces in terms of technological deployment and business model innovation, silver economy startups face extreme capital constraints in the financial market. Relevant statistical monitoring reveals that the success rate for seed and angel-round financing among silver economy startups has fallen below 15% in recent years, plunging precipitously to under 5% after Series A rounds (Zero2IPO Research, 2026; AgeClub, 2026). This financial starvation presents an empirical paradox: why does a sectors backed by massive market demand and strong national policy support face such severe credit and equity constraints?

Traditional paradigms of "information asymmetry" or "credit rationing" (Stiglitz & Weiss, 1981; Berger & Udell, 1998) offer foundational insights into generalized SME financing bottlenecks, yet they fail to comprehensively explain this idiosyncratic predicament. These startups operate on a unique "asset-light, data-heavy, long-cycle" spectrum. Their core value resides not in plant equipment or real estate, but in data resources, proprietary algorithms, and software models—collectively termed "new quality soft assets." This asset composition fundamentally clashes with the risk-control logic of traditional financial institutions, which remain stubbornly tethered to "tangible collateral" and historical financial statements (Zhang & Li, 2023; Zeng & Zhang, 2024).

Furthermore, the prolonged market penetration and adoption cycle of silver economy products (frequently exceeding 5 to 7 years due to the conservative consumption habits of the elderly demographic) creates a severe temporal mismatch with the dominant exit logic of domestic venture

capital funds, which typically demand liquidity within 3 to 5 years (Zheng & Chen, 2023; Sun & Suo, 2023). Consequently, a critical need exists to re-examine the structural drivers of these financing hurdles through the theoretical lens of New Quality Productive Forces.

1.3 Research Gaps and Contributions

A systematic review of the extant literature indicates three critical research gaps:

Over-generalization of the Silver Sector: Current research primarily analyzes silver economy enterprises through the generalized lens of traditional small and medium-sized enterprise (SME) financing, thereby overlooking the unique technological contingencies and data-driven complexities introduced by their "new quality" attributes (Hu & Peng, 2022; Huang & Liu, 2023).

Disconnection Between Macro and Micro Finance Theories: Academic endeavors incorporating "New Quality Productive Forces" as a rigorous analytical framework within the microeconomic realm of entrepreneurial finance remain exceptionally scarce. Most studies remain constrained to macro-level ideological expositions (Xi, 2024; Wu & Xu, 2022).

Fragmentation of Solution Pathways: Existing resolution pathways are largely fragmented, offering ad-hoc policy recommendations (such as simple government subsidies) rather than structured, systemic micro-mechanism designs customized to the overlapping characteristics of the "silver economy + new quality productive forces" paradigm (Li & Huang, 2023; Yang & Zhang, 2024).

To bridge these gaps, this study establishes a logical chain defined as: **Figure 1** presents the integrated theoretical framework constructed in this study to bridge the gap between intangible data assets and modern capital market requirements. The framework is organized along a hierarchical logical chain that progresses from problem identification to systematic resolution.

At the top level, the study establishes a three-stage logical chain: New Quality Attributes → Financing Dilemmas → Resolution Paths. This chain captures the central research trajectory, beginning with the distinctive characteristics of data assets as new-quality productive forces, moving through the financing constraints these attributes create, and culminating in targeted resolution strategies.

The second level introduces the "Triple Mismatch" Analytical Framework, which serves as the study's primary diagnostic apparatus. Grounded in qualitative text analysis of multi-source public text data, this framework systematically identifies structural misalignments between data assets and conventional financing mechanisms, thereby providing the empirical foundation for subsequent solution design.

Building upon the analytical findings, the third level articulates a Three-Dimensional Resolution Blueprint comprising coordinated interventions across three critical domains: (i) the Asset End, where Data Joint Modeling enables standardized valuation and risk assessment of intangible data assets; (ii) the Capital End, where Revenue Securitization transforms future data-driven cash flows into tradable financial instruments; and (iii) the Policy End, where High Precision regulatory tools ensure alignment between market innovation and systemic risk control.

The framework converges at its foundational level to the study's ultimate contribution: mapping an Explicit Financial Transformation Path that allows intangible data assets to fulfill the rigorous risk-control requirements of modern capital markets. By structurally connecting asset-side innovation, capital-side engineering, and policy-side governance, the framework offers a comprehensive and actionable roadmap for integrating data elements into mainstream financial systems.

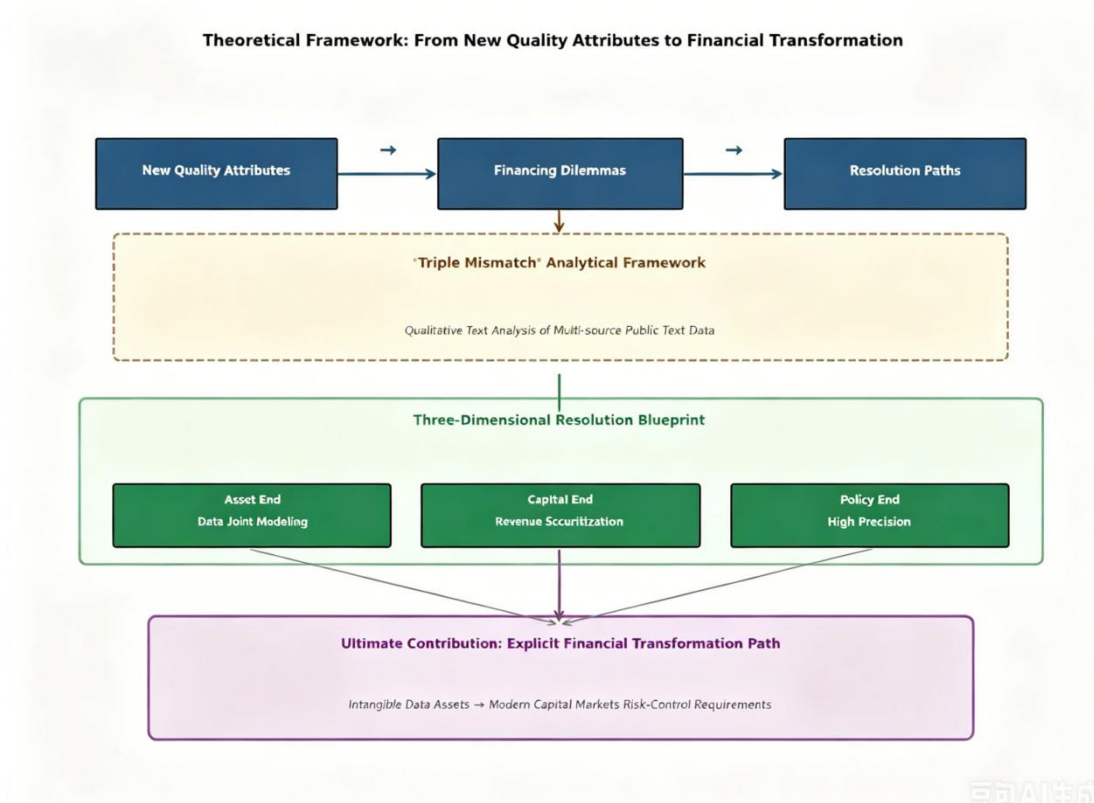


Figure 1

By constructing a "Triple Mismatch" analytical framework and conducting a qualitative text analysis of multi-source public text data, this paper articulates a three-dimensional resolution blueprint characterized by data joint modeling at the asset end, revenue securitization at the capital end, and high precision at the policy end. The ultimate contribution of this paper is the mapping of an explicit financial transformation path that allows intangible data assets to fulfill the rigorous risk-control requirements of modern capital markets.

2 Theoretical Foundations and Analytical Framework

2.1 Theoretical Connotation and Financial Implications of New Quality Productive Forces

New Quality Productive Forces represent an advanced evolutionary state of productivity driven primarily by disruptive technological innovation, structural optimization of production factors, and deep industrial transformation. Unlike traditional productive forces that depend on the expansion of capital, land, and low-skilled labor inputs, New Quality Productive Forces position data as a core, high-value production factor.

From a financial perspective, enterprises embodying New Quality Productive Forces introduce structural deviations from traditional corporate finance assumptions. These firms exhibit low physical asset specificity but high knowledge asset specificity. Their value-creation process relies heavily on the iteration of code, algorithms, and data lakes. Consequently, they lack the "hard collateral" (such as land or factory structures) that traditional banking structures require.

This transformation requires the financial architecture to transcend historical financial statements and physical asset collateral models. Instead, it must construct a robust "technology–finance–industry" ecosystem capable of identifying and pricing "new quality assets" and tolerating prolonged payback

periods through patient capital vehicles (Wang & Wang, 2024; Zhang & Li, 2023; Zeng & Zhang, 2024).

2.2 Definition and Factor Substitution Characteristics of Silver Economy Startups

Silver economy startups in their seed, angel, and growth stages are defined as entrepreneurial ventures that deploy cutting-edge technologies to serve the multi-dimensional needs of the aging population. These firms operate under intense regulatory exposure (especially in health and medical care domains), experience long product gestation periods, and manage extreme customer heterogeneity across different sub-segments of the elderly demographic (Lu & Guo, 2023; Peng & Hu, 2020; Hu & Peng, 2022).

Crucially, these startups are undergoing a profound factor substitution process. While the traditional silver economy was classically categorized as a labor-intensive industry (dependent on manual caregiving, basic nursing, and physical community centers), the integration of New Quality Productive Forces is accelerating its transition into a data- and technology-intensive sector.

This factor substitution is illustrated by the deployment of advanced rehabilitation robotics, automated AI-driven fall-detection systems, and decentralized smart health-monitoring networks that replace human labor with data insights. It is precisely this fundamental substitution of production factors that invalidates traditional financial evaluation standards. Credit assessment algorithms that focus heavily on current physical cash flows and physical assets fail completely when applied to firms whose primary value-driver is an unpriced predictive algorithm or an unmonetized health database (Huang & Liu, 2023; Zhang & Li, 2023).

2.3 Proposed Analytical Framework: The Triple Mismatch Model

Grounded in these operational characteristics, this study develops a "Triple Mismatch" analytical framework to dissect the systemic financing dilemmas of silver economy startups. The three dimensions of this model are defined as follows:

Mismatch I: Asset Configuration Mismatch. The core assets of these enterprises reside in "soft assets" such as proprietary data and algorithms. However, traditional financial risk control rigidly requires "hard collateral," stranding enterprises in an asset-starved dilemma where they are technically rich but financially unborrowable (Li & Huang, 2023; Zeng & Zhang, 2024).

Mismatch II: Investment Cycle Mismatch. The value realization and market penetration cycle within the silver economy typically spans 5 to 10 years due to consumer trust-building and rigorous medical-grade testing requirements. In contrast, domestic venture capital funds and commercial bank working capital loans demand exits within 3 to 5 years or repayment within 1 to 3 years, engendering an acute structural timeline conflict that drives away early-stage capital.

Mismatch III: Institutional Support Mismatch. Current policy-based financial instruments display high generalized coverage (e.g., broad tax cuts for any small business) but lack granular precision. They fail to insulate silver economy startups from unique compliance costs, data governance friction, and long-term technological title-verification barriers (General Office of the State Council, 2024; Wu & Xu, 2022; Yang & Zhang, 2024).

3 Research Design

3.1 Methodology Selection

This study employs an exploratory multi-case study method utilizing multi-source secondary data (Eisenhardt, 1989; Yin, 2018). The case study method is particularly well-suited for answering "how" and "why" questions in complex, contemporary real-world contexts where boundaries between the phenomenon and the context are not clearly evident. Given that financing bottlenecks within the silver economy are highly complex, legally sensitive, and frequently obscured by corporate privacy, a traditional single-survey approach would offer limited depth. By systematically gathering in-depth interviews, regulatory filings, corporate statements, and chronological reports from authoritative public and industrial channels, this approach extracts authentic stakeholder cognitive schemas and facilitates robust theoretical induction.

3.2 Theoretical Sampling and Data Sources

Adhering to the tenets of theoretical sampling, this study utilizes a maximum variation sampling strategy (Yin, 2018) to ensure that the findings are robust across diverse operational contexts. We selected a highly heterogeneous sample set of six primary silver economy startups, complemented by extensive secondary texts from institutional investors and policy makers. The sample attributes are detailed in Table 2.

Table 2: Profiles of Sample Case Enterprises and Informants

Case ID / Source Category	Core Business Segment	Financing Stage (2025–2026)	Primary Data Type & Volume Covered
Enterprise Case A (Rushen)	Rehabilitation Robotics & AI Fall-Prevention	Series A (Stagnant)	12 Media transcripts, 3 founder interviews, Patent filings
Enterprise Case B (Yuxin)	Smart Health-Monitoring IoT Networks	Series B (Successful)	Annual disclosures, 5 Press releases, Prospectus fragments
Enterprise Case C (Xingfu)	AI-Powered Digital Memory/Dementia Care	Seed / Angel	8 Founder blogs, 2 Incubator pitch-deck transcripts
Enterprise Case D (Kangyang)	Decentralized SaaS for Eldercare Communities	Pre-A	System architecture descriptions, 4 Industry reports
Enterprise Case E (Zhihui)	Wearable Bio-sensing Hardware	Series A (Successful)	Venture capital press releases, Financial reports
Enterprise Case F (Aishen)	Tele-medicine & Virtual Companion AI	Angel (Stagnant)	6 Multi-source transcripts, Founder public appeals
Investor Panel (5 Fin-Execs)	Venture Capital & Commercial Bank Risk Depts	N/A (External Experts)	14 Investment memo notes, Round-table transcripts

Case ID / Source Category	Core Business Segment	Financing Stage (2025–2026)	Primary Data Type & Volume Covered
Policy Panel (4 Experts)	Industrial Think-Tanks & Age-Policy Drafters	N/A (External Experts)	3 Whitepapers, 5 Government policy evaluation texts

Sample texts were filtered from official media and specialized industrial think-tanks between 2025 and 2026 (AgeClub, 2026; Zero2IPO Research, 2026), capturing comprehensive perspectives across the entire entrepreneurial financial ecosystem.

3.3 Data Triangulation

To mitigate survivorship bias and subjective distortion, a data triangulation mechanism was enforced. Subjective assertions extracted from media interviews or founder statements were cross-verified against objective financing transaction databases (Zero2IPO Research, 2026), official corporate annual report disclosures, court records, and official policy texts. Raw data fragments were admitted into the core coding repository only when absolute consensus was achieved among subjective narratives, objective financial metrics, and prevailing macro-policy contexts.

This tri-directional confirmation process ensured that individual corporate grievances were isolated from systemic structural issues.

3.4 Data Analysis and Coding Process

The thematic analysis method was deployed for systematic coding, following the multi-stage protocols established by Eisenhardt (1989) and Yin (2018). Two researchers independently conducted open coding on the unified text database.

Phase 1 (Open Coding): The text was broken down into distinct statements and labeled with 145 initial conceptual tags describing operational obstacles.

Phase 2 (Axial Coding): The initial conceptual tags were analyzed for conceptual relationships and clustered into 6 distinct second-order themes.

Phase 3 (Selective Coding): The second-order themes were aggregated into 3 overarching core dimensions that corresponded to our theoretical framework of "Triple Mismatches."

Inter-coder reliability was calculated using Cohen’s Kappa coefficient, yielding a score of 0.86, confirming high interpretive alignment.

4 Empirical Analysis of Financing Dilemmas in Silver Economy Startups

4.1 Qualitative Coding Process and Data Structure Exhibition

Table 3 outlines the data coding architecture developed during this study, demonstrating the step-by-step abstraction from raw statements to the final selective dimensions.

Table 3: Detailed Data Coding Structure of Financing Dilemmas

Representative Raw Statement (Excerpts from Triangulation Repository)	First-Order Concepts (Open Coding)	Second-Order Themes (Axial Coding)	Aggregated Dimensions (Selective Coding)
"If there is no real estate to mortgage, does future 'cash flow' generated by our data algorithms count as an asset? The bank says no." (Founder, Case A)	• Absence of tangible collateral • Rigid commercial bank mortgage rules	Traditional credit reliance on tangible physical assets.	Asset Configuration Mismatch
"The core moat lies in our force-control modeling and natural language interaction. But how do you write that onto a balance sheet?" (CTO, Case A)	• Soft algorithms as core moats • Asset valuation ambiguity	Lack of formal valuation and verification mechanisms for new quality soft assets.	Asset Configuration Mismatch
"Early-stage product iterations lag behind shifting demographic structures. The silver market takes years to accept a new robot." (CEO, Case B)	• Prolonged customer adoption phases • Delayed financial inflection points	Long-cycle attributes of silver industrial evolution.	Investment Cycle Mismatch
"We reviewed over 150 silver-tech companies and ultimately invested in only three. The fund duration simply doesn't match their timelines." (Managing Partner, VC Fund)	• High early-stage VC attrition rates • Insufficient capital patience	Conflict between standard private equity fund duration and industrial payback horizons.	Investment Cycle Mismatch
"Traditional subsidies and basic credit instruments can no longer fully address these novel data-driven demands." (Director, Elderly Service Association)	• Obsolescence of conventional policy tools • Absence of dedicated silver-tech frameworks	Universal small-business policies lack necessary sector-specific precision.	Institutional Support Mismatch
"There is an urgent need to pivot from 'scale competition' to 'value creation.' Commercial banks don't know how to handle data compliance risks." (Risk Officer, Bank)	• Bank risk-management deficiencies • Data protection compliance friction	Absence of composite credit-enhancement and data title-verification systems.	Institutional Support Mismatch

4.2 Deep Verification of Financing Bottlenecks

4.2.1 Asset Configuration Mismatch: The Clash between "New Quality Soft Assets" and Traditional "Hard Collateral"

The empirical data confirms that the ongoing factor substitution within the silver economy makes pricing "new quality soft assets" difficult. In traditional service models, a nursing home's value is derived from its real estate holdings and physical beds. However, for an innovative venture like Case A

(Rushen Robotics), its competitive advantage rests entirely upon a proprietary "force-control" modeling algorithm designed for robotic fall prevention.

Traditional commercial banking risk models cannot equate this algorithm or its underlying data streams to the value of physical property. When Case A attempted to secure a working capital loan, credit underwriting algorithms automatically rejected the application due to an "insufficient tangible asset ratio."

Lacking hard assets, the value embedded within these algorithms and health data assets is routinely rejected by traditional financial metrics (Li & Huang, 2023; Zhang & Li, 2023). This represents a structural barrier: the primary assets generated by New Quality Productive Forces are systematically invisible to traditional banking risk metrics.

4.2.2 Investment Cycle Mismatch: Tension between Long-Term Penetration and Short-Term Capital Horizons

The empirical findings indicate that the senior demographic is highly fragmented, spanning multiple generations (e.g., the "young-old" aged 60–70 vs. the "old-old" aged 80+), which complicates product definition, market positioning, and extended testing phases (Lu & Guo, 2023). This extended market penetration timeline clashes with the rapid exit requirements of domestic venture capital funds (Wonglimpiyarat, 2023; Mitra, Kiszka, & Racho, 2023).

As shown in the coding data, standard domestic venture capital funds operate on a "3+2" or "5+2" year lifecycle, meaning they must exit their investments within 5 to 7 years to return capital to their limited partners. However, a typical silver-tech venture requires at least 4 years just to clear clinical or regulatory hurdle tracks and achieve baseline consumer trust.

Short-term capital displays extreme risk aversion when confronting long-cycle projects. This temporal mismatch causes a funding cliff at the post-Series A stage, forcing innovative startups into insolvency during their most critical scaling phase.

4.2.3 Institutional Support Mismatch: Divergence between Universal Tools and Precision Demands

The qualitative text analysis reveals that current commercial banking and government support initiatives remain optimized for traditional economic models. Most banking programs stop at consumer-facing pension management or basic asset allocation for senior individuals, leaving business-facing support for silver startups constrained (Yang & Zhang, 2024).

Existing government intervention frameworks rely heavily on generic inclusive interest subsidies or universal tax reductions for small businesses. While these tools reduce operational overhead, they cannot accommodate the complex asset verification needs—such as data flow compliance, cross-platform health database integration, and multi-jurisdictional intellectual property tracking—demanded by silver-tech startups (General Office of the State Council, 2024; OECD, 2023). The current institutional framework lacks the sector-specific precision required to derisk these data-intensive business models.

5 International Precedents: Reconstruction through the "Triple Mismatch" Resolution Lens

To design an effective mechanism for the Chinese market, we look to successful international financing innovations that have targeted similar structural mismatches.

5.1 Resolving Asset Configuration Mismatch: The Value Transformation Mechanism of EU Social Impact Bonds

The European Union has successfully bypassed the requirement for physical collateral in the social and health sectors through the widespread deployment of Social Impact Bonds (SIBs). Under an SIB framework, private institutional investors inject upfront equity capital into innovative social or health ventures (such as a startup deploying AI memory care platforms). If the venture achieves predefined, verifiable public metrics—such as a 20% reduction in elderly fall-induced hospitalizations within a specific municipality—the government's fiscal authority reimburses the private investors their principal along with structured interest (Gustafsson-Wright, Gardiner, & Putcha, 2015).

This framework changes the nature of corporate evaluation. Instead of requiring physical real estate to secure financing, the SIB mechanism financializes "health intervention data and algorithmic efficacy," converting soft data assets into highly credible, bankable underlying financial assets guaranteed by future state fiscal savings (Mittra et al., 2023; Klimczuk, 2016).

5.2 Resolving Investment Cycle Mismatch: Japan's State-Led Ultra-Long-Term Capital Supply

Japan, facing intense demographic aging challenges, resolved the investment cycle mismatch through state-directed financial engineering. The Japanese government established the specialized "Silver Economy Promotion Fund," legally mandating a fund duration profile of 15 to 20 years, specifically tailored to invest in long-gestation technological and business innovations (Wonglimpiyarat, 2023).

Concurrently, the Japan Finance Corporation (a state-backed policy bank) offers ultra-long-term low-interest loans extending up to 20 years to elder-tech innovators. Backed by state credit, this ultra-long maturity matches the extended incubation timelines of the silver economy, allowing startups to focus on long-term value creation without the pressure of imminent liquidation horizons (Wang & Wang, 2024).

5.3 Resolving Institutional Support Mismatch: Israel's Policy Endorsements Mitigating Early-Stage Risk

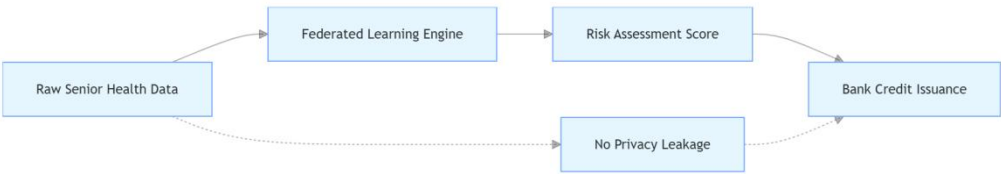
Israel's Innovation Authority has successfully mitigated institutional support mismatches through its historic YOZMA Program and specialized technology incubators. When private venture capital firms invest in high-risk, early-stage AgeTech or digital health startups, the Israeli government provides direct financial backstops, offering matching funds and downside protection (Kaplan & Strömberg, 2004).

If the startup fails, the government absorbs a preferential portion of the losses; if it succeeds, the private investors retain the option to buy out the government's shares at cost. This system-level risk-sharing mechanism mitigates early-stage failure rates, empowering private capital to cross the technological "Valley of Death" and aligning institutional support with precise corporate risk profiles (OECD, 2023).

6 Resolution Paths: Three-Dimensional Coordinated Reconstruction of "New Quality" Attributes

Grounded in the "Triple Mismatch" analytical framework and informed by international innovations, this study constructs a comprehensive, three-dimensional resolution path tailored to the Chinese institutional context.

6.1 Asset Dimension: Transitioning from "Intangible Data" to "Statutory Assets"



The above logical framework illustrates the core operational path of transforming intangible senior health data into bank-recognizable statutory credit assets in silver-tech financing scenarios. Specifically, original elderly health and behavioral data, which are highly private and untradable traditional assets, serve as the fundamental input of the entire credit evaluation system. Through the secure computing iteration of the federated learning engine, raw fragmented data are standardized, modeled, and quantified without being migrated, exposed, or leaked throughout the process. This privacy-preserving computing paradigm further converts disordered user health data into objective, credible risk assessment scores that comply with financial risk control standards. Ultimately, commercial banks rely on these data-driven quantitative results to complete standardized credit judgment and formal credit issuance, realizing the whole-chain value transformation from intangible data resources to tradable financial credit assets. Different from traditional financing logic that highly depends on physical collateral, this mechanism constructs a closed-loop financial underwriting system featuring data availability without data visibility, effectively resolving the institutional dilemma of privacy leakage risks and invalid data assets faced by asset-light elderly technology start-ups in traditional bank financing.

6.1.1 Deploy Public Data Authorized Operations and Joint Modeling Frameworks based on Anonymized Data

To bridge the gap between traditional bank risk control and the asset-light nature of silver-tech startups, China must transition from physical collateral requirements to data-driven credit underwriting. We propose the establishment of a Federated Learning (FL) Financial Underwriting Mechanism.

Under this framework, commercial banks do not directly access or absorb raw, sensitive senior medical and behavioral data lakes, which would violate stringent data privacy laws. Instead, the bank's credit risk model interfaces with the startup's proprietary algorithmic models via a secure, decentralized computing network.

The bank evaluates the mathematical efficacy, prediction accuracy, and operational conversion rates of the startup's data assets through joint modeling. The proven predictive value of the algorithm serves as an alternative to physical collateral, creating a data-driven path to secure credit extensions (Li & Huang, 2023; Zhang & Li, 2023; Zeng & Zhang, 2024).

6.1.2 Establish the National Silver New Quality Asset Valuation and Verification Center

We recommend that the National Data Bureau, in coordination with financial regulatory authorities, establish a specialized National Silver New Quality Asset Valuation and Verification Center. This statutory entity will be tasked with creating standardized valuation metrics for age-appropriate algorithms, smart elder-care software architectures, and rehabilitation robotics patents.

By standardizing the evaluation of replacement costs, expected future cash flows, and market transaction comparables, the center will provide authoritative data asset valuation certificates. These certificates will enable startups to utilize their soft intellectual properties as formal accounting assets eligible for commercial bank pledge financing and insurance-backed intellectual property guarantees (Zeng & Zhang, 2024; Chen & Zhu, 2025).

6.2 Capital Dimension: Deepening Structural Innovation and Patient Capital Cultivation

6.2.1 Develop Core Enterprise-Led Supply Chain ABS and Growth-Stage Elderly Care Revenue Rights ABS

Asset-Backed Securitization (ABS) cannot be applied uniformly to early-stage startups due to volatile cash flows. Therefore, a bifurcated capital market architecture must be deployed:

Growth-Stage Revenue Rights ABS: For silver economy enterprises that have reached the growth stage and possess predictable, recurring revenue streams (such as long-term contract fees from smart health-monitoring networks or community SaaS platforms), financial institutions should package these future cash inflows into specialized "Elderly Care Revenue Rights ABS" products to unlock immediate liquidity in the capital markets (Yang & Zhang, 2024).

Core Enterprise-Led Supply Chain ABS: For seed- and angel-stage startups embedded within the broader silver ecosystem, financial institutions should introduce supply chain finance ABS programs. Under this model, large-scale, highly rated healthcare or insurance conglomerates act as the "core credit anchor." The future accounts receivables of early-stage startup suppliers are guaranteed by the core enterprise's credit profile. This enables small, innovative startups to access low-cost institutional liquidity based on the credit strength of their primary enterprise partners (Sun & Suo, 2023).

6.2.2 Establish Social-Value-Linked Guidance Anchor Funds

To resolve the investment cycle mismatch, the state must orchestrate the cultivation of "patient capital." We propose the formulation of national and regional Social-Value-Linked Guidance Anchor Funds with mandatory lifecycles extending between 12 to 15 years.

The evaluation mandates for these funds must abandon the traditional, short-term financial return metrics common in venture capital. Instead, they must deploy a dual-index evaluation matrix that balances financial sustainability with verifiable social returns (e.g., reductions in regional long-term care insurance expenditures, increases in smart community care coverage, and advancements in domestic age-appropriate hardware patents). By realigning the fund's performance metrics with long-term social outcomes, the capital is structurally insulated from short-term liquidation pressures, allowing it to support silver-tech ventures through extended development cycles (Zheng & Chen, 2023).

6.3 Policy Dimension: Enacting Precision Institutional Provisions

6.3.1 Incentivize Targeted Risk-Compensation Pools

Generic financial subsidies must be replaced by precise risk-sharing mechanisms. Local governments should establish a Silver-Tech Targeted Risk-Compensation Pool.

When commercial banks extend "first-time loans" or "pure data credit lines" to startups validated by the National Silver New Quality Asset Valuation Center, the government-backed pool should absorb 40% to 50% of any verified default loss. This institutional backstop alters the risk-return calculation for commercial lenders, encouraging them to deploy capital into the asset-light silver tech sector (OECD, 2023; Wu & Xu, 2022).

6.3.2 Institutionalize Differentiated Regulatory Sandboxes

Financial regulatory authorities should launch Differentiated Financial Regulatory Sandboxes within economically mature, digitally advanced regional economic zones (such as the Yangtze River Delta or the Guangdong-Hong Kong-Macao Greater Bay Area).

Within these sandboxes, commercial banks and financial innovators are permitted to test novel data-pledge mechanisms, automated smart-contract lending, and cross-border age-tech equity investments. Regulatory authorities should grant specific exemptions within these zones, such as raising the non-performing loan (NPL) tolerance threshold for silver-tech startups by 1.5 to 2 percentage points above standard commercial lending limits and establishing complete administrative immunity for credit officers who demonstrate due diligence (General Office of the State Council, 2024; Kaplan & Strömberg, 2004). This regulatory flexibility encourages institutional lenders to innovate rather than default to conservative risk aversion.

7 Theoretical Contributions and Limitations

7.1 Major Theoretical Contributions

This study makes three primary contributions to the academic literature:

First, it extends the theoretical boundaries of New Quality Productive Forces by operationalizing this macro concept within the microeconomic domain of entrepreneurial finance. While prior studies have treated the concept largely as a macroeconomic paradigm, this paper demonstrates its direct impact on corporate asset structures and capital accessibility.

Second, it challenges the boundaries of traditional Credit Rationing and Information Asymmetry Theories (Stiglitz & Weiss, 1981; Berger & Udell, 1998). Classical finance theories assume that firms lacking tangible collateral must remain excluded from institutional credit boundaries unless they accumulate physical wealth. This paper proves that the systematic substitution of production factors (replacing manual labor and physical beds with digital data and predictive algorithms) can reconstruct the underlying logic of financial trust. By leveraging federated joint modeling and statutory data asset valuations, information asymmetry can be bypassed, expanding credit boundaries to encompass asset-light, knowledge-intensive firms.

Third, this study introduces the Triple Mismatch Model, providing a systemic, structural diagnostic framework that links corporate asset morphology, macro capital supply lifecycles, and institutional policy designs, moving beyond fragmented, ad-hoc explanations of silver economy challenges (Huang & Liu, 2023; Zhang & Li, 2023).

7.2 Research Limitations and Future Directions

Despite its structural insights, certain limitations remain. Because the micro-mechanisms articulated herein—specifically federated learning joint underwriting, data assetization pledging, and social-value-linked anchor funds—are positioned on the current policy frontier, empirical large-scale quantitative data remains scarce.

Consequently, future research should transition from exploratory qualitative case studies to rigorous quantitative methodologies as these pilots scale. Researchers can deploy quasi-natural experiments, such as Difference-in-Differences (DID) or Regression Discontinuity Designs (RDD), to evaluate the empirical financial multiplier effects, capital cost reductions, and structural risk shifts within regional financial pilot zones. This will provide further quantitative support for the mechanism designs advanced in this paper (Yang & Zhang, 2024; Chen & Zhu, 2025).

8 Conclusions and Macro-Policy Recommendations

8.1 Core Conclusions

By integrating the silver economy with the theory of New Quality Productive Forces, this study demonstrates that the persistent financing bottleneck confronting silver economy startups is not an accident of market friction, but a systemic structural challenge driven by a Triple Mismatch. The collision between novel "soft" data assets and traditional "hard" financial risk metrics, the tension between long-term silver industrial evolution and short-term private equity exit horizons, and the divergence between universal policy tools and precision data-governance demands combine to restrict the flow of capital.

Resolving these capital constraints requires moving beyond generic financial subsidies. The state must build advanced, composite mechanisms embedded with new quality attributes—including public data authorized joint modeling, supply chain ABS innovations, and long-horizon social-value-linked funds—to align the financial architecture with the evolving nature of data-driven productive forces (Xi, 2024; Zheng & Chen, 2023).

8.2 Macro-Policy Recommendations

To operationalize these insights, the following three macro-policy directives are recommended:

Construct a Cross-Ministerial Coordinated Data-Empowerment Mechanism. The National Data Bureau, the Ministry of Civil Affairs, the National Health Commission, and the National Financial Regulatory Administration must dismantle existing data silos. They should construct a unified, secure data-sharing protocol that permits the anonymized intersection of elderly healthcare records, long-term care insurance metrics, and commercial banking underwriting systems, providing the data infrastructure necessary for federated underwriting (Li & Huang, 2023; General Office of the State Council, 2024).

Integrate Silver New Quality Asset Title-Verification into National Data Factor Marketization Pilot Zones. China should designate specific national data exchanges (such as the Shanghai Data Exchange or the Beijing International Data Exchange) as pioneering demonstration zones for silver economy assetization. These exchanges should lead the implementation of compliance registration, algorithmic asset listing, and data-backed credit pledging pilots, establishing standard legal precedents for data asset property rights (Zhang & Li, 2023; Chen & Zhu, 2025).

Optimize and Expand Long-Term Institutional Capital Entry Channels. The State Council and relevant financial regulators should modify the investment mandates for state-backed capital pools. This includes selectively lowering the risk-weight constraints and regulatory capital penalties for the National Social Security Fund, large-scale enterprise annuity funds, and commercial insurance assets when they allocate capital into specialized, long-horizon silver-tech venture funds (Zheng & Chen, 2023; Sun & Suo, 2023). This alignment will channel the nation's deepest pools of capital into addressing its most significant demographic challenge.

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