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The Impact of Hyperbolic Discounting on Asset Accumulation for Later Life: A Study of Active Investors Aged 65 Years and over in Japan

Honoka Nabeshima *, Sumeet Lal, Haruka Izumi, Yuzuha Himeno, Mostafa Saidur Rahim Khan and Yoshihiko Kadoya

School of Economics, Hiroshima University, 1-2-1 Kagamiyama, Higashi-Hiroshima 739-8525, Japan; lsumeet@hiroshima-u.ac.jp (S.L.); b221337@hiroshima-u.ac.jp (H.I.); b222992@hiroshima-u.ac.jp (Y.H.); khan@hiroshima-u.ac.jp (M.S.R.K.); ykadoya@hiroshima-u.ac.jp (Y.K.)
* Correspondence: m244041@hiroshima-u.ac.jp

Abstract: Asset accumulation in later life is a pressing issue in Japan due to the growing gap between life expectancy (87.14 years for women, 81.09 years for men in 2023) and the retirement age (65 or less). This gap heightens financial insecurity, emphasizing the need to meet asset goals by 65. Hyperbolic discounting, driven by present-biased preferences, often hinders this process, but empirical evidence for those aged 65 and older remains limited. Moreover, prior research has overlooked the varying impacts of hyperbolic discounting across different wealth levels. This study addresses these gaps by analyzing data from 6709 active Japanese investors aged over 65 (2023 wave) using probit regression. Wealth thresholds are categorized into four levels: JPY 20 million, JPY 30 million, JPY 50 million, and JPY 100 million. The results show that hyperbolic discounting significantly impairs asset accumulation at the JPY 100 million level but not at lower thresholds. This effect likely reflects the complex nature of hyperbolic discounting, which primarily affects long-term savings and investments. The findings underscore the importance of addressing hyperbolic discounting in later-life financial planning. Recommendations include implementing automatic savings plans, enhancing financial literacy, and incorporating behavioral insights into planning tools to support better asset accumulation outcomes.

Keywords: asset accumulation; hyperbolic discounting; financial insecurity; anxiety after retirement; wealth threshold; behavioral finance; financial wellbeing; financial literacy; Japan

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1. Introduction

The accumulation of assets for later life is a pressing issue in Japan due to the extended period during which people live after retirement. The increasing gap between the average life expectancy—87.14 years for women and 81.09 years for men in 2023 (Ministry of Health, Labour and Welfare 2024)—and the mandatory retirement age, which remains at 65 or lower (Ikezoe 2018), creates significant financial challenges. This roughly 20-year gap intensifies insecurity and anxiety about financial futures, emphasizing the need to achieve asset accumulation goals by age 65 for a comfortable later life. In Japan, these goals range from JPY 20 million (USD 130,000) to JPY 168 million (USD 1.1 million) (Financial Council Market Working Group 2019; Nojiri 2023; Nomura Research Institute 2023; Kennedy 2023). However, the Financial Council Market Working Group (2019) reports a nearly 50% disparity between the financial assets held by individuals aged 60 and older and the amount they consider sufficient for later life, underscoring the urgency of addressing this

issue. Hyperbolic discounting, a behavioral bias that leads individuals to favor immediate rewards over long-term benefits, is a key obstacle to achieving these financial goals (Zhang 2013). Several studies (Laibson 1996, 1997, 1998; Angeletos et al. 2000; O'Donoghue and Rabin 1999; Harris and Laibson 2003; Love and Phelan 2015; Janssens et al. 2017; Cagetti 2003; Cao and Werning 2018) suggest that hyperbolic discounting significantly affects asset accumulation, but most rely on theoretical models and simulations. These studies leave a gap in empirical evidence directly exploring the relationship between hyperbolic discounting and real-world asset accumulation. Moreover, they do not focus on individuals aged 65 and older, who face unique financial challenges, nor do they examine how hyperbolic discounting affects asset creation across different asset levels. This study addresses these gaps by empirically investigating the impact of hyperbolic discounting on asset accumulation goals for individuals aged 65 and older. Using regression analysis, it offers novel, data-driven insights to inform policy and financial planning.

This study uses Laibson's (1996, 1997) framework to examine the relationship between hyperbolic discounting and asset accumulation. This theoretical model explains how present-biased preferences negatively impact financial decision-making by reducing the likelihood of consistent saving and investment behaviors, ultimately undermining long-term asset accumulation. Building on this theory, previous studies have extensively explored this relationship. Angeletos et al. (2000) demonstrated that hyperbolic discounting significantly reduces liquid asset savings, with individuals exhibiting present-biased preferences saving considerably less. Laibson (1998) and O'Donoghue and Rabin (1999) further showed that these biases lead to suboptimal investment decisions. Harris and Laibson (2003) expanded on this by highlighting how present-biased individuals are less likely to engage in long-term financial planning, resulting in lower liquid asset holdings. Additional evidence supports these findings. Love and Phelan (2015), Janssens et al. (2017), and Cagetti (2003) demonstrated that hyperbolic discounting significantly decreases the likelihood of accumulating sufficient assets for later life. Cao and Werning (2018) further investigated the conditions under which hyperbolic discounting affects saving and dissaving behaviors, showing that present-biased preferences can lead to either outcome depending on the specific circumstances. Although not directly linked to asset accumulation, recent studies reveal other adverse financial behaviors associated with hyperbolic discounting. These include increased panic selling (Lal et al. 2024), excessive credit card use (Kuramoto et al. 2024), and poor investment decisions (Kang and Ye 2016; Abideen et al. 2023), further strengthening the connection between hyperbolic discounting and suboptimal financial outcomes.

Asset accumulation for later life is critical, yet Japan lacks a national consensus on the exact amount required for a comfortable retirement. This ambiguity stems from a lack of studies focusing on the specific financial assets needed for a worry-free post-retirement life. Household financial assets typically include cash, deposits, stocks, bonds, investment trusts, life insurance, and pension insurance, but the exact amount necessary varies based on individual circumstances. Government agencies often estimate minimum thresholds using factors such as average living costs, life expectancy, and social safety nets. For example, the Financial Council Market Working Group (2019) suggested that an elderly couple needs JPY 20 million for a 30-year post-retirement life, although this figure has been widely debated. In contrast, Kennedy (2023) estimated that JPY 168 million is necessary for a comfortable retirement. Similarly, the Nomura Research Institute (2023) provided benchmarks of JPY 30 million, JPY 50 million, and JPY 100 million for the upper mass retail segment, semi-wealthy, and wealthy populations, respectively. These estimates, however, are often based on average income and spending patterns and may not fully account for individual perceptions of financial security. Japan's current economic uncertainty and

high inflation further complicate the determination of financial adequacy for later life. This study adopts a comprehensive approach by including all asset levels in its analysis, recognizing that hyperbolic discounting may interact differently with various financial thresholds. These differences could significantly influence the financial strategies and decisions of older individuals, especially those who remain active in financial markets while planning for retirement.

This study seeks to address three key research questions: How does hyperbolic discounting influence asset accumulation for later life among individuals aged 65 and older in Japan? Does the impact of hyperbolic discounting vary across different levels of asset accumulation goals, such as JPY 20 million, JPY 30 million, JPY 50 million, and JPY 100 million? Finally, how do sociodemographic and economic factors mediate the relationship between hyperbolic discounting and asset accumulation? Based on these questions, we hypothesize that hyperbolic discounting negatively affects asset accumulation, with stronger present biases leading to lower accumulated assets (H1). Furthermore, we expect this negative effect to be more pronounced for higher asset accumulation goals, as achieving these goals requires greater financial discipline and long-term planning (H2). Additionally, we hypothesize that sociodemographic factors, such as age, health status, and economic conditions, mediate this relationship, with older individuals and those in uncertain economic environments being more adversely affected (H3). These research questions and hypotheses provide a focused framework for examining the role of hyperbolic discounting in shaping financial preparedness for later life in Japan.

This study makes three key contributions to the existing literature. First, it provides the first empirical evidence on how hyperbolic discounting influences asset accumulation needed for later life across different levels in Japan, using a robust dataset. Second, it focuses specifically on active investors aged 65 and older—individuals nearing the end of their life cycles but still actively participating in financial markets. This group offers unique insights into how aging, health issues, and evolving preferences affect hyperbolic tendencies, potentially hindering their ability to accumulate sufficient assets. Third, we categorize later-life asset requirements into four levels—JPY 20 million, JPY 30 million, JPY 50 million, and JPY 100 million—offering a nuanced analysis of how hyperbolic discounting interacts with these thresholds while accounting for sociodemographic and economic factors. The findings can guide policymakers and financial institutions in developing effective financial policies and strategies. These measures could include programs aimed at mitigating hyperbolic discounting to help older active investors better manage their asset accumulation and secure financial stability.

2. Theoretical Background

This study is grounded in behavioral finance theory, particularly Laibson's (1996, 1997) model of hyperbolic discounting, which elucidates how present-biased preferences hinder long-term financial decision-making. Hyperbolic discounting occurs when individuals disproportionately value immediate rewards over future benefits, leading to inconsistencies in saving and investment behaviors. This tendency can severely undermine asset accumulation, especially when financial goals require sustained commitment over extended periods. Laibson's theoretical framework has been widely validated in the literature. Angeletos et al. (2000) demonstrated that individuals exhibiting present-biased preferences save significantly less, particularly in liquid assets, compared to their time-consistent counterparts. Similarly, O'Donoghue and Rabin (1999) and Harris and Laibson (2003) showed that hyperbolic discounting leads to suboptimal investment decisions and reduces engagement in long-term financial planning. Love and Phelan (2015) and Janssens et al. (2017) further illustrated that hyperbolic discounting negatively impacts the likelihood of accumulating

sufficient assets for later life. These studies collectively highlight the detrimental effects of hyperbolic discounting on financial preparedness and serve as the theoretical basis for this research.

While these foundational studies provide valuable insights, they often rely on theoretical models and simulations rather than empirical evidence, particularly in the context of later-life asset accumulation. Furthermore, most of the research focuses on generalized populations without taking into account the unique financial behaviors of older adults, who face distinct challenges such as declining income streams, evolving health needs, and shifting life priorities. This gap underscores the need for a tailored examination of hyperbolic discounting among individuals aged 65 and older, particularly in Japan, where extended retirement periods intensify financial pressures.

To address these gaps, this study builds upon Laibson's model by introducing a conceptual framework that integrates behavioral biases with Japan's unique socioeconomic context. Anchored in hyperbolic discounting theory, the framework first posits that present-biased preferences hinder consistent saving and investment behaviors, especially for older individuals whose time horizons are shorter and financial flexibility more limited. This behavioral dimension forms the basis for understanding how psychological biases disrupt long-term financial planning and asset accumulation.

Next, the framework incorporates the concept of financial thresholds, which represent the asset levels necessary for a comfortable retirement (e.g., JPY 20 million, JPY 30 million, JPY 50 million, and JPY 100 million). It hypothesizes that hyperbolic discounting interacts differently with these thresholds, with individuals exhibiting stronger present biases being less likely to achieve higher asset levels. This dimension introduces a practical lens for assessing how behavioral biases translate into tangible financial outcomes across varying asset accumulation goals.

Finally, the framework integrates sociodemographic and economic factors, recognizing that variables such as age, health status, and economic environment mediate the relationship between hyperbolic discounting and financial behaviors. These influences are particularly relevant in Japan, where the aging population faces compounded challenges due to economic uncertainty and inflation. This dimension adds contextual depth, enabling the framework to capture the unique intersection of behavioral biases and external conditions in shaping asset accumulation.

This theoretical foundation bridges the gap between behavioral finance theory and empirical analysis by applying hyperbolic discounting to the specific financial challenges faced by Japan's aging population. By integrating behavioral biases with asset threshold dynamics and sociodemographic influences, the study provides a nuanced framework to understand the factors that hinder financial preparedness in later life.

This framework also aligns with prior research that links hyperbolic discounting to other adverse financial behaviors, such as panic selling (Lal et al. 2024), excessive credit card use (Kuramoto et al. 2024), and poor investment decisions (Kang and Ye 2016; Abideen et al. 2023). By situating these tendencies within the context of Japan's retirement landscape, the study extends the theoretical foundation to offer actionable insights for policymakers and financial institutions. These insights can inform interventions aimed at mitigating the effects of hyperbolic discounting, ultimately helping older individuals achieve their financial goals and secure a comfortable retirement.

3. Literature Review

The increasing gap between life expectancy and the retirement age creates significant financial challenges for individuals in Japan. The Ministry of Health, Labour and Welfare (2024) provides statistical evidence on life expectancy, emphasizing that Japanese

individuals live, on average, more than 20 years beyond the mandatory retirement age of 65. This longevity amplifies the need for robust retirement planning, as highlighted by Ikezoe (2018), who examined Japan's mandatory retirement system and its implications for financial security. These studies establish the demographic and institutional factors that underpin the urgency of asset accumulation in Japan.

Despite these challenges, there is no national consensus on the amount of financial assets required for a comfortable retirement. Reports such as the Financial Council Market Working Group (2019) estimate that elderly couples need a minimum of JPY 20 million for a 30-year post-retirement period. However, these estimates vary widely. For instance, Nojiri (2023) and Kennedy (2023) report that average annual incomes and financial expectations for retirees differ substantially, creating ambiguity about the benchmarks for financial adequacy. These findings underscore the importance of exploring individual-level factors influencing retirement savings and asset accumulation.

Japan's wealth distribution further complicates retirement planning. According to the Nomura Research Institute (2023), 1.49 million wealthy households have significant financial assets, which is approximately JPY 364 trillion. However, this wealth is unevenly distributed, leaving a substantial portion of the population underprepared for retirement. This observation aligns with broader discussions on income inequality, as highlighted by Horioka (1990) and the Japan Investment Trusts Association (2024), which emphasize the disparities in income and wealth accumulation among Japanese households.

Behavioral biases, particularly hyperbolic discounting, have emerged as significant barriers to effective financial planning. Laibson's (1996, 1997) foundational work on hyperbolic discounting demonstrates how present-biased preferences undermine consistent saving and investment behaviors. Subsequent studies by Angeletos et al. (2000), O'Donoghue and Rabin (1999), and Harris and Laibson (2003) extend this theory, showing that individuals with strong present biases tend to under-save and make suboptimal investment decisions. These findings are supported by Love and Phelan (2015) and Cagetti (2003), who demonstrated that hyperbolic discounting significantly decreases the likelihood of accumulating sufficient assets for retirement.

The influence of hyperbolic discounting on financial behavior is further substantiated by studies such as Lal et al. (2024), which link present bias to panic selling during financial crises, and Kuramoto et al. (2024), which explore its role in excessive credit card use. These studies highlight the broader implications of behavioral biases for financial outcomes, suggesting that hyperbolic discounting is a key factor in explaining suboptimal financial behaviors in Japan.

While the existing literature provides a robust theoretical foundation for understanding hyperbolic discounting, several gaps remain. First, most studies rely on simulations or theoretical models, with limited empirical evidence on how hyperbolic discounting affects real-world asset accumulation, particularly among older individuals. For example, studies by Zhang (2013) and Cao and Werning (2018) focus on saving behaviors in general populations but do not account for the unique financial challenges faced by retirees. Second, little attention has been paid to how hyperbolic discounting interacts with varying asset thresholds, such as JPY 20 million or JPY 100 million, which are critical for understanding the financial needs of Japanese retirees. Finally, existing research rarely explores the mediating role of sociodemographic factors, such as age and economic conditions, in shaping the relationship between behavioral biases and asset accumulation.

This study addresses these gaps by empirically examining the impact of hyperbolic discounting on asset accumulation among individuals aged 65 and older in Japan. Building on the theoretical model of Laibson, and incorporating insights from the reviewed literature, the study explores how hyperbolic discounting interacts with asset thresholds and

sociodemographic factors to influence financial preparedness. By doing so, it contributes novel insights into the behavioral finance literature and informs strategies for improving retirement outcomes in an aging society.

4. Data and Methods

4.1. Data

This study primarily used data from the 2023 wave of the "Survey on Life and Money," an online survey conducted jointly by Rakuten Securities and Hiroshima University. The data collection occurred in November and December 2023, targeting active Rakuten Securities account holders aged 18 and older. To enhance the analysis, several variables were merged from the 2022 wave, as some respondents had participated since 2022. The survey includes questions covering demographic, socioeconomic, and psychological characteristics. The analysis focuses exclusively on respondents aged 65 and older to examine the relationship between hyperbolic discounting and asset accumulation in later life. After removing missing variables, the final sample consisted of 6709 observations, representing 35.89% of the original 18,693 valid responses from participants in the targeted age group.

The data collection process was largely based on the randomly selected active Rakuten Securities account holders. This method mitigates selection bias, ensuring that every individual in the target population has an equal chance of being included in the sample, thereby reducing biases that could confound the results. All survey instruments were standardized, ensuring consistent data collection across all selected respondents aged 18 years over. This standardization involved using identical wording, response options, and administration procedures for all questions related to demographic, socioeconomic, and psychological characteristics. By doing so, measurement errors were reduced and the reliability of the responses was enhanced. Finally, robust statistical controls were applied to account for potential confounding factors. For example, variables such as gender, age, marital status, number of children, household income, years of education, financial literacy, impatience, risk aversion, and a myopic view of the future were included as control variables in the regression models. This helps isolate the effect of hyperbolic discounting on asset accumulation by controlling for other variables that might influence the outcomes.

Although data were initially collected from respondents aged 18 and over, this research focused exclusively on those aged 65 and older to suit the study's context. This filtering process ensured that the sample was representative of the broader population of active investors aged 65 and older in Japan. By focusing on this specific age group, the study captures a relevant and representative sample, enhancing the generalizability of the findings to older adults concerned with asset accumulation for later life. To ensure the representativeness of the sample, we compared our sample characteristics with national demographic and socioeconomic data from reliable sources such as the Statistics Bureau of Japan and the National Institute of Population and Social Security Research.

The survey instruments underwent expert validation and pilot testing to ensure their clarity and alignment with the study objectives for respondents aged 18 years and over. Experts reviewed the survey questions to confirm they accurately captured the constructs of interest, such as hyperbolic discounting and financial asset accumulation, among many other socioeconomic and psychological variables. The pilot test involved administering the survey to a small subset of the target population (active Rakuten Securities account holders aged 18 years and older) to identify and rectify any ambiguities or issues with the questions. This process ensured that the survey questions were clear, understandable, and relevant to the study objectives. After the successful pilot testing and data collection period, for the context of this study, we filtered out respondents aged below 65 years to focus on older adults. Despite this filtering, the process of expert validation and pilot testing ensured

that the survey instruments were free from errors and ambiguities, thereby enhancing the reliability of the data collected. Finally, the findings were cross-verified with secondary data sources and stakeholder feedback. This triangulation approach involved comparing the survey results with existing data from other similar or related studies or financial reports on asset accumulation among older adults in Japan. Additionally, feedback from stakeholders, such as financial advisors and policymakers, was solicited to validate the relevance and accuracy of the findings.

4.2. Variables

The dependent variables in this study are four binary indicators that represent the holdings of the respondents' household financial assets: JPY 20 million or more, JPY 30 million or more, JPY 50 million or more, and JPY 100 million or more. A value of 1 is assigned if a respondent meets any of these thresholds and 0 otherwise. Given the ambiguity and varying estimates of the financial assets needed for a comfortable retirement, this study adopts these specific asset accumulation thresholds based on their practical significance and prevalence in the financial planning literature. For instance, the Financial Council Market Working Group (2019) suggests that an elderly couple needs JPY 20 million for a 30-year post-retirement life, while the Nomura Research Institute (2023) provides benchmarks of JPY 30 million, JPY 50 million, and JPY 100 million for different wealth segments. These thresholds reflect significant milestones in financial security and are commonly used benchmarks in policy discussions and financial planning. By analyzing these specific levels, this study aims to capture the various financial strategies and decisions influenced by hyperbolic discounting at different asset levels.

The primary independent variable is hyperbolic discounting, estimated using two survey questions (detailed in Appendix A) based on the methodology of Ikeda et al. (2010). Question 1 asks respondents whether they prefer to receive a reward after 2 or 9 days. Typically, individuals favor immediate rewards (option A) over delayed ones (option B). However, when the utility of option B exceeds that of option A, respondents switch their choice to B. This switching continues as the interest rate progressively increases with each subsequent question. The respondents' discount rates are calculated based on the interest rates at their switching points, denoted as DR1 for Question 1. A similar calculation is performed for Question 2, which involves a more distant time horizon (90–97 days), denoted as DR2. Respondents who switch their choices multiple times are excluded from the analysis. Hyperbolic discounting is identified when respondents exhibit higher impatience over shorter time horizons than longer ones (DR1 > DR2), classifying them as hyperbolic discounters.

Control variables include gender, age, marital status, number of children, household income, years of education, financial literacy, impatience, risk aversion, and a myopic view of the future. Financial literacy is scored using three questions listed in Appendix B. Impatience is calculated as the average of the standardized values of DR1 and DR2, derived using the following equation:

$$Impatience = \frac{1}{2}\sum_{i=1}^{2}[(DR_i - E(DR_i))/\sigma(DR_i)] \quad (1)$$

For the panel samples, certain variables—hyperbolic discounting, impatience, years of education, and financial literacy—were drawn from the 2022 wave of the survey. Detailed definitions of all variables are provided in Table 1.

Table 1. Variable definitions.

Variables	Definition
Dependent Variable	
Over 20 million yen	Binary variable: 1 = holds more than JPY 20 million in household financial assets, 0 = otherwise
Over 30 million yen	Binary variable: 1 = holds more than JPY 30 million in household financial assets, 0 = otherwise
Over 50 million yen	Binary variable: 1 = holds more than JPY 50 million in household financial assets, 0 = otherwise
Over 100 million yen	Binary variable: 1 = holds more than JPY 100 million in household financial assets, 0 = otherwise
Independent Variable	
Hyperbolic Discounting	Binary variable: 1 = hyperbolic discounter, 0 = otherwise
Male	Binary variable: 1 = male, 0 = female
Age	Continuous variable: respondents' age
Being Married	Binary variable: 1 = having a spouse, 0 = otherwise
Number of Children	Continuous variable: the number of children
Household income	Continuous variable: the total annual income including tax for the household in 2023 (unit: JPY)
Log of Household Income	Log (household income)
Years of Education	Continuous variable: years of education
Financial Literacy	Discrete variable: the average score of three questions related to financial literacy
Impatience	Continuous variable: respondents' average standardized time discount rate
Risk Aversion	Continuous variable: respondents' risk aversion (the answer to the following question: when you usually go out with an umbrella, what is the probability of rain?)
Myopic view of the Future	Discrete variable: 1 = completely opposite, 2 = somewhat opposite, 3 = cannot say, 4 = somewhat agree, 5 = completely agree with the idea that "the future is uncertain, so there is no point in thinking about it."

4.3. Descriptive Statistics

The descriptive statistics are presented in Table 2. The results show that 58.9%, 44.4%, 26.9%, and 9.7% of the respondents, who are active investors, have savings of at least JPY 20 million, JPY 30 million, JPY 50 million, and JPY 100 million, respectively. Additionally, 17.3% of the respondents are classified as hyperbolic discounters. Comparatively, Lal et al. (2024) reported a prevalence of hyperbolic discounting bias of about 11% among investors, while Kang and Ikeda (2014) found that 67.3% of the general population in Japan exhibited hyperbolic discounting bias. The lower prevalence of hyperbolic discounting in this study compared to that of the general population can be attributed to the fact that the respondents are active investors. This group is more likely to engage in rational financial decision-making in order to maximize their long-term utility. However, the difference between Lal et al. (2024) and this study may be due to the age composition of the respondents. It is plausible that older investors are more prone to hyperbolic discounting biases than their

younger counterparts, as aging can heighten the preference for immediate rewards over long-term benefits.

Table 2. Descriptive statistics.

Variable	Mean	Std. Dev.	Min	Max
Dependent Variable				
Over JPY 20 million	0.5887614	0.492095	0	1
Over JPY 30 million	0.4440304	0.4968946	0	1
Over JPY 50 million	0.2693397	0.4436498	0	1
Over JPY 100 million	0.0970338	0.2960259	0	1
Independent Variable				
Hyperbolic Discounting	0.1733492	0.3785771	0	1
Male	0.8223282	0.3822647	0	1
Age	69.22134	3.937275	65	94
Being Married	0.8181547	0.3857457	0	1
Number of Children	1.809062	1.014975	0	9
Household income	5,552,690	3,865,415	1,000,000	20,000,000
Log of Household Income	15.335170	0.6151449	13.81551	17
Years of Education	15.062300	2.091524	9	21
Financial Literacy	0.844040	0.2430484	0	1
DR1	0.651687	0.9095279	−0.01	3
DR2	0.588480	0.8707431	−0.01	3
Impatience	−0.000000007	0.9374174	−0.7074134	2.6757
Risk Aversion	0.616679	0.2045486	0	1
Myopic View of the Future	2.282009	0.9096349	1	5
Observation		6709		

In terms of demographic characteristics, 82.2% of the respondents are male, with an average age of 69 years. A total of 81.8% are married, and the respondents have an average of approximately two children. The average household income is JPY 5.6 million. The respondents completed an average of 15 years of education, and their average financial literacy score is 0.84. This financial literacy level suggests that aging respondents in this study are financially well literate. Lal et al. (2024), using the same dataset, reported an average financial literacy score of 0.80 on a scale of 1 for all respondents. For context, the average financial literacy score among the general population in Japan is 0.58, with older individuals consistently performing better (Kadoya and Khan 2020). The higher financial literacy levels observed among older individuals in this study align with previous research, which highlights the role of experience and accumulated financial knowledge in enhancing literacy among older populations.

Psychologically, the average risk aversion score in the sample is 0.6, while the average degree of myopia is 2.3. These findings suggest moderate levels of risk aversion and a noticeable tendency toward short-term decision-making. Together, these characteristics provide a nuanced understanding of the financial behaviors of older, active investors in Japan, providing insights that are critical for contextualizing the findings of this study.

The distribution of household financial assets by hyperbolic discounting is shown in Table 3. According to the ANOVA test, hyperbolic discounting is not a significant predictor on its own.

Table 3. Distribution of household financial assets by hyperbolic discounting.

Household Financial Assets	Hyperbolic Discounting		Total
	0	1	
Under JPY 20 million	2266 40.86%	493 42.39%	2759 41.12%
Over JPY 20 million	812 14.64%	159 13.67%	971 14.47%
Over JPY 30 million	964 17.38%	208 17.88%	1172 17.47%
Over JPY 50 million	951 17.15%	205 17.63%	1156 17.23%
Over JPY 100 million	553 9.97%	98 8.43%	651 9.70%
Total	5546 100%	1163 100%	6709 100%
F-statistics	F = 1.07		

4.4. Methods

This study explores the relationship between asset accumulation and hyperbolic discounting among individuals aged 65 and older. According to time-consistent economic theories, individuals typically discount the value of future rewards exponentially with delay (Samuelson 1937). Mathematically, the present value (V) of receiving a utility (A) at time t, when delayed in the future, is expressed as follows:

$$V(A,t) = A \times \delta^t \tag{2}$$

where the discount rate δ represents a constant proportional decrease in value with each added delay period (Story et al. 2014). However, some individuals exhibit hyperbolic discounting, where they discount immediate rewards more heavily than rewards in the distant future (Story et al. 2014; Green and Myerson 1996). The utility function for hyperbolic discounters is expressed as

$$V(A,t) = A \times \frac{1}{1+kt} \tag{3}$$

where k is a parameter that indicates the rate at which the value is discounted.

Since our dependent variables are binary, we conduct probit model analyses using Equations (4) to (7):

$$Y_{1i} = f(HD_i, X_i, \varepsilon_i) \tag{4}$$

$$Y_{2i} = f(HD_i, X_i, \varepsilon_i) \tag{5}$$

$$Y_{3i} = f(HD_i, X_i, \varepsilon_i) \tag{6}$$

$$Y_{4i} = f(HD_i, X_i, \varepsilon_i) \tag{7}$$

where Y_{1i}, Y_{2i}, Y_{3i}, and Y_{4i} represent the measures of assets exceeding JPY 20 million, JPY 30 million, JPY 50 million, and JPY 100 million for the ith respondent, respectively. HD indicates whether a respondent exhibits hyperbolic discounting. X is a vector of the respondent's demographic, socioeconomic, and psychological characteristics, and ε is the error term. The full specifications of Equations (4) to (7) are below. The probit model is ideal for analyzing binary dependent variables, making it suitable for this study. This methodology is widely used in financial behavior research among older adults. For example, Gillen

and Kim (2014) employed probit analyses to investigate the role of personality traits in the receipt of financial help among older adults. Similarly, Maji and Prasad (2024) used binary probit regression to examine the prevalence of present bias and its impact on savings and borrowing behaviors among Indians. These studies demonstrate the robustness and relevance of the probit model in analyzing financial decisions and behaviors.

$$\begin{aligned} Over\ JPY\ 20\ million_i &= \beta_0 + \beta_1 Hyperbolic\ Discounting_i + \beta_2 Male_i + \beta_3 Age_i \\ &+ \beta_4 Being\ Married_i + \beta_5 Number\ of\ Children_i \\ &+ \beta_6 Log\ of\ Household\ Income_i + \beta_7 Years\ of\ Education_i \\ &+ \beta_8 Financial\ Literacy_i + \beta_9 Impatience_i \\ &+ \beta_{10} Risk\ Aversion_i + \beta_{11} Myopic\ view\ of\ the\ Future_i + \varepsilon_i \end{aligned} \tag{8}$$

$$\begin{aligned} Over\ JPY\ 30\ million_i &= \beta_0 + \beta_1 Hyperbolic\ Discounting_i + \beta_2 Male_i + \beta_3 Age_i \\ &+ \beta_4 Being\ Married_i + \beta_5 Number\ of\ Children_i \\ &+ \beta_6 Log\ of\ Household\ Income_i + \beta_7 Years\ of\ Education_i \\ &+ \beta_8 Financial\ Literacy_i + \beta_9 Impatience_i \\ &+ \beta_{10} Risk\ Aversion_i + \beta_{11} Myopic\ view\ of\ the\ Future_i + \varepsilon_i \end{aligned} \tag{9}$$

$$\begin{aligned} Over\ JPY\ 50\ million_i &= \beta_0 + \beta_1 Hyperbolic\ Discounting_i + \beta_2 Male_i + \beta_3 Age_i \\ &+ \beta_4 Being\ Married_i + \beta_5 Number\ of\ Children_i \\ &+ \beta_6 Log\ of\ Household\ Income_i + \beta_7 Years\ of\ Education_i \\ &+ \beta_8 Financial\ Literacy_i + \beta_9 Impatience_i \\ &+ \beta_{10} Risk\ Aversion_i + \beta_{11} Myopic\ view\ of\ the\ Future_i + \varepsilon_i \end{aligned} \tag{10}$$

$$\begin{aligned} Over\ JPY\ 100\ million_i &= \beta_0 + \beta_1 Hyperbolic\ Discounting_i + \beta_2 Male_i + \beta_3 Age_i \\ &+ \beta_4 Being\ Married_i + \beta_5 Number\ of\ Children_i \\ &+ \beta_6 Log\ of\ Household\ Income_i + \beta_7 Years\ of\ Education_i \\ &+ \beta_8 Financial\ Literacy_i + \beta_9 Impatience_i \\ &+ \beta_{10} Risk\ Aversion_i + \beta_{11} Myopic\ view\ of\ the\ Future_i + \varepsilon_i \end{aligned} \tag{11}$$

Multicollinearity was tested by calculating the correlation coefficient and the variance inflation factor (VIF), as the variables may be interrelated, leading to biased estimates. As presented in Appendix C, the correlation coefficients between each variable are below 0.7 and the VIF is below 2 in all estimated models, so multicollinearity is not a concern.

5. Estimation Results

To explore the relationship between asset accumulation levels and hyperbolic discounting among active investors aged 65 and above in Japan, we performed a cross-sectional probit regression analysis using asset thresholds considered essential for later life: over JPY 20 million, JPY 30 million, JPY 50 million, and JPY 100 million. Each model includes demographic, socioeconomic, and psychological variables to assess the robustness of the link between hyperbolic discounting and asset accumulation.

5.1. Financial Assets of over JPY 20 Million

Table 4 shows that hyperbolic discounting is not statistically significant, suggesting that present-biased preferences have a limited impact on asset accumulation at this threshold. Although hyperbolic discounting is not statistically significant at this threshold, its economic impact can still be estimated. For an average respondent, being a hyper-

bolic discounter reduces the probability of having over JPY 20 million by approximately 1.5 percentage points in Model 4. While the effect size is small and not statistically significant, it underscores a slight economic influence of present-bias tendencies even at lower asset thresholds.

Table 4. Probit regression estimation results for over JPY 20 million.

Independent Variables	Dependent Variable: Over JPY 20 Million			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Hyperbolic Discounting	−0.0393	−0.0404	−0.0560	−0.0416
	(0.0407)	(0.0408)	(0.0424)	(0.0427)
Male		0.1165 ***	−0.0215	−0.0309
		(0.0415)	(0.0444)	(0.0446)
Age		0.0002	0.0138 ***	0.0149 ***
		(0.0039)	(0.0042)	(0.0043)
Being Married		0.2467 ***	−0.0483	−0.0486
		(0.0437)	(0.0469)	(0.0471)
Number of Children		−0.0533 ***	−0.0723 ***	−0.0725 ***
		(0.0163)	(0.0171)	(0.0171)
Log of Household Income			0.6476 ***	0.6378 ***
			(0.0296)	(0.0298)
Years of Education			0.0924 ***	0.0881 ***
			(0.0083)	(0.0084)
Financial Literacy			0.5462 ***	0.5042 ***
			(0.0673)	(0.0677)
Impatience				−0.0496 ***
				(0.0172)
Risk Aversion				0.1239
				(0.0804)
Myopic View of the Future				−0.1040 ***
				(0.0182)
Constant	0.2312 ***	0.0198	−12.2921 ***	−11.9494 ***
	(0.0170)	(0.2760)	(0.5636)	(0.5713)
Observations	6709	6709	6709	6709
Pseudo R-squared	0.000102	0.00586	0.0995	0.105
Log likelihood	−4544	−4517	−4092	−4069
p-value	0.335	3.38×10^{-10}	0	0

Robust standard errors in parentheses. *** $p < 0.01$.

Among the demographic variables, male gender and marital status are positively associated with asset holdings only in Model 2, while the number of children consistently exhibits a negative association across all models. Age is a significant positive predictor in Models 3 and 4. Socioeconomic factors, including household income, years of education, and financial literacy, are positively associated with asset holdings in Models 3 and 4. Psychological variables, such as impatience and myopia, negatively impact asset accumulation, indicating that a short-term focus hinders financial growth.

5.2. Financial Assets of over JPY 30 Million

As shown in Table 5, hyperbolic discounting does not significantly predict asset accumulation at this threshold. For the average respondent, being a hyperbolic discounter reduces the probability of having over JPY 30 million by approximately 2.3 percentage points in Model 4. While this impact is not statistically significant, it highlights the potential influence of hyperbolic discounting on individuals with moderate financial goals.

Table 5. Probit regression estimation results for over JPY 30 million.

Independent Variables	Dependent Variable: Over JPY 30 Million			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Hyperbolic Discounting	−0.0142	−0.0137	−0.0261	−0.0138
	(0.0406)	(0.0407)	(0.0423)	(0.0427)
Male		0.1470 ***	0.0058	−0.0061
		(0.0418)	(0.0449)	(0.0451)
Age		−0.0023	0.0121 ***	0.0132 ***
		(0.0039)	(0.0041)	(0.0042)
Being Married		0.2197 ***	−0.0840 *	−0.0882 *
		(0.0441)	(0.0477)	(0.0478)
Number of Children		−0.0731 ***	−0.0950 ***	−0.0950 ***
		(0.0162)	(0.0170)	(0.0171)
Log of Household Income			0.6783 ***	0.6689 ***
			(0.0293)	(0.0295)
Years of Education			0.0984 ***	0.0941 ***
			(0.0084)	(0.0084)
Financial Literacy			0.5489 ***	0.5006 ***
			(0.0704)	(0.0709)
Impatience				−0.0423 **
				(0.0174)
Risk Aversion				0.1020
				(0.0800)
Myopic View of the Future				−0.1132 ***
				(0.0182)
Constant	−0.1383 ***	−0.1474	−13.1038 ***	−12.7218 ***
	(0.0169)	(0.2750)	(0.5584)	(0.5656)
Observations	6709	6709	6709	6709
Pseudo R-squared	1.34×10^{-5}	0.00626	0.107	0.113
Log likelihood	−4608	−4579	−4114	−4090
p-value	0.726	0	0	0

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Among the demographic variables, male gender is positively associated with asset holdings only in Model 2, while marital status shifts from a positive to a negative association in Models 3 and 4. The number of children consistently shows a significant negative relationship, and age emerges as a strong positive predictor in the latter model. Socioeconomic variables, such as household income, education, and financial literacy, are strongly positively associated with asset accumulation in Models 3 and 4. Psychological factors, including impatience and myopia, are significantly linked to lower asset accumulation.

5.3. Financial Assets of over JPY 50 Million

Table 6 shows that hyperbolic discounting remains insignificant across all models. At this threshold, being a hyperbolic discounter decreases the probability of having over JPY 50 million by approximately 3.8 percentage points in Model 4, even though the relationship is not statistically significant. This finding emphasizes a slightly larger economic impact as financial goals increase.

Table 6. Probit regression estimation results for over JPY 50 million.

Independent Variables	Dependent Variable: Over JPY 50 Million			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Hyperbolic Discounting	−0.0325	−0.0322	−0.0450	−0.0366
	(0.0435)	(0.0436)	(0.0458)	(0.0463)
Male		0.2037 ***	0.0796	0.0647
		(0.0461)	(0.0500)	(0.0504)
Age		−0.0052	0.0093 **	0.0100 **
		(0.0042)	(0.0044)	(0.0044)
Being Married		0.1732 ***	−0.1396 ***	−0.1506 ***
		(0.0478)	(0.0515)	(0.0518)
Number of Children		−0.0942 ***	−0.1200 ***	−0.1188 ***
		(0.0174)	(0.0185)	(0.0186)
Log of Household Income			0.7162 ***	0.7074 ***
			(0.0316)	(0.0317)
Years of Education			0.0982 ***	0.0933 ***
			(0.0091)	(0.0091)
Financial Literacy			0.3587 ***	0.2973 ***
			(0.0782)	(0.0786)
Impatience				−0.0261
				(0.0188)
Risk Aversion				0.1523 *
				(0.0864)
Myopic view of the Future				−0.1331 ***
				(0.0202)
Constant	−0.6092 ***	−0.3943	−13.8272 ***	−13.3948 ***
	(0.0180)	(0.2959)	(0.6048)	(0.6127)
Observations	6709	6709	6709	6709
Pseudo R-squared	7.13×10^{-5}	0.00828	0.116	0.123
Log likelihood	−3908	−3876	−3455	−3428
p-value	0.456	0	0	0

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The male variable is positively associated with asset holdings only in Model 2, and marital status follows a similar pattern, shifting from positive to negative across the models. The number of children is consistently negatively related to financial assets, while age becomes a significant positive predictor in Models 3 and 4. Socioeconomic factors, such as household income, education, and financial literacy, show significant positive associations with asset accumulation. Psychological variables indicate that impatience does not significantly affect asset holdings, while risk aversion has a marginally positive association, suggesting that greater risk aversion may facilitate asset accumulation. Myopia is negatively associated with financial asset accumulation.

5.4. Financial Assets of over JPY 100 Million

As shown in Table 7, hyperbolic discounting becomes a significant predictor in Models 3 and 4, suggesting that present-biased preferences influence asset accumulation at higher levels. For an average respondent, being a hyperbolic discounter reduces the probability of having over JPY 100 million by approximately 8.2 percentage points in Model 4. This statistically significant result highlights the pronounced economic impact of hyperbolic discounting at higher financial thresholds. This finding underscores the critical role of present-bias tendencies in hindering the long-term financial discipline required for achieving substantial asset goals.

Table 7. Probit regression estimation results for over JPY 100 million.

Independent Variables	Dependent Variable: Over JPY 100 Million			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Hyperbolic Discounting	−0.0937	−0.0916	−0.1301 **	−0.1179 *
	(0.0575)	(0.0578)	(0.0620)	(0.0625)
Male		0.1932 ***	0.0893	0.0845
		(0.0616)	(0.0698)	(0.0702)
Age		−0.0033	0.0129 **	0.0136 **
		(0.0055)	(0.0058)	(0.0058)
Being Married		0.1278 **	−0.2249 ***	−0.2302 ***
		(0.0624)	(0.0692)	(0.0693)
Number of Children		−0.1223 ***	−0.1661 ***	−0.1657 ***
		(0.0228)	(0.0247)	(0.0246)
Log of Household Income			0.8727 ***	0.8678 ***
			(0.0443)	(0.0443)
Years of Education			0.1003 ***	0.0975 ***
			(0.0122)	(0.0122)
Financial Literacy			0.2305 **	0.1974 *
			(0.1102)	(0.1100)
Impatience				−0.0310
				(0.0256)
Risk Aversion				0.0677
				(0.1086)
Myopic view of the Future				−0.0616 **
				(0.0272)
Constant	−1.2832 ***	−1.1132 ***	−17.0761 ***	−16.8841 ***
	(0.0230)	(0.3818)	(0.8648)	(0.8723)
Observations	6709	6709	6709	6709
Pseudo R-squared	0.000633	0.0110	0.171	0.172
Log likelihood	−2136	−2113	−1772	−1769
p-value	0.103	1.20×10^{-8}	0	0

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Among the demographic factors, male gender is positively associated only in Model 2, while age is a positive predictor in Model 3. The influence of marital status shifts from positive in Model 2 to negative in Models 3 and 4, indicating a transition from supportive to detrimental effects on the accumulation of larger assets. The number of children is consistently negatively associated across all models. Socioeconomic factors, such as household income, education, and financial literacy, show strong positive associations in Models 3 and 4. Among the psychological factors, myopia is negatively associated with asset accumulation in Model 4.

6. Discussion

The influence of hyperbolic discounting on asset accumulation for a comfortable later life in Japan is a critical yet underexplored area of financial research, particularly for individuals aged 65 and older. Behavioral theories suggest that present-biased preferences hinder financial capabilities, reduce the likelihood of consistent saving and investment behaviors, and ultimately impede long-term asset accumulation. Building on this theoretical foundation, our study empirically confirms the relationship between hyperbolic discounting and asset accumulation. Our analysis offers valuable insights into the complex relationship between present-biased preferences and asset accumulation in later life among active investors aged 65 and older in Japan. These findings emphasize the need to address present-biased preferences in financial planning to improve preparedness for later life.

This study's main findings, which focused on hyperbolic discounting and its impact on asset accumulation for later life, revealed significant effects at the JPY 100 million level, but not at lower levels (e.g., JPY 20 million, JPY 30 million, or JPY 50 million) among active investors. This can be explained by the nature of hyperbolic discounting, which primarily affects long-term investments and savings by encouraging individuals to prioritize immediate rewards over future gains (Lal et al. 2024; Bawalle et al. 2024). Larger, long-term financial goals, such as accumulating JPY 100 million for later life, require sustained commitment and delayed gratification, making the effects of hyperbolic discounting more pronounced (Zhang 2013). Additionally, Japan's high savings rate and cultural emphasis on financial prudence encourage cautious investment behavior, helping to mitigate the short-term effects of hyperbolic discounting (Tanaka and Murooka 2012; Horioka 1990). However, as assets grow, so does the temptation to prioritize immediate consumption, particularly among older individuals who may experience greater life satisfaction from current consumption (Hettich et al. 2018). This is compounded by the natural tendency to discount future rewards at higher rates. The relationship between hyperbolic discounting and stock market participation is especially relevant for older individuals in Japan (Fujiki et al. 2012). Hyperbolic discounters often delay entering the stock market, despite its potential for higher long-term returns, because they prioritize immediate rewards (Love and Phelan 2015). As a result, they may enter the market later in life when their investment horizon is shorter and the psychological cost of delayed consumption is greater (Toman 2022). This delayed entry can hinder asset accumulation, as it reduces the compounding effect essential for building significant savings over time for later life (Angeletos et al. 2000; Laibson 1998).

At lower and middle asset thresholds, such as JPY 20 million, JPY 30 million, and JPY 50 million, the required savings and investment behaviors are less demanding, achievable with relatively short-term planning and less stringent financial discipline (Ogawa and Ohno 2024). These smaller goals do not require the same level of sustained effort or delayed gratification, making them less vulnerable to the negative effects of hyperbolic discounting. The significant impact of hyperbolic discounting on accumulating JPY 100 million for later life, compared to lower thresholds, is therefore due to the greater need for long-term financial discipline and commitment (Frederick et al. 2002). In Japan, achieving lower and middle asset thresholds for later life largely depends on higher income during working years. A report by the Japan Investment Trusts Association (2024) highlights the significant disparity in assets for later life in Japan, driven by income gaps during working years. Furthermore, higher income not only supports personal savings but also enables access to more substantial corporate retirement benefits and public pensions, which are the primary sources of retirement income (Wakabayashi 2001). Employees in larger corporations typically receive more generous retirement benefits on average (Central Labour Relations Commission 2021; Bureau of Industrial and Labor Affairs 2022), and those who contribute more to the system during their working years receive higher welfare pension payouts. For individuals over 65, high income and asset accumulation during their working years were more strongly influenced by socioeconomic factors, such as education and family background (Sakamoto and Chen 1992; Pöntinen and Uusitalo 1975), than by time preferences such as hyperbolic discounting. This may explain why hyperbolic discounting is not significantly related to the JPY 20 million, JPY 30 million, and JPY 50 million thresholds.

These findings make a significant contribution to the behavioral finance literature by shedding light on the interaction between hyperbolic discounting and asset planning for later life. While previous studies have explored the theoretical impact of this cognitive bias on financial planning and asset accumulation (Laibson 1996, 1997, 1998; Angeletos

et al. 2000; O'Donoghue and Rabin 1999; Harris and Laibson 2003; Love and Phelan 2015; Janssens et al. 2017; Cagetti 2003; Cao and Werning 2018), this research provides the first empirical evidence of its existence. It also reveals that the relationship between hyperbolic discounting and asset accumulation is not consistently significant across all asset thresholds, highlighting the complex nature of this bias and its substantial influence on long-term financial goals (O'Donoghue and Rabin 1999). This underscores the need for customized financial strategies that address these varying effects to improve preparedness for later life and financial well-being. The connection between hyperbolic discounting and asset accumulation reinforces the theory that cognitive biases play a critical role in long-term retirement planning (Diamond and Köszegi 2003), extending beyond socioeconomic and personal factors. These insights have practical implications for individual investors, financial advisors, later-life planners, policymakers, and the academic community. For individuals aged 65 and over in Japan, particularly those aiming for significant savings such as the JPY 100 million goal, strategies should focus on overcoming present-bias tendencies, with financial advisors promoting automatic savings plans to encourage regular and consistent contributions to long-term goals. Automating the saving process can help mitigate the tendency to prioritize immediate consumption over future savings, emphasizing the importance of delayed gratification and the compounding effect to achieve larger goals for later life. Later-life planners should consider the psychological aspects of investment decisions, such as delayed stock market participation, and encourage earlier engagement with diversified investment opportunities. Policymakers could develop interventions, such as enhancing financial literacy programs and educating older individuals about behavioral biases, to mitigate impulsive financial decision-making and promote long-term financial stability. Furthermore, the findings of this study contribute to the behavioral finance literature by providing empirical evidence of the interaction between hyperbolic discounting and asset accumulation for later life. Future research should explore these biases in different cultural contexts and asset thresholds to understand their broader implications while examining other psychological behaviors and their impact on financial planning to further enrich the field.

Notwithstanding its contributions, this study has several limitations that should be considered when interpreting the results. First, the data may not be fully representative of all Japanese households, as it focuses on active Rakuten Securities account holders. However, with 6709 valid samples from individuals aged 65 and above, it remains one of the largest surveys in Japan, enabling an analysis of upper-middle- and high-asset households (over JPY 50 million or JPY 100 million), which are typically underrepresented. Second, over 80% of the respondents were male, potentially leading to gender-biased estimates in the regression analysis. While this gender distribution reflects Japan's investment environment, where the majority of investors are male, caution should be taken when generalizing these findings to the broader population. Third, this study did not control for other factors influencing asset accumulation, such as inheritance, which were not included in the survey. Fourth, the cross-sectional nature of the data prevents the provision of longitudinal evidence on how hyperbolic discounting affects asset accumulation over time. Despite these limitations, this study is the first to empirically demonstrate the association between hyperbolic discounting and asset accumulation for later life by amount levels.

7. Conclusions

This study provides the first empirical evidence of the significant impact of hyperbolic discounting on asset accumulation for a comfortable later life in Japan, particularly at the highest asset threshold of JPY 100 million. The findings emphasize that hyperbolic discounting notably affects long-term financial goals, highlighting the need for customized

strategies for mitigating its effects. While hyperbolic discounting significantly influences higher asset accumulation, its impact is less pronounced at lower and medium asset thresholds, suggesting that the level of financial discipline required varies with the magnitude of savings goals.

These insights underscore the critical role of cognitive biases, such as hyperbolic discounting, in later-life planning, which extend beyond socioeconomic and personal factors. Practical implications for individual investors and later-life planners include adopting automatic savings plans, promoting financial literacy and education programs, and integrating behavioral insights into financial planning tools. Policymakers should consider interventions to improve financial literacy and mitigate impulsive decision-making. Academically, this research contributes to the behavioral finance literature by providing empirical evidence of the interaction between hyperbolic discounting and asset accumulation. Such strategies and insights can help mitigate impulsive decision-making, reinforce long-term financial discipline, and improve preparedness for later life, ultimately contributing to greater financial stability.

Our findings reveal that hyperbolic discounting significantly impacts long-term asset accumulation goals, particularly for larger thresholds like JPY 100 million, highlighting the need for strategies for mitigating present-bias tendencies. Key interventions include adopting automatic savings plans to ensure consistent contributions, promoting financial literacy programs to enhance decision-making, and encouraging early and sustained stock market participation to leverage the compounding effect of investments. For lower and middle asset thresholds, strategies should focus on income generation during working years, supported by policies for reducing income disparity. These targeted approaches aim to improve financial preparedness for later life, addressing the challenges posed by extended life expectancy and post-retirement financial needs.

Future research should address the limitations of this study by incorporating longitudinal data to provide a deeper understanding of the impact of hyperbolic discounting over time. Additionally, exploring the role of factors such as inheritance, health status, and unexpected financial shocks could offer further insights into asset accumulation dynamics. Investigating the effectiveness of various interventions, such as financial education programs, framing techniques, or behavioral nudges (e.g., personalized savings goals or reminders about future financial security) can help counteract present-bias tendencies and promote more consistent long-term saving behavior. Finally, comparative studies in different cultural and economic contexts could enhance the generalizability of these findings and offer a broader perspective on the influence of cognitive biases in planning for later life. Finally, exploring the relationship between hyperbolic discounting and financial well-being could examine how behavioral biases influence not only asset accumulation but also subjective perceptions of financial security and satisfaction in retirement. This broader perspective would offer a more holistic understanding of financial preparedness in later life.

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Institutional Review Board Statement: The data used in this study were obtained from an online questionnaire that contains only socioeconomic-related questions, and the Declaration of Helsinki does not apply. We consulted the appropriate authorities at Hiroshima University regarding the ethical considerations for our survey. According to their guidelines, the Ethical Committee for Epidemiology of Hiroshima University, which adheres to the principles of the Declaration of Helsinki, oversaw matters related to the ethical framework of our study. However, the formal submission of ethical approval to this committee was not required within the scope of this study. For reference, more information about the Ethical Committee for Epidemiology of Hiroshima University can be found at the following link: https://ethics.hiroshima-u.ac.jp/human-genome/%E5%A7%94%E5%93%A1%E4%BC%9A%E3%81%AB%E9%96%A2%E3%81%99%E3%82%8B%E6%83%85%E5%A0%B1/ (accessed on 18 November 2024).

Informed Consent Statement: Written informed consent was obtained from all participants in the questionnaire survey under the guidance of the institutional compliance team.

Data Availability Statement: The data supporting the findings of this study were collected by Rakuten Securities in collaboration with Hiroshima University. These data are not publicly available due to restrictions under the licensing agreement of the current study. However, they can be made available by the authors upon reasonable request and with permission from Rakuten Securities and Hiroshima University.

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Appendix A

Table A1. Q1. You will receive a certain amount of money. You can receive it after 2 days or 9 days, but the amount is different. If you have the following options, A or B, regarding the date and amount you will receive, which one would you choose? Choose any combination of 1 to 8 you like.

	Option A	Option B
(1)	Receive JPY 10,000 after 2 days	Receive JPY 9981 after 9 days
(2)	Receive JPY 10,000 after 2 days	Receive JPY 10,000 after 9 days
(3)	Receive JPY 10,000 after 2 days	Receive JPY 10,019 after 9 days
(4)	Receive JPY 10,000 after 2 days	Receive JPY 10,038 after 9 days
(5)	Receive JPY 10,000 after 2 days	Receive JPY 10,096 after 9 days
(6)	Receive JPY 10,000 after 2 days	Receive JPY 10,191 after 9 days
(7)	Receive JPY 10,000 after 2 days	Receive JPY 10,383 after 9 days
(8)	Receive JPY 10,000 after 2 days	Receive JPY 10,574 after 9 days

Table A2. Q2. You will receive a certain amount of money. You can receive it after 90 days or 97 days, but the amount is different. If you have the following options, A or B, regarding the date and amount you will receive, which one would you choose? Choose any combination of 1 to 8 you like.

	Option A	Option B
(1)	Receive JPY 10,000 after 90 days	Receive JPY 9981 after 97 days
(2)	Receive JPY 10,000 after 90 days	Receive JPY 10,000 after 97 days
(3)	Receive JPY 10,000 after 90 days	Receive JPY 10,019 after 97 days
(4)	Receive JPY 10,000 after 90 days	Receive JPY 10,038 after 97 days
(5)	Receive JPY 10,000 after 90 days	Receive JPY 10,096 after 97 days

Table A2. *Cont.*

	Option A	Option B
(6)	Receive JPY 10,000 after 90 days	Receive JPY 10,191 after 97 days
(7)	Receive JPY 10,000 after 90 days	Receive JPY 10,383 after 97 days
(8)	Receive JPY 10,000 after 90 days	Receive JPY 10,574 after 97 days

Appendix B

Table A3. Q3. Assume that you have JPY 10,000 in your savings account and the interest rate is 2% per year. Also assume that the deposited money and interest are never withdrawn from the account. Five years from now, how much will be in your savings account? Please choose one from the following four.

(1)	Over JPY 10,200
(2)	Exactly JPY 10,200
(3)	Less than JPY 10,200
(4)	I do not know

Table A4. Q4. Suppose the interest rate on your savings account is 1% per year and the inflation rate is 2% per year. After a year, how much do you think you can buy with the money in that account?

(1)	I can buy more things than I can today
(2)	I can buy exactly the same number of things as I can today
(3)	I can only buy things for today or less
(4)	I do not know

Table A5. Q5. Please tell us what you think is closest to the following sentences. Buying the stock of a single company is generally a safer investment than buying a stock investment trust*. *Financial products that invest in stocks of several companies.

(1)	Correct
(2)	Mistake
(3)	I do not know

Appendix C

Table A6. Correlation matrix.

	Hyperbolic Discounting	Male	Age	Being Married	Number of Children	Log of Household Income	Years of Education	Financial Literacy	Impatience	Risk Aversion	Myopic View of the Future
Hyperbolic Discounting	1										
Male	0.0233	1									
Age	0.0279	0.0073	1								
Being Married	0.0076	0.2257	−0.0079	1							
Number of Children	0.0252	0.0025	0.0496	0.3355	1						
Log of Household Income	0.0076	0.078	−0.0851	0.2821	0.1391	1					
Years of Education	0.0126	0.2079	−0.0858	0.1012	−0.0261	0.199	1				

Table A6. *Cont.*

	Hyperbolic Discounting	Male	Age	Being Married	Number of Children	Log of Household Income	Years of Education	Financial Literacy	Impatience	Risk Aversion	Myopic View of the Future
Financial Literacy	−0.0026	0.1071	−0.0364	0.0637	0.0046	0.1246	0.166	1			
Impatience	0.1307	0.0361	0.0735	0.0289	−0.0102	−0.0182	−0.0041	0.0055	1		
Risk Aversion	0.0014	0.0373	0.0372	−0.0001	−0.0366	0.0157	0.0803	0.0289	−0.0053	1	
Myopic view of the Future	−0.0061	−0.0874	0.0388	−0.0637	−0.0098	−0.1145	−0.1279	−0.1483	0.0331	−0.0835	1
Over JPY 20 million	−0.0118	0.0521	−0.0022	0.0693	−0.0175	0.3005	0.2041	0.1521	−0.038	0.044	−0.1275
Over JPY 30 million	−0.0043	0.0583	−0.0106	0.0566	−0.0361	0.3137	0.2134	0.1452	−0.0334	0.0434	−0.1323
Over JPY 50 million	−0.0091	0.0642	−0.0192	0.0362	−0.0543	0.3106	0.1986	0.1021	−0.0244	0.0499	−0.131
Over JPY 100 million	−0.0198	0.043	−0.012	0.0109	−0.0624	0.2919	0.1546	0.0612	−0.0255	0.025	−0.0684

Table A7. VIF test results.

Variable	Over JPY 20 Million	Over JPY 30 Million	Over JPY 50 Million	Over JPY 100 Million
Being Married	1.27	1.27	1.27	1.27
Log of Household Income	1.15	1.15	1.15	1.15
Number of Children	1.15	1.15	1.15	1.15
Years of Education	1.12	1.12	1.12	1.12
Male	1.11	1.11	1.11	1.11
Financial Literacy	1.06	1.06	1.06	1.06
Myopic View of the Future	1.05	1.05	1.05	1.05
Impatience	1.03	1.03	1.03	1.03
Age	1.03	1.03	1.03	1.03
Hyperbolic Discounting	1.02	1.02	1.02	1.02
Risk Aversion	1.02	1.02	1.02	1.02
Mean VIF	1.09	1.09	1.09	1.09

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