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Insatiable Wealth Preference: Evidence from Japanese Household Survey*

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Abstract

This study theoretically considers household behavior with wealth preference and empirically investigates the validity of insatiable wealth preference using a nationally representative survey. With wealth preference, the marginal rate of substitution of asset holdings for consumption depends on the nominal interest rates of assets at each point in time. From this property, we derive a reduced-form model and estimate it to find that the marginal utility of holding financial assets remains strictly positive as asset holdings increase and has a strictly positive lower bound; that is the insatiability of wealth preference. We also show that this property plays a crucial role in creating secular demand stagnation and expanding asset price bubbles.

JEL classification: D12, E21, E43, E71
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1. Introduction

This study theoretically considers household behavior with wealth preference and empirically shows that wealth preference is insatiable. This property plays a crucial role in creating critical malfunctions in advanced economies. Secular demand stagnation in which the paradoxes of toil, thrift, and flexibility appear, and expanding asset price bubbles along which the transversality condition is valid (i.e., rational bubbles).

Under this property, the marginal utility of financial asset holdings slowly declines and approaches a strictly positive level whereas the marginal utility of consumption decreases faster than that of asset holdings and approaches zero, as consumption and asset holdings increase. Therefore, consumption initially increases with asset holdings, and then increases less; it eventually stops increasing, resulting in secular stagnation with aggregate demand shortages. In this state, prices continue to decline, which expands the real value of financial assets, but the marginal utility of asset holdings does not change; hence, consumption is not stimulated. Higher productivity and more flexible price adjustments worsen deflation, which makes it more advantageous for households to reduce consumption and accumulate financial assets. This implies the paradoxes of toil and flexibility, respectively. Greater wealth preference directly decreases consumption, implying the paradox of thrift. Additionally, insatiable wealth preference enables asset prices to continue expanding beyond the fundamental values determined by dividends. [1]

[Insert Figure 1 here]

[1] Household wealth preferences also have the effect of widening inequalities in household asset holdings, as analyzed by Michau, Ono and Schlegl (2023).

[Insert Figure 2 here]

Such a relationship between household consumption and financial asset holdings is clearly observed in Japanese macroeconomic data. Figure 1 shows that household consumption grew steadily in line with the growth of financial assets until the early 1990s. After that, while financial assets continued to grow, household consumption slowed significantly and never recovered, leading to prolonged economic stagnation. This nature of the Japanese economy is evident when compared to the U.S. economy, where consumption continues to grow as financial assets increase (Figure 2), and is often referred to as the "Japanese disease".[2]

Secular demand stagnation due to a strictly positive marginal utility of asset holdings was first theoretically discussed by Ono (1994, 2001) and later extended by several studies. Recent examples are Ono and Ishida (2014), Murota and Ono (2015), Michau (2018), Illing et al. (2018), Hashimoto and Ono (2020), Michaillat and Saez (2022), and Hashimoto et al. (2023) among others. With insatiable wealth preference, ever-expanding equity prices (or rational bubbles) are supported because they satisfy the transversality condition, as shown by Ono (1994, Chap. 11).[3]

However, very few empirical researches examine the existence and insatiability of wealth preference. There are two exceptions, Ono et al. (2004) and Ono and Yamada (2018).[4] The former examines the existence of a strictly positive lower bound of the marginal utility of wealth by applying a parametric method to Japanese macroeconomic time-series data of

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[2] The US economy also experienced a similar downturn, but it was small and short. Inagaki et al. (2023) apply a model with insatiable wealth preference to the Japanese and US data and analyze the Japanese stagnation since the early 1990s and the US slowdown in output growth since 2008.

[3] Michau et al. (2023) investigate the conditions for rational 'constant' bubbles to appear under satiable wealth preference.

[4] Gechert and Siebert (2022) carry out a simple laboratory experiment and conclude the possible existence of wealth preferences.

consumption and financial assets, and a non-parametric method to household data from the Tokyo metropolitan area. The latter empirically finds that status preference for wealth is such that households care about the difference of their asset holdings from the social average, and theoretically proves that such status preference makes the marginal utility of asset holdings constant and leads to secular demand stagnation. However, due to a lack of asset data, it uses income data instead of asset data by assuming that income is closely related to asset holdings. This study uses microdata from a nationally representative survey on Japanese household consumption and wealth, and examines the explanatory power of wealth preference and the plausibility of the existence of a positive lower bound of the marginal utility of financial asset holdings.[5]

Several empirical studies focus on the effects of asset holdings on consumption behavior. Most of them assume that consumption directly depends on income; thus, they focus on the marginal propensity to consume (MPC) with respect to income and discuss how the MPC varies with the level of asset holdings. For example, Arrondel et al. (2019) and Fisher et al. (2020) report that households with greater asset holdings have lower MPCs.[6] This finding is consistent with our model although consumption does not depend on income in our model. With wealth preference, consumption is directly related to asset holdings in such a way that the intertemporal marginal rate of substitution of consumption is equal to the benefit of holding assets, which consists of the real rate of return and the marginal rate of substitution of asset

[5] Kahneman and Deaton (2010) insist that happiness rises with income up to $60,000-$90,000 per year and flattens for higher income. Killingworth et al. (2023) re-examine this property and find that happiness rises with income at least up to $500,000 per year (impossible to estimate for higher incomes due to lack of data). This suggests that wealth preferences do not diminish even as people earn very high incomes.

[6] Some studies focus on the MPC with respect to temporary and permanent income shocks due to different kinds and levels of assets. Carroll et al. (2011) examine the effects of changes in real-estate and financial-asset values on the marginal propensity of consumption while Carroll et al. (2014) compare the response of consumption to a temporary income shock in rich and poor countries with different wealth levels. Kaplan et al. (2014) compare the impact of temporary income fluctuations on the MPC between hand-to-mouth households and wealthy households.

holdings for consumption. If wealth preference is insatiable, the MPC appears to decrease as asset holdings increase because households with higher income tend to hold greater assets and consumption increases much more slowly than asset holdings.

Other empirical studies focus on the marginal propensity to save (MPS) and find a positive relationship between asset holdings and the MPS, implying that “the rich save more” (Dynan et al. 2004; Hendricks 2007; Hori et al 2016; Bozio et al. 2017; Gandelman 2017). Similar to studies focusing on the MPC, they show that “the rich consume less.” Income is included as an explanatory variable of the MPS, and assets are regarded as sources of income. This idea is shared with research that examines the impact of stock price changes on consumption, (Byrne and Davis 2003; Christelis et al. 2015; Starr-McCluer 2002).[7]

In contrast to previous studies, our study focuses on the direct relationship between consumption and asset holdings at each point in time, which is obtained from the household dynamic optimization behavior with wealth preference. Carroll (2000) also treats household behavior with wealth preference. He compares the plausibility of the life cycle, dynasty, and wealth preference models and concludes that the wealth preference model is the most plausible. In his wealth preference model, he assumes that the elasticity of the marginal utility of consumption is greater than that of asset holdings and finds that the richer individuals are, the lower their propensity to consume. While we share this idea, we further find that the marginal utility of holding assets remains strictly positive and show that this property explains typical malfunctions in advanced economies such as secular demand stagnation and explosive asset price bubbles.

[7] Other studies investigating the relationship between stock price fluctuations and consumption include Mankiw and Zeldes (1991) and Koop (2008). Mankiw and Zeldes (1991) focus on the difference in consumption behavior between shareholders and non-shareholders. Meanwhile, Koop (2008) applies a Bayesian model to examine how consumption is related to asset holdings influenced by stock price changes, and income.

This study utilizes household-level micro data to examine the insatiability of wealth preference. We use data from the Japan Household Panel Survey on Consumer Preferences and Satisfaction (JHPS-CPS) conducted by the Institute of Social and Economic Research (ISER) at Osaka University, enabling us to observe the relationship between household financial assets and consumption. Our results suggest that the marginal utility of wealth has a strictly positive lower bound, aligning with our model's implications.

The rest of the paper is organized as follows: Section 2 presents the model structure and obtains the conditions for secular demand stagnation and explosive asset price bubbles to appear. Section 3 empirically analyzes the plausibility and insatiability of wealth preference using the survey data. Finally, Section 4 summarizes our results and concludes the study.

2. The Model

We present the model structure and summarize how secular demand stagnation and persistently expanding asset price bubbles appear if the marginal utility of asset holdings remains strictly positive.

A. Households

A representative household has a labor endowment normalized to unity, but its actual labor supply x can be lower than unity

$$x \leq 1,$$

because unemployment may occur. Given the nominal wage W and commodity price P, the household supplies labor x, earns labor income Wx, receives government transfer τ (or pays lump-sum tax if τ is negative), consumes c, saves $\dot{A}$, and owns total assets A; A consists of money M, interest-bearing financial assets B of which the nominal interest rate is R^b, and real estate l of which the nominal price is Q. Further, l is allocated to its own housing h and rent housing supply $l-h$ of which the nominal rate of return is R^l. Obviously, $l-h$ is negative if the household rents an accommodation. Then, the flow budget equation and the stock constraint are as follows:

$$\dot{A} = R^b B + R^l Q(l-h) + Wx - Pc + P\tau, \quad A = M + B + Ql,$$

which reduce to

$$\dot{a} = R^b b + R^l q(l-h) + wx - c - \pi a + \tau, \quad a = m + b + ql, \tag{1}$$

where lower-case letters imply real values and π is the inflation rate of P.

The household receives utility from real consumption c, real money balances m for the transaction motive, real financial asset holdings $m+b$ for the wealth preference, and housing h. The household's lifetime utility is as follows:

$$\int_0^\infty e^{-\rho t}\,[u(c) + v(m) + \beta(m+b) + \psi(h)]dt, \tag{2}$$

where the functions satisfy

$$u'(c) > 0,\ \ u'(0) = \infty,\ \ u'(\infty) = 0,\ \ u''(c) < 0,$$

$$v'(m) > 0,\ \ v'(0) = \infty,\ \ v'(\infty) = 0,\ \ v''(m) < 0,$$

$$\beta'(m+b) > 0,\ \ \beta'(0) = \infty,\ \ \beta'(\infty) = \beta_0 > 0,\ \ \beta''(m+b) \leqq 0,$$

$$\psi'(h) > 0,\ \ \psi'(0) = \infty,\ \ \psi'(\infty) = 0,\ \ \psi''(h) < 0.$$

Note that $\beta_0 > 0$ implies a strictly positive lower bound of the marginal utility of financial asset holdings.

The household maximizes the lifetime utility (2) subject to the two equations in (1). Given the Hamiltonian H of the maximization problem:

$$H = u(c) + v(m) + \beta(m+b) + \psi(h) + \xi(a - m - b - ql)$$
$$+\lambda(R^b b + R^l q(l-h) + wx - c - \pi a + \tau),$$

the first-order optimal conditions are as follows:

$$u'(c) = \lambda,$$

$$v'(m) + \beta'(m + b) = \xi,$$

$$\beta'(m + b) + \lambda R^b = \xi,$$

$$\psi'(h) = \lambda R^l q = \xi q,$$

$$\dot{\lambda} = (\rho + \pi)\lambda - \xi.$$

They reduce to

$$\rho + \sigma\frac{\dot{c}}{c} + \pi = \frac{v'(m)}{u'(c)} + \frac{\beta'(m+b)}{u'(c)} = R^b + \frac{\beta'(m+b)}{u'(c)} = R^l = \frac{\psi'(h)}{qu'(c)}, \quad (3)$$

where $\sigma = -u''(c)c/u'(c) > 0$. The first term shows the nominal intertemporal substitution rate of consumption, which is equalized to the respective benefits of money, interest-bearing assets, and real estate, consisting of each nominal rate of return and benefit of holding them. The last term shows the marginal rate of substitution of housing payment for consumption payment, where the real housing price q implies the level of real consumption required to get a unit of h.

The transversality condition is

$$\lim_{t\to\infty} \lambda a \exp(-\rho t) = 0. \quad (4)$$

B. Firms and Markets

The firm sector is competitive and has a linear technology:

$$y = \theta x.$$

Hence, the real wage w is invariant over time and satisfies

$$w\left(= \frac{W}{P}\right) = \theta, \quad \pi = \frac{\dot{W}}{W}. \quad (5)$$

The government expands nominal money M at a time rate of μ and transfers it to households; hence,

$$\frac{\dot{M}}{M} = \mu(> 0), \quad \tau = \mu m.$$

The commodity, interest-bearing asset, money, and real estate markets satisfy

commodity: $c = \theta x$,

interest-bearing assets: $b = 0$,

money: $m = \frac{M}{P}, \quad \frac{\dot{m}}{m} = \mu - \pi$,

real estate: $h = l = \bar{l}$, (6)

where we assume that the net supply of interest-bearing assets is zero and that the total supply of real estate l is constant, for simplicity. In the labor market, the nominal wage adjustment is perfect if full employment exists, but sluggish and depends on the deflationary gap if unemployment occurs. Thus, we have

labor: W perfectly adjusts if $x = 1$,

$$\frac{\dot{W}}{W} = \alpha(x - 1) \qquad \text{if } x < 1. \tag{7}$$

C. Demand Stagnation

We show that insatiable wealth preference, $\beta'(\infty) = \beta_0 > 0$, yields secular demand stagnation. In the steady state with full employment, where $\dot{c}/c = 0$ and $x = 1$, from (3) and (6), c and m satisfy

$$(c, m) = (\theta, m^f), \quad \text{where} \quad \rho + \mu = \frac{v'(m^f) + \beta'(m^f)}{u'(\theta)} \left(> \frac{\beta_0}{u'(\theta)}\right), \tag{8}$$

and q satisfies

$$\rho + \mu = \frac{\psi'(\bar{l})}{q u'(\theta)}.$$

The left-hand side of the second equation in (8) represents the desire for present consumption while the right-hand side represents the desire for accumulating assets when consumption takes the full-employment level θ. The full-employment steady state exists if and only if

$$\rho + \mu > \beta_0/u'(\theta). \tag{9}$$

If not, m^f that satisfies (8) does not exist. In this case, the desire for present consumption is lower than the desire for accumulating assets for any m; hence, consumption falls below θ, leading to aggregate demand shortages.

If a steady state with stagnation is reached, demand shortages persist and deflation continues. Real money m continues to expand, resulting in $v'(m) = 0$ and $\beta'(m) = \beta_0$, as is clear from the properties of $v(.)$ and $\beta(.)$ given below Equation (2). Therefore, from (3), (6) and (7), the nominal interest rate of b reaches zero ($R^b = 0$) and c satisfies

$$c = c^s, \quad \text{where} \quad \rho + \alpha\left(\frac{c^s}{\theta} - 1\right) = \frac{\beta_0}{u'(c^s)}, \quad \frac{\dot{m}}{m} = \mu - \alpha\left(\frac{c^s}{\theta} - 1\right) > 0. \tag{10}$$

For the solution of c^s to exist between 0 and θ, that is, $c^s \in (0, \theta)$, and the transversality condition (4) to be valid, we must have

$$\alpha < \rho < \frac{\beta_0}{u'(\theta)}, \quad \mu < \frac{\beta_0}{u'(c^s)}, \tag{11}$$

where the first inequality enables $c^s (< \theta)$ to exist and the second makes $\dot{m}/m (= \mu - \pi) < \rho$ implying that the transversality condition (4) is valid. If (9) is invalid, that is, the full-employment steady state does not exist, and the second inequality of (11) is invalid, that is, the transversality condition in the stagnation steady state is invalid, no dynamic equilibrium path exists.

Thus, the conditions for each steady state to exist are as follows:[8]

[8] These conditions are essentially the same as those obtained by Ono and Ishida (2014).

Proposition 1: *The full-employment steady state and the stagnation steady state appear under the following conditions:*

If $\frac{\beta_0}{u'(\theta)} - \rho > \frac{\beta_0}{u'(c^s)}$,

$\mu > \frac{\beta_0}{u'(c^s)}$: *the full-employment steady state;*

$\frac{\beta_0}{u'(c^s)} \geq \mu > \frac{\beta_0}{u'(\theta)} - \rho$: *the full-employment and stagnation steady states;*

$\frac{\beta_0}{u'(\theta)} - \rho \geq \mu$: *the stagnation steady state.*

If $\frac{\beta_0}{u'(c^s)} \geq \frac{\beta_0}{u'(\theta)} - \rho$,

$\mu > \frac{\beta_0}{u'(\theta)} - \rho$: *the full-employment steady state;*

$\frac{\beta_0}{u'(\theta)} - \rho \geq \mu \geq \frac{\beta_0}{u'(c^s)}$: *no dynamic equilibrium path;*

$\frac{\beta_0}{u'(c^s)} > \mu$: *the stagnation steady state.*

Remark: *If* $\beta_0 = 0$, *full employment is always reached in steady state; thus, the positivity of* β_0 *is critical for secular demand stagnation to arise.*

In the stagnation steady state, national income is determined by consumption. This causality is opposite to that in the conventional Keynesian consumption function: national income determines consumption and a greater desire for saving leads to a lower MPC. Most empirical studies share this causality and examine the relationship between the MPC (or MPS) and asset holdings. In the present model, in contrast to the conventional view, strong wealth preference is consistent with a high MPC. This is because strong wealth preference makes consumption less than the full-employment level; hence, investment disappears, which equalizes income to consumption and makes the MPC equal one.

D. Bubbles

With insatiable wealth preference, ever-expanding asset price paths are supported and satisfy the transversality condition. To show this property, we change the definition of b to equities of an asset that yields a constant quantity z of the commodity. Then, the commodity market equilibrium given by the first equation of (6) becomes

$$c = \theta x + z,$$

and the real rate of return on b is

$$r^b (= R^b - \pi) = (z + \dot{b})/b.$$

Therefore, from the first equation in (3) where $\dot{c}/c = 0$, we find

$$\rho - \frac{\beta'(m+b)}{u'(c)} = \frac{v'(m)}{u'(c)} - \pi = \frac{z+\dot{b}}{b}, \tag{12}$$

where from (6) and (7), π satisfies

$$\pi = \mu \quad \text{under full employment,}$$

$$\pi = \alpha\left(\frac{c^s - z}{\theta} - 1\right) \text{ under stagnation.} \tag{13}$$

From (12) and (13), we obtain the following proposition, of which the proof is set out in Appendix A.

Proposition 2: *A stable asset price and expanding asset price bubbles appear under the following conditions:*

If $\beta_0 = 0$*, full employment occurs in the steady state and only a stable asset price appears.*

If $\rho > \frac{\beta_0}{u'(\theta+z)} > 0$*, full employment occurs in the steady state and both a stable asset price and explosive asset price bubbles can appear.*

If $\frac{\beta_0}{u'(\theta+z)} \geq \rho$*, aggregate demand stagnation occurs in the steady state and both a stable asset price and explosive asset price bubbles can appear.*

Remark: *Only if* β_0 *is strictly positive, explosive asset price bubbles appear.*

E. Alternative Assumptions on Wealth Preference

As for the persistent positivity of the marginal utility of asset holdings, Murota and Ono (2011), Ono and Yamada (2018), and Michaillat and Saez (2022) assume a status preference with respect to asset holdings, $\beta(a - \bar{a})$, where $\bar{a}$ represents the social average of asset holdings a. Given that the representative household's asset holdings a is equal to the social average $\bar{a}$, the marginal utility of wealth remains positive:

$$\beta'(a - \bar{a}) = \beta'(0) > 0,$$

for any $a(= \bar{a})$. Michau (2018) assumes that the utility of wealth depends on the household assets minus government liabilities so that the net wealth holdings equal real capital. Therefore, no matter how much the nominal price declines and the real value of financial asset holdings increases, the household net wealth stays the same and the marginal utility of wealth stays positive.

All these settings yield the property that the marginal utility of financial asset holdings stays positive.

3. Empirical Analysis

In section 2 we have shown that secular demand stagnation and explosive asset price bubbles can appear only if the marginal utility of financial assets has a strictly positive lower bound (i.e., $\beta_0 > 0$). The validity of this property is empirically examined in this section.

We modify the model to incorporate households with different sizes. With all the other properties the same as in Section 2, a household has n household members, and only the head of the household has a labor endowment, which is unity. The household head determines household consumption, money, asset holdings, and housing by considering the sum of all members' utilities of consumption and housing. We assume that each member receives utility from consumption and housing per capita while all assets are held by the household head.

The lifetime utility function (2) of the household head is rewritten as follows:

$$\int_0^\infty e^{-\rho t}\left[nu\left(\frac{c}{n}\right) + v(m) + \beta(m+b) + n\psi\left(\frac{h}{n}\right)\right]dt, \tag{14}$$

which is maximized subject to the flow budget equation and asset constraint in (1).[9] The first-order optimal conditions are as follows:

$$\rho + \sigma\frac{\dot{c}}{c} + \pi = \frac{v'(m)}{u'\left(\frac{c}{n}\right)} + \frac{\beta'(m+b)}{u'\left(\frac{c}{n}\right)} = R^b + \frac{\beta'(m+b)}{u'\left(\frac{c}{n}\right)} = R^l = \frac{\psi'\left(\frac{h}{n}\right)}{qu'\left(\frac{c}{n}\right)}.$$

During the present data period (2005-2019), R^b is zero and the housing rent is almost unchanged.[10] Therefore, from the above equation, we have

$$\frac{\beta'(m+b)}{u'\left(\frac{c}{n}\right)}(= R^l - R^b) = R^l = \text{constant}. \tag{15}$$

We assume specific functional forms of $u(c/n)$ and $\beta(m+b)$ as follows:

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[9] We discuss alternative assumptions on the effect of the household size on utility in Appendix B and mention the plausibility of the present setting.

[10] According to the Housing and Land Survey of Japan, conducted by the Statistics Bureau of the Ministry of Internal Affairs and Communications, the average housing rent in Japan was 60,467 yen in 2008, 59,456 yen in 2013, and 60,863 yen in 2018; housing rents have changed little over the period. Simizu et al. (2010) also find that the housing rent is stable in Japan and that the stickiness is three times greater than that of the United States.

$$u\left(\frac{c}{n}\right) = \frac{\left(\frac{c}{n}\right)^{1-\sigma} - 1}{1-\sigma}, \quad \beta(m+b) = \beta_0 \cdot (m+b) + \beta_1 \frac{(m+b)^{1-\omega} - 1}{1-\omega}.$$

Applying them to (15) gives

$$R^l = \frac{\beta_0 + \beta_1 (m+b)^{-\omega}}{\left(\frac{c}{n}\right)^{-\sigma}},$$

which reduces to

$$\left(\frac{c}{n}\right)^{-\sigma} = \gamma_0 + \gamma_1 (m+b)^{-\omega}; \ \gamma_0 = \frac{\beta_0}{R^l}, \ \ \gamma_1 = \frac{\beta_1}{R^l}, \tag{16}$$

where $(m+b)^{-\omega}$ and $(c/n)^{-\sigma}$ exhibit a linear relationship. If γ_0 is positive, then $\beta_0 > 0$ and the marginal utility of holding assets eventually stops declining, while that of consumption declines. We empirically validate the hypothesis that $\gamma_0 > 0$ using micro data of Japanese households in the following argument.

A. Data

We use data from the Japan Household Panel Survey on Consumer Preferences and Satisfaction (hereinafter referred to as JHPS-CPS), conducted by the Institute of Social and Economic Research (ISER) at Osaka University. The JHPS-CPS is an annual, nationally representative panel survey of residents in Japan.[11] The survey is based on self-administered paper questionnaires that are distributed to and collected from participating households in February each year during 2005–2013 and 2016–2019.[12] The sample consists of 27,842

[11] The sample is stratified according to the geographical area and the city size. All municipalities are classified into 40 stratums: 10 geographical areas and 4 categories corresponding to the population size. The number of sample subjects in each stratum is distributed in proportion to the resident population aged 20–69 years. The unit of sampling spot in each stratum is the census unit and is selected by random systematic sampling.

[12] The JHPS-CPS formally began in 2005 and was conducted annually thereafter until 2013. After a halt, the survey was resumed in 2016. During the survey period, new households were added to the sample in 2006 and 2009. All respondents are given a cash voucher (JPY 1,500 (USD 15) in 2009－2013 and 2016－2019, JPY 1,000 (USD 10) in the other years) by completing the survey.

households, with approximately 1,300 to 4,000 households reporting their family structures and financial situations each year.

The key variables are assets and consumption. For the assets variable, we follow Starr-McCluer (2002), Koop (2008), and Christelis et al. (2015), who highlighted the robust correlation between financial assets and consumption among various asset types, and focused on financial assets as the primary source of asset information. The JHPS-CPS asks the quantity of household financial assets using ten specified categories:

1. Less than JPY 2.5 million (JPY 2.5 million)
2. JPY 2.5 million to less than JPY 5 million (JPY 3.75 million)
3. JPY 5 million to less than JPY 7.5 million (JPY 6.25 million)
4. JPY 7.5 million to less than JPY 10 million (JPY 8.25 million)
5. JPY 10 million to less than JPY 15 million (JPY 12.5 million)
6. JPY 15 million to less than JPY 20 million (JPY 17.5 million)
7. JPY 20 million to less than JPY 30 million (JPY 25 million)
8. JPY 30 million to less than JPY 50 million (JPY 45 million)
9. JPY 50 million to less than JPY 100 million (JPY 75 million)
10. More than JPY 100 million.

The distribution of households by asset category in our sample is as follows: 1. 26.34%, 2. 15.81%, 3. 10.13%, 4. 9.44%, 5. 10.26%, 6. 7.48%, 7. 8.79%, 8. 6.75%, 9. 3.95%, 10. 1.05%. We exclude households in the top category (1.05%) from our sample because we are unable to identify their range of asset holdings, which could undermine the accuracy of the analysis. For the other categories, we use the median value (in parentheses) as each household's asset holdings.

For the consumption variable, we use household expenditure, including utility bills and services and excluding durable consumer goods (e.g. cars, houses, and high-value electrical appliances), taxes, social insurance premiums, and mortgage payments. Following (15), we use consumption divided by the household size.

Besides these key variables, we use household information such as the age and education of the household head and the family structure. Table 1 presents the descriptive statistics.

[Insert Table 1 here]

B. Estimation Model

We verify the relationship between household financial assets and consumption given by (16). For simplicity, we assume that the curvature of the utility functions for consumption and assets are the same, that is, $\sigma = \omega$, in the main analysis.[13] We consider $\sigma = 0.3$ as the standard value, following Anderson and Mellor (2008), who measure the relative risk aversion using the lottery choice of Holt and Laury (2002).[14] Then, the empirical equation becomes

$$(consumption_{it})^{-0.3} = \gamma_0 + \gamma_1(financial\ asset_{it})^{-0.3} + \gamma_2 X'_{it} + \gamma_3(year_t) + u_i, \quad (17)$$

where γ_0 and γ_1 are parameters, and $(consumption_{it})$ and $(financial\ asset_{it})$ are household i's consumption per capita and financial asset holdings, respectively. X'_{it} denotes dummy variables representing household characteristics, such as the age and educational level of the household head, the family structure, and the prefecture in which the household lives. Additionally, we include year dummies to control for idiosyncratic shocks across years, which capture changes in the CPI and housing rent R^l across years although neither the CPI nor the rent index changes much during the analysis period.[15] We do not control for household fixed

[13] We check the robustness for different values of σ and ω in the next subsection.

[14] Anderson and Mellor (2008) report that the mode of risk aversion in their experiment is $0.15 < \sigma < 0.41$. We suppose $\sigma = 0.3$ as the standard value of the risk parameter.

[15] The average of the annual CPI inflation rate from 2005 to 2019 was 0.0035%. See footnote 10 for the

effects, because there are almost no switches between the categories of asset holdings in our sample.

We estimate equation (17) using ordinary least squares and test whether γ_0 is strictly positive, that is, whether the marginal utility of wealth has a strictly positive lower bound. If the hypothesis of $\gamma_0 \leq 0$ is rejected, we empirically validate a strictly positive lower bound of the marginal utility of wealth among the sample households.

C. Results

Graphical Evidence:

We present graphical evidence of the positive relationship between consumption and financial asset holdings, represented by (17), and the existence of a positive lower bound of the marginal utility of wealth ($\gamma_0 > 0$). Figure 3 shows the relationship between $(financial\ asset_{it})^{-0.3}$ and $(consumption_{it})^{-0.3}$, where a box plot illustrates the median and 25 and 75 PCTLs of consumption with the 95% confidence interval bar for each asset level, and the predicted line is based on a single regression. It shows that the two factors are positively correlated and that the intercept of their prediction line is strictly greater than zero. This result is consistent with our hypothesis.

[Insert Figure 3 here]

---

housing rent.

Main Results:

Table 2 presents the estimates based on Equation (17). We report estimation results for a model without any control variables in column (1). We control only for the year-fixed effect in column (2). Then, we add regional dummies in column (3) and household characteristics in column (4) as additional control variables. We also report the p-value of the one-tailed test of $H_0: \gamma_0 \leq 0$ at the bottom of each column.

The coefficient of $(financial\ asset_{it})^{-0.3}$ is positive, 0.545 in columns (1) and (2), 0.371 in column (3), and 0.399 in column (4). These estimates are statistically significant at the 1% level. In addition, the hypothesis of $\gamma_0 \leq 0$ is rejected at the 1% significance level in all models.

[Insert Table 2 here]

Robustness of a Positive Lower Bound:

We examine whether our result on the one-tailed test for $\gamma_0 > 0$ is robust to different values of σ and ω. Figure 4 illustrates the intercept estimates of the model shown in column (3) of Table 2 and their 95% confidence intervals for several values of σ and ω. The vertical axis represents the intercept estimates, the horizontal axis represents ω ranging from 0.1 to 0.9, and the dots with various symbols are plotted for different values of σ ranging from 0.2 to 0.6.

Figure 4 shows that intercept γ_0 is significantly greater than zero for all combinations of σ and ω. We do not report results for $\sigma < 0.2$ because the estimate of the intercept increases as σ decreases so that we can obviously reject the hypothesis ($\gamma_0 \leq 0$). This result shows that the marginal utility of asset holdings has a strictly positive lower bound for a wide range of σ and ω values; hence, from the two remarks of Propositions 1 and 2, secular demand stagnation and expanding equity price bubbles can appear.

[Insert Figure 4 here]

Status Preference:

Wealth preference may be derived from “status preference” (see Murota and Ono 2011, Ono and Yamada 2018, Dioikitopoulos et al. 2019), and then a stronger status preference has a negative effect on people’s desire to consume, as does a stronger wealth preference. We examine this property using the status preference question in the JHPS-CPS.

The JHPS-CPS asks the following question about residential choice from a status preference perspective:

> Given the same conditions for other factors such as safety and comfort, which area would you choose to live in, one where the residents are richer than you or one where they are poorer than you?
>
> 1. an area where the residents are much richer than you,
> 2. an area where the residents are a little richer than you,
> 3. an area where the residents are almost as rich as you,
> 4. an area where the residents are a little poorer than you,
> 5. an area where the residents are much poorer than you,
> 6. either.

We define those who choose 3, 4 or 5 as having status preference (the status preference dummy = 1), and rewrite equation (17) as follows:

$$\begin{aligned}(consumption_{it})^{-0.3} = \delta_0 &+ \delta_1(financial\ asset_{it})^{-0.3} + \delta_2(status\ preference_{it}) \\ &+\delta_3(financial\ asset_{it})^{-0.3} * (status\ preference_{it}) \\ &+\delta_4 X'_{it} + \delta_5(year_t) + u_i. \qquad (18)\end{aligned}$$

Table 3 reports the estimates based on Equation (18). Column (1) replicates the same estimates of Column (4) in Table 2 for comparison. They are not exactly the same because the samples in Table 3 are a subset of those in Table 2, as some of the samples in Table 2 did not respond to the status preference question. Column (2) reports the estimation results with status preference.

First, the coefficient of status preference δ_2 is positive (i.e., $\delta_0 + \delta_2 > \delta_0$), suggesting that the intercept γ_0 in (16) and (17) is larger for households with a stronger status preference. From (16), a larger γ_0 decreases per-capita consumption c/n for given financial asset holdings $(m + b)$; hence, a stronger status preference discourages household consumption. Second, the coefficient of the interaction term δ_3 is negative (i.e., $\delta_1 + \delta_3 < \delta_1$), indicating that the coefficient γ_1 in (16) and (17) is smaller for households with a stronger status preference. From (16), we find

$$\frac{\partial^2(\frac{c}{n})}{\partial(m+b)\partial\gamma_1} = \frac{\omega}{\sigma}(m+b)^{-(1+\omega)}(\gamma_0 + \gamma_1(m+b)^{-\omega})^{-\frac{1+2\sigma}{\sigma}}(\gamma_0 - \frac{\gamma_1}{\sigma}(m+b)^{-\omega}) \lesseqgtr 0$$

$$\text{if} \quad m + b \lesseqgtr \left(\frac{\gamma_1}{\gamma_0\sigma}\right)^{\frac{1}{\omega}},$$

implying that a smaller γ_1 makes per-capita consumption c/n less responsive to a rise in asset holdings $(m + b)$ for rich households. These results suggest that a stronger status preference has a negative effect on household consumption, as does a stronger wealth preference.

Confirmation of Model Fit:

We confirm our model fitting by predicting consumption using financial assets and our estimates of γ_0 and γ_1 in Equation (17).

In Figure 5, the lower panel shows the distribution of asset values, while the upper panel shows the predicted value of consumption for each financial asset value and the 25th to 75th percentile range bar for the raw value of consumption. Each predicted value is located around the middle of each range for most asset values. The group with high assets is worse in predicting the consumption level than the other groups; however, only a few households belong to the group, as shown in the lower panel of Figure 5. Thus, our model can depict the relationship between financial asset holdings and consumption.

[Insert Figure 5 here]

4. Conclusion

This study considers household behavior with wealth preference and empirically examines whether the marginal utility of wealth holdings has a strictly positive lower bound. This property is vital in theoretically explaining secular demand stagnation and expanding asset price bubbles. We use household-level micro data from a nationally representative household survey. Our results suggest that the marginal utility of wealth has a strictly positive lower bound; therefore, secular demand stagnation and expanding asset price bubbles can occur.

Appendix A: Proof of Proposition 2

If full employment is reached and the asset price is stable in steady state ($\dot{b} = 0$), from (12) and (13) we have

$$\frac{v'(m)}{u'(\theta+z)} - \mu = \frac{z}{b}, \quad \rho - \frac{\beta'(m+b)}{u'(\theta+z)} = \frac{z}{b}. \tag{A1}$$

The first equation gives b as a function of m, $b(m)$. Using the properties of the utility functions given below (2), we find that

$$b = b(m), \; b(0) = 0, \; b(\bar{m}) = \infty \; \text{ where } \frac{v'(\bar{m})}{u'(\theta+z)} = \mu; \; b'(m) > 0. \tag{A2}$$

We first consider the case where $\rho > \beta_0/u'(\theta+z) \geq 0$. By substituting $b(m)$, which satisfies (A2), to the second equation in (A1), we find

$$-\infty = \rho - \frac{\beta'(0+b(0))}{u'(\theta+z)} < \frac{z}{b(0)} = \infty,$$

$$\rho - \frac{\beta'(\bar{m}+b(\bar{m}))}{u'(\theta+z)} = \rho - \frac{\beta_0}{u'(\theta+z)} > 0 = \frac{z}{b(\bar{m})},$$

implying that m and $b(m)$ have finite solutions in $0 < m < \bar{m}$ and $0 < b < \infty$. This solution of b gives a stable asset price. If explosive bubbles ($b \to \infty$) occur in this case, from (12) and (13) we have

$$\frac{\dot{b}}{b} = \rho - \frac{\beta_0}{u'(\theta+z)} > 0.$$

Therefore, $\dot{b}/b < \rho$ and the transversality condition (4) is valid if $\beta_0 > 0$. If $\beta_0 = 0$, $\dot{b}/b = \rho$ and the transversality condition is invalid.

In sum, if $\beta_0 = 0$, the full-employment steady state is reached and only a stable asset price is feasible. If $\rho > \beta_0/u'(\theta+z) > 0$, the full-employment steady state is reached and both a stable asset price and explosive bubbles are feasible.

Next, we consider the case where $\rho \leq \beta_0/u'(\theta+z)$. The full-employment steady state must satisfy (12); hence,

$$\rho - \frac{\beta'(m+b)}{u'(\theta+z)} = \frac{z+\dot{b}}{b} > 0. \tag{A3}$$

However, from (A2), if $\rho \leq \beta_0/u'(\theta+z)$, we have

$$\rho - \frac{\beta'(m+b)}{u'(\theta+z)} < \rho - \frac{\beta_0}{u'(\theta+z)} \leq 0,$$

implying that (A3) never holds. Therefore, the full-employment steady state is invalid in this case.

If the stagnation steady state is reached when $\rho \leq \beta_0/u'(\theta+z)$, $c^s < \theta + z$, deflation continues and m expands to infinity, leading to $\beta'(m+b) = \beta_0$ and $v'(m) = 0$. Therefore, from (12) and (13),

$$0 < \rho - \frac{\beta_0}{u'(c^s)} = -\alpha\left(\frac{c^s - z}{\theta} - 1\right) = \frac{z + \dot{b}}{b} < \rho. \quad \text{(A4)}$$

From (A4), if b is stable ($\dot{b} = 0$), b has a positive solution. If b is expanding ($\dot{b}/b > 0$), $\dot{b}/b$ is less than ρ; hence, the transversality condition is valid. Therefore, both a stable asset price and explosive bubbles are feasible.

Appendix B: Household-Size Weight

We consider various household-size weights on consumption using the following utility function:

$$\max \int_0^\infty e^{-\rho t}\left[n\frac{\left(\frac{c}{n^\eta}\right)^{1-\sigma} - 1}{1-\sigma} + v(m) + \beta(m+b)\right]dt,$$

where c/n^η is the standardized consumption per capita. By applying this function to Equation (3) we obtain

$$n^{-\left(\frac{1-\eta(1-\sigma)}{\sigma}\right)}c = n^{-\left(\frac{(1-\eta)(1-\sigma)}{\sigma}\right)}\left(\frac{c}{n}\right) = \left(\frac{R^l}{v'(m)+\beta'(m+b)}\right)^{\frac{1}{\sigma}} \equiv \Theta,$$

where Θ is constant for given money m, interest-bearing assets b, and R^l. From this property, we obtain

$$c = n^{\frac{1-\eta(1-\sigma)}{\sigma}}\Theta, \quad \frac{c}{n} = n^{\frac{(1-\eta)(1-\sigma)}{\sigma}}\Theta. \quad \text{(A5)}$$

In the text we adopt $\sigma = 0.3$.

Many studies (e.g., Buhmann et al. 1988; Gottschalk and Smeeding 1997; Mani et al. 2013) adopt a square root of the household size as the equivalence scale (i.e., $\eta = 0.5$). In this case, as the household size is doubled, household consumption c is 4.5 times more and per capita consumption c/n is 2.2 times more, which are both unrealistically too high. Moreover, if $\eta < 1$, the power exponent of n in the second equation of (A5) is positive, implying that c/n increases as n is larger, which is unrealistic.

If $\eta = 1$, c/n is unchanged regardless of the value of σ. As η is larger, c/n sharply decreases. For example, it becomes 0.85 times if $\eta = 1.1$, and 0.72 times if $\eta = 1.2$. Thus, we choose $\eta = 1$.

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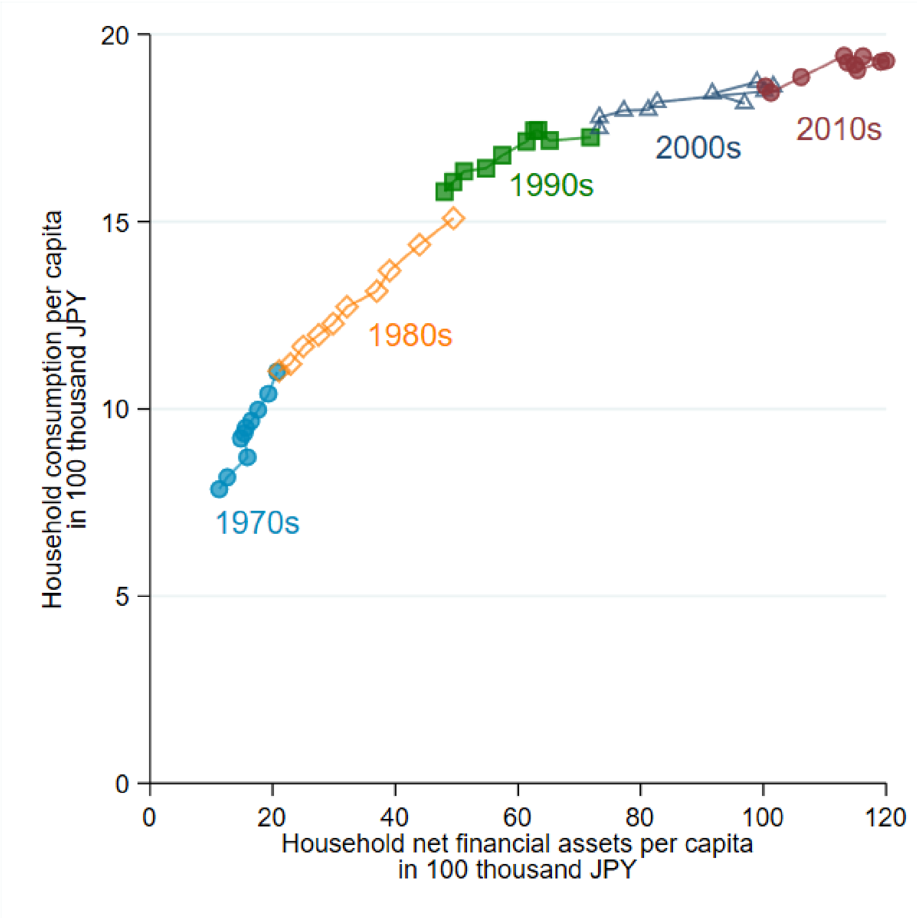
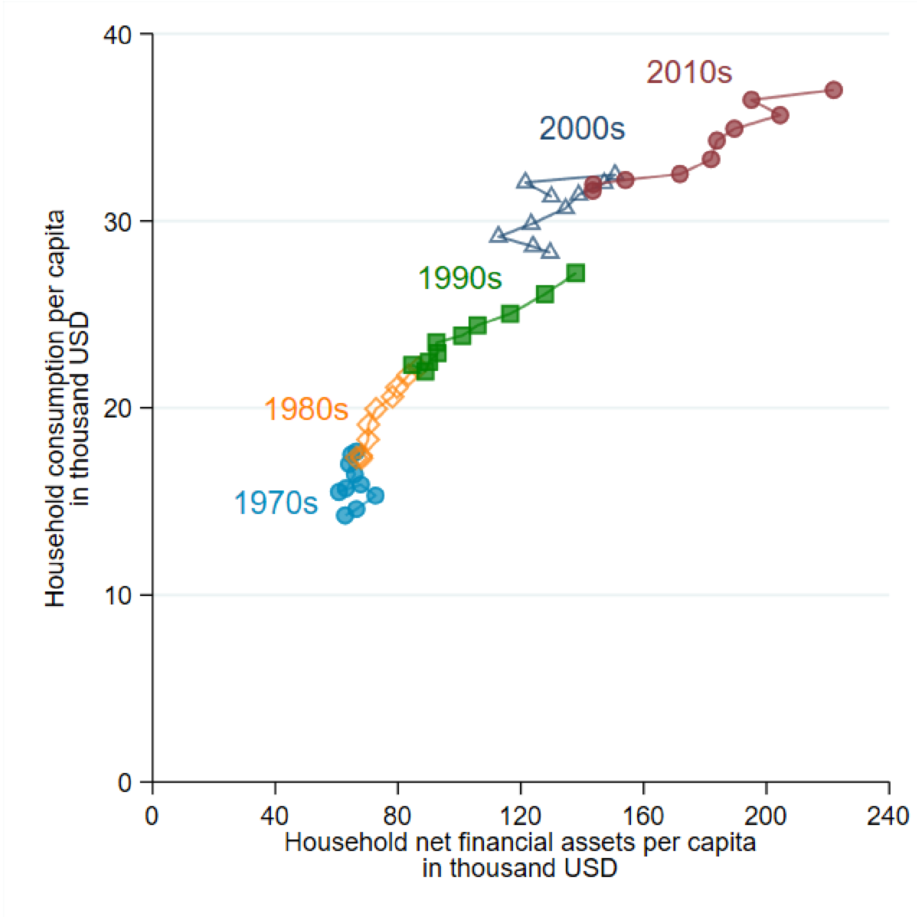
Figure 1—Trends in relationship between financial assets and consumption in Japan



Source: System of National Accounts in Japan.

Notes：This figure shows the macro trends of the relationship between household financial assets per capita and consumption per capita, excluding imputed rent, in Japan. The sample covers the period from 1970 to 2019, and the value of assets and consumption are shown with different symbols for each decade. The values of assets and consumption are real values based on 2015 values.

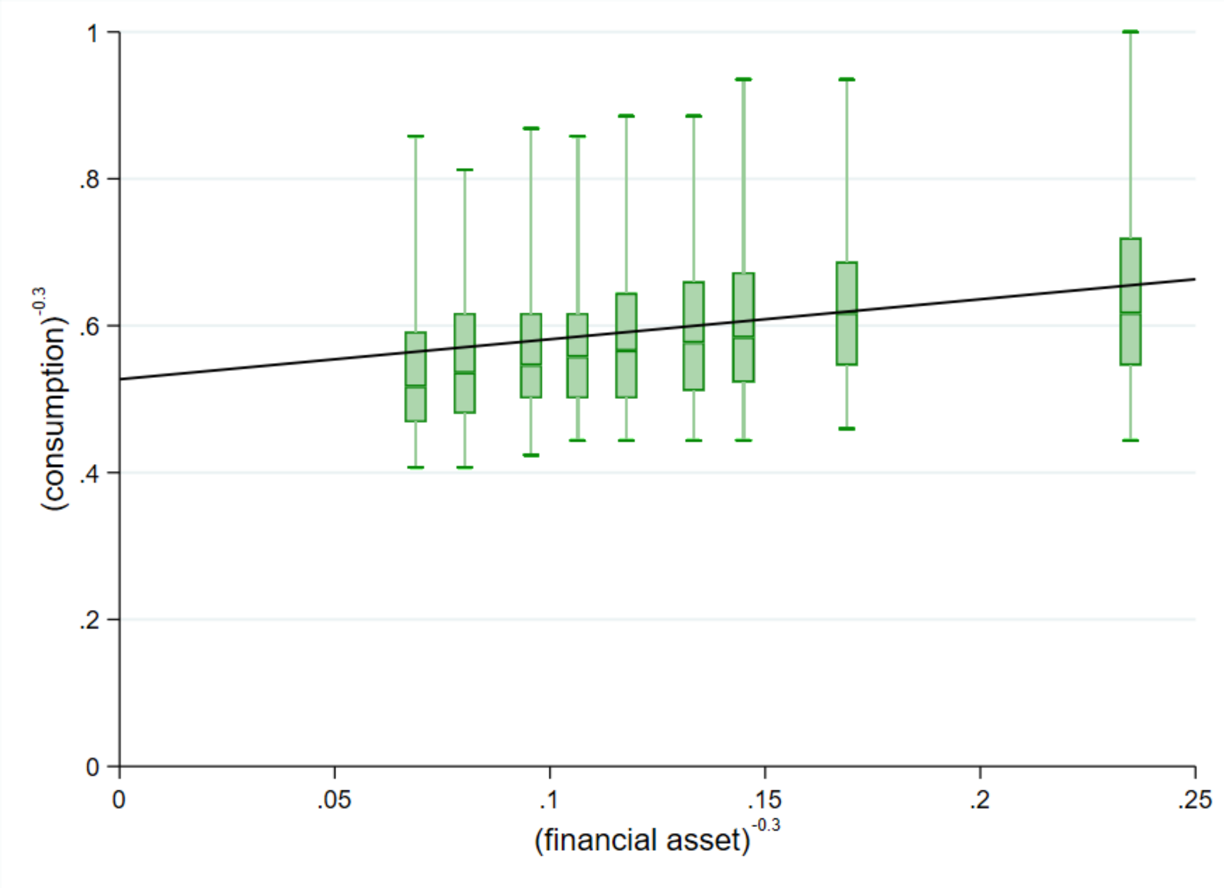
Figure 2—Trends in relationship between financial assets and consumption in the United States



Source: U.S. Bureau of Economic Analysis.

Notes：This figure shows the macro trends of the relationship between household financial assets per capita and consumption per capita, excluding imputed rent, in the United States. The sample covers the period from 1970 to 2019, and the value of assets and consumption are shown with different symbols for each decade. The values of assets and consumption are real values based on 2017 values.

Figure 3—Relationship between $(consumption_{it})^{-0.3}$ and $(financial\ asset_{it})^{-0.3}$

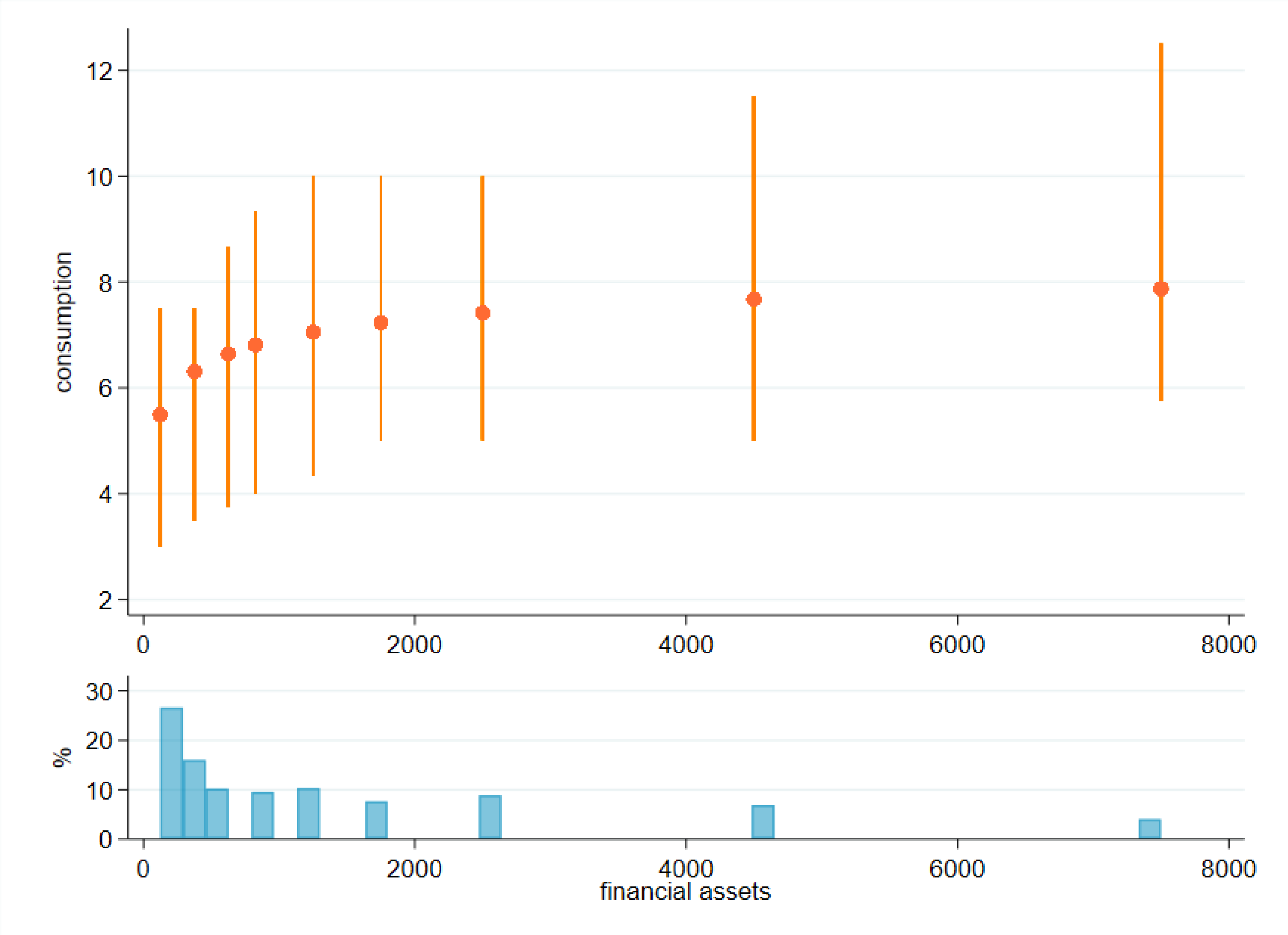


Notes: This figure shows the relationship between $(financial\ asset_{it})^{-0.3}$ and $(consumption_{it})^{-0.3}$. The box plot illustrates the median and 25 and 75 PCTLs of consumption with the 95% confidence interval bar for each asset level, and the predicted line is based on a single regression.

Figure 4—Robustness check

Notes: This figure illustrates the intercept estimates from the model shown in column (3) of Table 2 and their 95% confidence intervals for several different values of σ and ω. The vertical axis represents the intercept estimates, the horizontal axis represents ω ranging from 0.1 to 0.9, and the dots with different symbols are plotted for different values of σ ranging from 0.2 to 0.6.

Figure 5—Actual and predicted values of consumption



Notes: The top panel shows the predicted value of consumption for each financial asset value from our model as dots and the 25th to 75th percentile range bar for the raw value of consumption. The bottom panel shows the distribution of financial asset holdings in the sample.

Table 1−Descriptive statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Financial Assets	27842	1324.278	1715.548	125	7500
Consumption	27842	6.985	5.018	1	130
House Owner	27842	0.861	0.346	0	1
Family Structure					
Single	27842	0.062	0.241	0	1
Couple	27842	0.217	0.412	0	1
Parents + Child(ren)	27842	0.446	0.497	0	1
Single parent + Child(ren)	27842	0.053	0.225	0	1
3 generations	27842	0.131	0.338	0	1
3 generations including parent's sibling	27842	0.008	0.087	0	1
Others	27842	0.083	0.276	0	1
Age of Household head					
20s	27842	0.036	0.187	0	1
30s	27842	0.115	0.319	0	1
40s	27842	0.208	0.406	0	1
50s	27842	0.250	0.433	0	1
60s	27842	0.257	0.437	0	1
70s	27842	0.134	0.340	0	1
Educational Background of Household Head：					
Junior High School	27842	0.125	0.331	0	1
High School	27842	0.463	0.499	0	1
Vocational School, Collage	27842	0.076	0.265	0	1
University	27842	0.308	0.461	0	1
Master	27842	0.024	0.152	0	1
Doctor	27842	0.005	0.069	0	1

Notes: Data are from the Japan Household Panel Survey on Consumer Preferences and Satisfaction (JHPS-CPS) in 2005–2013 and 2016–2019 conducted by the Institute of Social and Economic Research (ISER) at Osaka University. The definitions of financial asset and consumption variables are found in Section 3 (A).

Table 2—Main results

	Outcome: $(consumption_{it})^{-0.3}$			
	(1)	(2)	(3)	(4)
$(financial\ asset_{it})^{-0.3}$	0.545***	0.545***	0.371***	0.399***
	(0.015)	(0.015)	(0.016)	(0.016)
γ_0 (intercept)	0.527***	0.515***	0.514***	0.513***
	(0.002)	(0.004)	(0.005)	(0.008)
Mean	0.611	0.611	0.611	0.611
Observations	27842	27842	27842	27842
Year Fixed Effect		✓	✓	✓
Regional Fixed Effect			✓	✓
Household Characteristics				✓
P-value (H_0: $\gamma_0 \leq 0$)	0.000	0.000	0.000	0.000

Notes: This table reports the estimates based on Equation (17). The definitions of financial asset and consumption variables are provided in Section 3 (A). Each column reports the following:
Column (1): the estimation results without any controls.
Column (2): the estimation results with only the year dummies.
Column (3): the estimation results with the region dummies added to the control variables in column (2).
Column (4): the estimation results with household characteristics added to the control variables in column (3).
The p-value at the bottom of each column reports the result of the one-tailed test of H_0: $\gamma_0 \leq 0$. Robust standard errors are in parentheses. Significance levels: *** p<0.01, ** p<0.05, and * p<0.10.

Table 3—The effects of status preference

	Outcome: $(consumption_{it})^{-0.3}$	
	(1)	(2)
$(financial\ asset_{it})^{-0.3}$	0.361***	0.417***
	(0.017)	(0.032)
status preference		0.023***
		(0.009)
$(financial\ asset_{it})^{-0.3}$ **status preference*		-0.075**
		(0.035)
γ_0 (*intercept*)	0.509***	0.500***
	(0.010)	(0.011)
Mean	0.609	0.609
R-squared	0.197	0.198
Observations	24717	24717
Year Fixed Effect	✓	✓
Regional Fixed Effect	✓	✓
Household Characteristics	✓	✓
P-value ($H_0: \gamma_0 \leq 0$)	0.000	0.000

Notes: This table reports the estimates based on Equation (18). Section 3 (A) provides the definitions of financial asset and consumption variables. Column (1) replicates the results from Column (4) in Table 2 for comparison. Column (2) reports the estimation results with the status preference dummy and the intersection of $(financial\ asset_{it})^{-0.3}$ and the status preference dummy. The p-value at the bottom of each column reports the result of the one-tailed test of $H_0: \gamma_0 \leq 0$. Robust standard errors are in parentheses. Significance levels: *** p<0.01, ** p<0.05, and * p<0.10.