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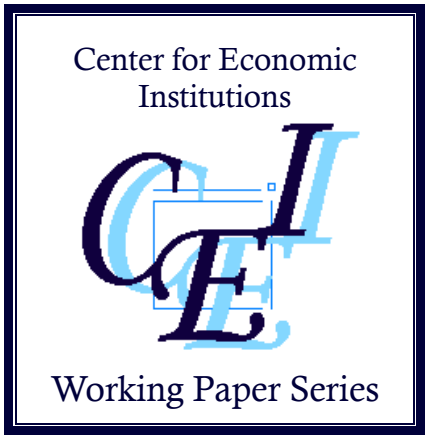

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Household Saving, Health, and Healthcare Utilisation in Japan*

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Abstract

The impact of health and healthcare utilisation on household savings and financial portfolios is explored using data from the Japanese Household Panel Survey (JHPS) and the Keio Household Panel Survey (KHPS). Whereas poor physical health is associated with higher savings and larger financial portfolios, poor mental health is found to have the opposite effects. Hospital visits, hospitalisation, and screening are associated with greater savings and larger financial portfolios. We also explore how the share of savings expressed as a proportion of total financial assets is affected by our health measures. We find that portfolio re-balancing effects associated with our health measures are outweighed by pure 'size' effects, in that our health measures affect the total value of a household's financial portfolio and its components (i.e., savings and securities), but not its overall composition.

Keywords: Asset Allocation; Censored Quantile Regressions; Fractional Models; Health and Healthcare Utilization; Savings and Financial Assets; Tobit Model.
JEL Classification: C33; C35; D14; G11.

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1 Introduction

Historically, household saving has been the subject of considerable attention in the academic literature and policymaking circles. Particular interest has focussed on the motivation to save, which has been investigated in a well-established empirical literature (Poterba 1994a,b; Hayashi 1997; Horioka and Watanabe 1997; Carroll and Samwick 1998) and a number of notable theoretical contributions (Bear 1961; Miller 1963; Leland 1968; Kimball 1990; Deaton 1991).[1] More recently, considerable attention has been paid to the decline in household saving, which for some countries has been described as being 'puzzlingly low' (see Lusardi, Skinner, and Venti 2001 for the United States). In the case of Japan, the saving rate turned negative in 2014 for the first time since 1955, when comparable data was first collected.[2] Whilst the Japanese household saving rate has been falling since the 1980s, the most recent declines stand in sharp contrast to the mid-1970s, during which almost a quarter of income was saved by households. Understanding the drivers of saving in Japan is therefore of considerable importance.[3] This is particularly so given the social and economic repercussions in Japan that are likely to arise as a result of its aging population and the sustained fall in fertility (MacKellar, Ermolieva, Horlacher, and Mayhew 2004). As acknowledged by the Japanese government in 2014: "With the net savings by households and the corporate sector on a declining trend, the current account surplus would structurally diminish and we will be forced to rely on foreign investment to fund our national debt without a steady reduction in the budget deficit" (Cabinet Office of Japan 2014, p.4).[4]

This paper extends the literature on saving by investigating its relationship with health and healthcare utilization in Japanese households. Very few contributions have explored these relationships in the context of Japan, which is characterised by a system of universal health insurance coverage. Our contribution takes a holistic view of the impact of health, in that wide-ranging information relating to health is utilized. Specifically, we explore the association between a household's financial position and mental health, physical health, and healthcare utilisation measures such as the number of hospital visits and if a respondent has undergone health screening. Household level data from the *Keio Household Panel Survey* (KHPS) and *Japanese Household Panel Survey* (JHPS) are exploited.

The saving motive and its relationship to health has been the focus of numerous studies, which investigate the hypothesis that individuals engage in precautionary saving to self-

[1] An excellent overview of the literature on household saving is provided in Browning and Lusardi (1996).

[2] See https://www.japantimes.co.jp/opinion/2015/02/13/editorials/negative-savings-rates-loom/. Retrieved on December 29, 2018.

[3] Braun, Ikeda, and Joines (2009) show that in the 1990s, Japan's aging population accounted for between two to three percentage points of the fall in the Japanese saving rate. The authors argue that for the rest of the 21st century, the average value of the Japanese saving rate will not rise above five percent, which is exceptionally low by historical standards.

[4] A summary of this report can also be found in the Population and Development Review (2015).

insure against future health events. In Palumbo (1999), data from the United States *Panel Study of Income Dynamics* (PSID) is used to show that elderly Americans engage in precautionary saving to guard against uncertain out-of-pocket medical expenses. Edwards (2008) is motivated by a theoretical model in which the risk of adverse health shocks is hedged by agents lowering their financial risk exposure through accumulating safer assets. He finds support for this theorised relationship using data from the United States *Study of Assets and Health Dynamics Among the Oldest Old* (AHEAD). Safer investment choices such as bills, bonds, and bank accounts are made by individuals who associate a greater likelihood that, within the next five years, the medical expenses associated with an adverse health shock will exhaust their household savings. Such behavior can be viewed as a form of precautionary saving. Further support for the precautionary saving motive is provided by Lusardi (2001), in which individuals sampled from the first wave of the United States *Health and Retirement Survey* (HRS) are observed to save more when confronted with greater income risks. This finding is reinforced in Kennickell and Lusardi (2004).

Yilmazer and Scharff (2014) exploit the United States HRS data to test the hypothesis that when confronted with higher health risks, near-elderly households are more likely to self-insure against unanticipated falls in future income and unanticipated future expenditures through accumulating precautionary savings. No evidence is found in support of this hypothesis. Rather, existing health status and medical conditions appear to drive saving behavior. Lower income and higher medical expenditure induced by poor current health status act to impede households from engaging in precautionary saving behavior. For the UK, Guariglia and Rossi (2004) analyse data from the 1996 to 2000 waves of the *British Household Panel Survey* (BHPS). Individuals do not appear to use precautionary saving as a means to self-insure against the risks of unanticipated private health care costs or falls in income whilst awaiting public treatment, due to being covered by a system of free universal healthcare. However, the authors suggest that should the quality of free healthcare decline, this situation may change.[5]

In addition to physical health, the effects of mental health can have a negative impact on saving behavior.[6] As in our own contribution, the importance of making such a distinction is

[5] For developing economies, some studies have found that the introduction of universal health coverage has led to a reduction in precautionary savings, as households are less vulnerable to the financial impact of health shocks. In the case of Thailand, Ushijima (2014) finds that since the introduction of the "30 baht scheme" in 2001, the living standards of affected households improved partially because of its impact in reducing precautionary savings and bolstering consumption. Kirdruang and Glewwe (2018) find little evidence that the introduction of the 30 baht scheme has any short- and long-run effects on precautionary savings, but note an increase in the consumption of consumer durables.

[6] A number of contributions have found that mental health impacts on an individual's degree of risk aversion, especially major depressive disorder (Zuckerman 1994; Eisenberg, Baron, and Seligman 1996; Smoski et al. 2008; Lindeboom and Melnychuk 2015). In the case of Japan, Maruyama, Kwon, and Morimoto (2001) find that mental health may be affected by the level of seismic intensity. Given that mental health may impact on an individual's degree of risk aversion and rate of time preference (Bogan and Fertig 2018), this may also suggest an indirect link between earthquake risk and the decision to allocate between safe and

underlined in Bogan and Fertig (2018), who exploit information in the United States PSID and the HRS to investigate the impact of mental health on retirement savings. Mental health problems are found to exert a sizable negative impact on savings held in retirement accounts. Psychological distress is found to reduce the probability of holding retirement accounts by up to twenty-four percentage points, with the share of retirement savings as a proportion of a financial portfolio falling up to sixty seven percentage points.[7] However, the number of studies that consider a role for mental health in the context of financial decision-making is small relative to those which focus on physical health, and as stated in Bogan and Fertig (2013), "...while theory strongly suggests that mental health could affect investment decisions...no empirical assessment of this issue exists." (p.957). In this regard, the present contribution is to the best of our knowledge the first to explore the relationship between mental health and saving behavior using micro-data on Japanese households.

More generally, whilst there exists a well-developed literature on saving in Japanese households, studies in which its relationship with health and healthcare utilization is investigated appear to be sparse. Nevertheless, there exist a number of important studies that analyse Japanese micro-data with a view to providing a more general overview of patterns of Japanese household saving behavior, as well as exploring the motives underlying the decision to save. Such contributions are exemplified by Kitamura and Takayama (1994), Horioka and Watanabe (1997), and Kitamura, Takayama, and Arita (2001). In the case of the latter contribution, the authors use data from the National Survey of Family Income and Expenditure from 1984, 1989, and 1994, and uncover a marked decline in the propensity for Japanese baby-boomers to save after 1989. Hayashi (1997) finds that the rate at which Japanese households save is significantly lower than generally thought, and further, that Japanese household wealth accumulation begins early, persisting until very late on in the life-cycle. The bequest motive plays an important coordinating role in ensuring that unconsumed wealth is transferred to future generations. Other contributions have also investigated the determinants of Japanese saving behavior in the context of bequests (Hayashi, Ando, and Ferris 1988), as well as exploring the disparity between saving rates in the United States and Japan (Hayashi, Ito, and Slemrod 1988).

In the context of health and financial decisions made at the household level, a paper of relevance to our own work is Aizawa and Helble (2015), who use KHPS data to explore the extent to which home ownership is affected by health conditions and health related behavior. Homeownership is associated with better health states, and is positively correlated with health care expenditure. This latter finding leads the authors to suggest that respondents who attend voluntary medical screenings more frequently do so as a means to invest more

risky assets.

[7] Individuals associated with a K-6 non-specific psychological distress score of above thirteen were deemed to suffer from severe psychological distress (see Kessler et al. 2003). Bogan and Fertig (2018) also use lower K-6 scores to construct a measure of moderate mental distress.

in their future health. This hypothesised mechanism is of relevance to our own findings, in that some of our own health measures are constructed using medical screening information.

In what follows, we show that health and healthcare utilisation both significantly affect household saving behavior in Japan. To preview our results, whereas poor physical health is associated with increased household savings, poor mental health is strongly associated with lower levels of savings. These findings are robust to a number of complementary empirical specifications, all of which exploit the panel nature of our data. Although our principal focus is on saving behavior and health, we show that our findings generally extend to the case where the total value of a household's financial assets – defined as savings *plus* risky assets such as shares and securities – is considered. Significantly, information relating to the value of a household's savings and securities enables us to estimate a system of equations in which the 'size versus composition' effects of health on a household's financial assets are evaluated. A fractional probit model (Papke and Wooldridge 1996) is used to model the value of savings expressed as a proportion of a household's total financial portfolio. This is estimated jointly with a Tobit specification in which the value of savings is modelled. We find that portfolio re-balancing effects are always outweighed by pure 'size' effects, in that even though an increase in a given health measure may be observed to increase (or decrease) the *share* of savings as a fraction of total financial assets, the overall impact on the total value of savings may be to reduce (or increase) it significantly. Finally, the impact of hospital visits, screening and treatments costs are all found to be positively associated with savings accumulation and the total value of financial assets.

2 Household saving and health indices

Our data is drawn from two household panel surveys conducted in Japan, namely the JHPS and KHPS. Both surveys are conducted by the Panel Data Research Center at Keio University,[8] and have been used relatively sparingly in the household finance literature.[9] Their establishment in the 2000s can be viewed as part of a wider response to the relative dearth of large-scale panel data surveys in Japan, which are of increasing interest to Japanese policymakers (Unayama 2018).

The KHPS has been conducted annually since 2004, whereas the JHPS was established

[8] Although it is funded by the Japanese Ministry of Education, Culture, Sports, Science, and Technology (MEXT), both surveys are designed by academic researchers.

[9] This is in part due to the recent inception of these surveys relative to more established ones such as the PSID in the United States, and the BHPS in the UK, which were established in 1968 and 1991, respectively. Significantly, writing in 1994, Kitamura and Takayama (1994) observed that panel data on household behavior was not collected by Japanese government agencies. This practice was also mostly true for private research institutions and universities. In contrast, the use of panel surveys in Japan is now more widespread, not only among government agencies, but also among research institutions and universities (Takayama, Inagaki, and Oshio 2012). See Unayama (2018) for an excellent overview of selected Japanese household surveys.

in 2009. Respondents from all eight regions of Japan participate in both surveys and each survey collects detailed information relating to respondents' socio-economic status, financial position, and personal characteristics. Although the JHPS and KHPS run in parallel to each other, and in many cases ask identical questions, the JHPS has a greater focus on education and healthcare. Nevertheless, it still shares a number of common health and healthcare related questions with the KHPS, which we exploit. This is in addition to utilising healthcare based questions which are specific to each survey. Around $4,000$ households and $7,000$ individuals are targeted by the KHPS, whereas the JHPS aims to survey around $4,000$ male and female respondents.[10] In this paper, we analyse data from the 2005-2016 waves of the KHPS survey, resulting in information relating to $5,171$ households, and which corresponds to $30,662$ household/year observations. For the JHPS, our information relates to $3,557$ households, resulting in $17,690$ household/year observations. We now turn to the construction of our saving and health measures.

2.1 Saving and financial assets

Both the KHPS and JHPS require respondents to report the value of the household's financial assets in two distinct categories, namely 'deposits' and 'securities'. Whilst this taxonomy is more parsimonious than that used in other contributions (see, for example, Carroll (2002) and Hurd (2002), where financial assets are classified into three distinct groups based on their perceived risk), it does allow us to identify two measures of household saving. Our first measure treats deposits as being synonymous with savings, noting that both surveys are identical with respect to the way that financial assets classes are defined. Our second measure takes the value of a household's total financial assets and is thus defined as savings *plus* securities. Specifically, savings are composed of: postal savings certificates; national and regional (for example, Shinkin) bank holdings of time deposits, installment savings and ordinary deposits; company deposits; gold investment and savings accounts; and wealth held in the form of medium-term government bond funds. The financial assets in this category are relatively risk free. In contrast, securities comprise: shares (reported at market value); bonds (at par value); stock investment trusts (market value); corporate and public bond investment trusts (market value); and loans in trust and money in trust (par value). Compared to savings, the assets contained in this category are higher risk and held by relatively fewer households. We explore the impact of our health measures on both saving and total financial assets, noting that our health measures may impact on these variables in different ways.[11]

[10] To deal with issues related to participant retention, $1,400$ new subjects were recruited to KHPS in 2007, and $1,000$ in 2012 (source: https://www.pdrc.keio.ac.jp/en/paneldata/datasets/jhpskhps/. Retrieved January 8, 2019).

[11] All variables are denominated in Yen and the values are reported in real terms, having been adjusted using the 2016 price level. We stress here that the values of other assets such as land and housing are not included in the financial asset categories in the KHPS or JHPS. We do, however, account for such assets

Table 1 reports the summary statistics for our dependent variables, specifically the (natural log) value of savings and total financial assets (savings plus securities). Of note here is the finding that across the entire sample, 22 (19) per cent of KHPS (JHPS) respondents report having no savings at all, whereas around 21 (19) percent of KHPS (JHPS) respondents report having no financial assets at all.[12] By way of comparison, Bricker et al. (2017) report that in 2013 only 5.5% of households failed to hold any financial assets in the United States. Similarly, in the UK in 2016, 98% of households held some form of formal financial asset (*Wealth and Assets Survey*, Office for National Statistics). This highlights the importance of exploring financial asset holding in Japan due to significant differences with similarly developed OECD countries.

Insert Tables 1 and 2 here

2.2 Health and healthcare utilization measures

Responses to self-reported questions are used to construct health and healthcare utilization measures. These comprise subjective measures of mental and physical health, in addition to objective measures corresponding to whether the individual required treatment at a range of health care providers and underwent health screening, as well as information pertaining to body mass index (BMI) and treatment cost.[13]

With respect to health treatment and screening, we note that Japanese healthcare is characterised by a framework of universal health insurance coverage.[14] Japanese law requires that all residents have some form of coverage. For the unemployed and self-employed, as well as university students and retired individuals, this takes the form of National Health Insurance ('*Kokumin Kenko Hoken*', hereafter NHI), which is a government health insurance scheme managed at the local municipality level. In contrast, regular employees are required to enrol in an insurance scheme which falls under the umbrella of the Work Place Health Insurance System ('*Shokuba Kenko Hoken*', hereafter WPHIS).[15] Individuals can choose the

using a net worth variable in our modelling approach, as detailed below.

[12] Log transformations were only applied to households with savings greater than zero. Households that reported zero savings were assigned a zero.

[13] As is standard in the literature, we use measures related to the head of household's health. An exception relates to our treatment costs variable, where we note that for married couples, there are two separate questions for treatment costs: one for the head of the household; and one for the spouse. Our measure of treatment cost is the sum of these two costs. We also note that our findings are robust to replacing the head of household's health with health measures relating to their spouse. We do not include health measures related to the head of household and their spouse in the same specification due to concerns regarding multicollinearity as suggested by the positive assortative matching literature.

[14] The present system of healthcare insurance was established in 1961. A comprehensive description of the Japanese healthcare system is provided in Sakamoto et al. (2018).

[15] WPHIS includes Employees' Health and Pension Insurance ('*Shakai Hoken*', hereafter EHPI), which is for individuals working in companies, government, and other organisations and bodies; and Private Schools Mutual Aid Society Insurance ('*Shigaku Kyousai*'), which is similar to EHPI, but restricted to those working

medical facilities at which they are examined and treated, irrespective of symptoms.[16] The costs to the individual associated with hospital visits and treatment are usually not entirely covered by mandatory health insurance. Japanese households typically pay thirty percent of the medical treatment cost,[17] with the exception of children and elderly people aged over seventy-five years. Whereas children up to the age of fifteen years of age can usually receive free healthcare (costs are reimbursed following the presentation of a Child Medical Care Certificate, or '*Iryo-sho*'), the cost for individuals over the age of seventy five is ten percent.[18] These fractions of the treatment cost are paid on the day but capped to a monthly limit to ensure affordability.[19]

To create measures of subjective health, responses to a series of survey questions relating to a range of physical and mental health symptoms are used. The questions asked are comparable to those which form the basis of the GHQ-12 scales (Goldberg 1972, Goldberg et al. 1997) and Kessler scales (Kessler et al. 2003), and assume the general form 'Do you ever experience the following these days?'. Panel A of Table 2 lists the symptoms used. Specifically, respondents are asked to report physical health symptoms including: 'headaches and dizziness'; 'palpitation and shortness of breath'; and 'digestive problems'. For mental health, respondents are asked to report symptoms such as: 'find meeting people tiresome'; 'dissatisfied with life'; and 'anxiety about the future'. The physical and mental health conditions are explicitly separated so as to explore whether they have distinct impacts on household saving. Moreover, in order to fully exploit the panel nature of our data, we use the set

in private schools and private universities. An employee's family and dependents are typically covered by WPHIS schemes (subject to dependents earning below a particular income threshold), with the cost being split between the employee and the employer. In contrast, NHI requires that each household member is enrolled individually, with premiums being adjusted according to the total annual income of the household. The total cost of these premiums, which can vary by municipality, is charged to the head of household.

[16] Masako (2009) notes that Japan has the highest OECD country average for doctor visits per patient by a considerable margin. Japan also has a high number of hospital beds per capita. The need to maintain the utilization rate of hospital beds has also led to stays at medical institutions being longer than the OECD average. Morita (2009) reports that whilst 100 percent of hospital beds are occupied in the UK, this figure falls to 70 percent for Japan.

[17] Despite Japanese residents being covered by mandatory health insurance, some individuals still choose to purchase additional insurance from private healthcare providers, which covers healthcare related expenses not covered by mandatory insurance. There may be rational reasons do this. First, even though mandatory health insurance schemes typically cover seventy percent of healthcare costs for Japanese households, extended hospital stays and prolonged treatment regimes may still lead to high out-of-pocket expenses. Second, private insurance providers may also pay for state-of-the-art treatments for conditions that are not covered by mandatory healthcare insurance. However, the willingness of an individual to take out private healthcare insurance may be a function of income, and may not be financially feasible for poorer households.

[18] In October 2018, Masahiro Sano, the vice-chairman of the National Federation of Health Insurance Societies in Japan warned that unless the contribution of the elderly was raised from ten to twenty percent, the Japanese healthcare system could collapse. See 'Health care system could collapse if elderly people's contributions not doubled: insurance official', *The Japan Times*, October 4, 2018. Article retrieved January 17, 2019 from https://www.japantimes.co.jp/news/2018/10/04/national/health-care-system-collapse-elderly-peoples-contributions-not-doubled-insurance-official/.

[19] In addition to being covered by mandatory health insurance, the costs that individuals will be expected to pay will vary according to salary, with wealthier (poorer) households paying more (less).

of symptoms which feature in all waves of our sample data sets across both surveys.[20] In both the KHPS and JHPS questionnaires, respondents were required to provide one of four possible responses to each question: 'often'; 'sometimes'; 'rarely'; or 'never'. In a similar spirit to the GHQ-12 caseness score, we dichotomise these variables such that if a respondent chooses 'often' or 'sometimes', we assign a value of one, otherwise a zero is assigned. A mental health index is subsequently constructed by summing the dichotomous outcomes, resulting in a four-point index, ranging from zero (if a respondent answers 'rarely' and 'never' to *all* mental health questions) to three (if a respondent answers 'sometimes' or 'often' to all mental health questions). Higher values of this index are indicative of greater levels of psychological distress. For physical health, a seven point index was constructed, ranging from zero (if a respondent answers 'rarely' and 'never' to *all* physical health questions) to six (if a respondent answers 'sometimes' or 'often' to *all* physical health questions). Higher values of this index correspond to poorer levels of physical health.[21]

The distribution of responses as captured by these mental and physical health indices are shown, respectively, in the upper and lower parts of Figure 1. For both the physical and mental health indices, the majority of respondents from both the KHPS and JHPS reply 'often' or 'sometimes' to at least one question. Put another way, respondents who report no issues with mental or physical well-being are in the minority. As shown in Table 3, the median KHPS and JHPS respondent has a mental health index score of one, whereas the median physical health score is two.

Insert Figure 1 here

Insert Table 3 here

The variable relating to hospitalisation and medical treatment was generated from the response to the question: 'Did you receive medical treatment or were you hospitalized last year?' with the potential responses being: 'no health problems'; 'had symptoms, but took no action'; 'treatment at hospital or clinic'; 'was hospitalized'; 'purchased over-the-counter medicine'; and 'other'. We collapsed the responses to this question into three variables indicating if the individual had: no health problems, did not act on a health problem or purchased over the counter medicine; received treatment at a hospital or clinic; and finally whether the individual was hospitalised. These responses are not mutually exclusive. As reported in Table 3, 45% individuals received no treatment at a clinic, 49% received such

[20] All responses are self-assessed. Neither the JHPS nor the KHPS survey provides information relating to whether respondents are taking medication for mental and physical illnesses.

[21] A number of studies have shown that because physical and mental health indices only capture part of an individual's true physical or mental health, they are susceptible to measurement error. This typically manifests itself in the form of a model's estimated parameters for these indices being subject downward bias (see for instance: Bound 1991; Bound, Schoenbaum, Stinebrickner, and Waidmann 1999; and Blundell, Britton, Dias, and French 2017).

treatment whilst, only 5% of individuals reported being hospitalised.[22] Figure 2 summarises these findings.

Our next health variable concerns whether the individual underwent medical screening. Specifically, respondents were asked: 'Did you receive a physical examination or cancer screening last year?' Panel C of Table 2 presents the potential responses to this question, whilst Figure 3 presents the distribution of responses relating to whether the respondent has received a physical examination or underwent various types of screening in the past twelve months. If a respondent answers in the affirmative a value of one is assigned, and a zero otherwise. We note here that the types of screening presented in Panel C are not mutually exclusive, and are markedly different in cost and scope.

Most respondents (58%) report undergoing periodic screening in the past year, which is free, and thus not associated with out-of-pocket medical expenses. All Japanese residents receive invitations to attend this form of screening each year.[23] For large employers there is a legal requirement to ensure that all employees attend this type of screening, although it is not in practice enforced. Rather, there is an expectation that individuals will attend.[24] The combination of these factors may account for the high rate of affirmative responses for this form of screening, which entails individuals undergoing basic procedures such as: the recording of body measurements, BMI, and blood pressure; hearing and eyesight tests; an electro-cardiogram (ECG); and providing a urine sample. We note here that the type of and number of tests included in the basic screening increases as one becomes older, with 35 years of age being an important benchmark. After reaching this age threshold, the additional screenings may include blood tests, ultrasound examinations, chest X-rays, and more involved procedures such as a barium meal.[25] Employees in large companies and organizations may also be enrolled in insurance schemes that offer a wider range of tests, as compared to the unemployed and self-employed with NHI coverage.[26]

In contrast to periodic screening, markedly fewer respondents report undergoing multiphasic screening (12%) and cancer screening (11%). Despite having similar frequencies, these forms of screening differ from each other in a number of ways. Unless directed by a physician to do so, in which case the costs for the recommended tests would be mostly cov-

[22] This is the wording of the KHPS question. The JHPS uses comparable wording, which enables us to construct measures that are consistent across time and surveys.

[23] This form of screening is typically called '*kenko shindan*'.

[24] An individual working for a large employer may be asked to pay the (subsidised) cost of the test on the day. This cost will be subsequently reimbursed by their employer.

[25] The inclusion of this latter form of screening is driven by the high incidence of gastric cancer in Japan. For instance, Naylor et al. (2006) find that compared to the UK, the incidence of gastric cancer in Japan is four times greater.

[26] Where certain tests are not offered to a particular age cohort as part of the basic screening, individuals may have the option to undergo these procedures but would be expected to pay the full cost. However, if an individual is referred to take additional tests by a physician, the majority of the cost would be borne by the insurer.

ered by insurance, individuals choosing to undergo multiphasic screening (which is typically called '*ningen doku*') are expected to pay the full cost. This form of screening is significantly more comprehensive and extensive in scope than an annual periodic screening, and depending on the types of multiphasic screening that one opts to undergo, may lead to substantial out-of-pocket costs.[27] In contrast, cancer screening will typically be performed as the result of a referral by a physician (in which case the majority of costs would be borne by the insurer), or, due to an individual participating in a national or municipal level screening programme, which would in turn be associated with relatively minor out-of-pocket expenses.[28] The 'Other screening' category is similar to that for 'Cancer screening', in that an individual will partake if directed by a physician. The types of screening undertaken here correspond to medical investigations not related to cancer, and may include, for instance, bone density scans and blood tests for non-cancerous related conditions.

Insert Figure 2 here

Insert Figure 3 here

For the JHPS sample, we have two additional measures of health: BMI and out-of-pocket treatment cost. These are shown in Figure 4. BMI is an objective measure of health which is defined as weight in kilograms divided by height in metres squared. It is indicative of a range of health outcomes, including cardiovascular disease and all-cause mortality, and in this sample is constructed using self-reported height and weight. The sample average for BMI is 23kg/m^2, a value that is generally considered healthy.[29] This finding aligns with

[27] The options available for individuals undergoing *ningen doku* include comprehensive blood tests, invasive procedures such as endoscopy and colonoscopy, and CT and MRI scans. This list is not exhaustive. Whilst the nature of some tests may require patients to stay in hospital overnight, undergoing this form of screening typically takes between half to a whole day. As noted above, the availability of certain tests in the annual periodic screening may differ according to whether or not an individual works for a large company or organisation (and will therefore be covered by a WPHIS scheme). More extensive periodic screening may be available for such workers as compared to individuals who are either unemployed or self-employed (and thus covered by NHI). In this regard, unemployed and self-employed individuals with health concerns may opt to take some of the screening options available in *ningen doku* that are not covered by their annual periodic screening. Whilst this may *prima facie* indicate that the Japanese healthcare system is not entirely equitable in terms of the type and cost of screenings available, we note below that government national screening programmes for common forms of cancer typically run at the municipal level, in parallel to the programme of periodic screening.

[28] Although it is possible to voluntarily undergo many forms of cancer screening using *ningen doku* without referral from a physician, many cities in Japan have well-established and heavily subsidised screening programmes for bowel, prostate, breast and cervical cancer. These programmes run in parallel to the system of annual periodic screening. Out-of-pocket expenses may be expected to be around 1000 Yen for most of these procedues, and eligibility is contingent on being in a particular age category. Individuals will be invited to attend these forms of screening every few years. Such programmes are arguably targeted at the unemployed and self-employed, who may be unable to receive these forms of screening given their ineligibility to join WPHIS / employer-based health plans (i.e., where the extent of screening may be be more comprehensive in scope than NHI related coverage).

[29] A BMI between 18·5–24·9kg/m^2 is classified as being in the normal range by the World Health Organization (WHO).

Maruyama and Nakamura (2015), who stress that when compared to other high income countries, the Japanese have a lower body mass index, and are characterised by considerably lower rates of obesity.[30]

Treatment costs correspond to expenditures made by the household for treatments at healthcare providers, which includes the cost of medicines. In Figure 4, we observe that just over 15 percent of households reported paying no treatment costs. Put another way, the vast majority of households experienced some form of out-of-pocket expenses for healthcare. We note here that out-of-pocket health expenditures have been used in a variety of contexts to measure health care utilisation and arguably reflect the health risks confronting the household.[31] Table 3 presents the summary statistics relating to the log transformation of treatment cost.

Insert Figure 4 **here**

3 Saving, health, and healthcare utilization

This section analyses the impact of health and healthcare utilization on household savings and total financial assets. When regressing savings and the total value of a household's financial assets on our various health measures, we include a set of standard control variables corresponding to head of household and household characteristics, including education, employment status, income, net worth and geographical location.[32] The full list of these controls is described in Table 4, and the corresponding summary statistics are provided in Table 5. We begin by using panel Tobit models to model our relationships of interest, which is a common modelling approach in the existing literature on household finances (see, for instance, Guariglia and Rossi (2004)). Specifically, we estimate a set of specifications based on an equation of the form

$$y_{it}^{*} = \mathbf{x}_{it}'\boldsymbol{\gamma} + \mathbf{h}_{it}'\boldsymbol{\phi} + \varepsilon_{it} \tag{1}$$

[30] By way of comparison, the average BMI for adults in the UK in 2017 was reported to be 27.7kg/m^2, which lies outside the WHO normal health range (source: http://healthsurvey.hscic.gov.uk/data-visualisation/data-visualisation/explore-the-trends/weight/adult/bmi.aspx. Retrieved January 2, 2019). Maruyama and Nakamura (2015) also report that the number of women being underweight is a growing public health concern in Japan, due to its association with higher rates of mortality and other physical health conditions.

[31] For instance, using household survey data from 2010, Baird (2016) finds that poor and middle-class families in the United States are between 1.5 to 4 times more likely to face large out-of-pocket medical expenses than their Canadian counterparts. The extent of the disparity is a function of the demographic group and spending threshold used.

[32] Both surveys also contain information about health insurance expenditure. As noted above, NHI is one of two main insurance programs in Japan, the other being WPHIS based schemes. The JHPS and the KHPS (from 2009 onwards) include a question relating to the total monthly NHI premium for all family members. However, neither study includes information relating to employer based schemes. For the available years, the NHI premium generally has a statistically insignificant impact on saving behaviour and the results presented in this paper are robust to the inclusion of this variable, that is they are similar in magnitude and statistical significance.

where

$$\varepsilon_{it} = \lambda_i + e_{it}, \tag{2}$$

such that

$$y_{it} = g\left(\mathbf{x}'_{it}\boldsymbol{\gamma} + \mathbf{h}'_{it}\boldsymbol{\phi} + \boldsymbol{\varepsilon}_{it}\right) = \begin{cases} 0 & if \quad y^*_{it} \leq 0 \\ y^*_{it} & if \quad 0 < y^*_{it} \end{cases} . \tag{3}$$

In expressions 1 to 3, y^*_{it} is a latent variable which corresponds to the observed dependent variable y_{it}, $\mathbf{x}_{it}$ is a matrix of control variables, $\mathbf{h}_{it}$ is a matrix of health measures, and $\boldsymbol{\gamma}$ and $\boldsymbol{\phi}$ are parameter vectors. The nature of our estimation strategy means that the health measures in $\mathbf{h}_{it}$ vary across specifications, whilst the elements of $\mathbf{x}_{it}$ remain fixed. To account for the panel nature of the data, ε_{it} is decomposed such that λ_i is a time-invariant fixed effect and $e_{it} = N(0, \sigma^2_e)$ is an independent and identically distributed random disturbance term. $t = 1, 2, ..., T$ denotes the year in the wave of the survey, and $i = 1, 2, ..., N$ denotes the household.[33]

Insert Tables 4 and 5 **here**

As the controls in $\mathbf{x}$ are not our focus, and are standard in the existing literature (see Browning and Lusardi (1996) for an excellent survey), we restrict ourselves to presenting a single set of estimates for these variables. This is apposite, since we find that the estimates for our control variables are generally unaffected by the inclusion of different health measures in $\mathbf{h}$.[34] These findings are reported in Table 6, and correspond to a set of specifications for the KHPS and JHPS in which $\mathbf{h}$ only contains the mental health index. To facilitate comparison of the impact of our health measures across different specifications, all estimates of our health measures are presented in Table 7. The estimates for our mental health index which correspond to the control variable estimates in Table 6 are presented in Panel A of Table 7. In these estimations, our health measures are treated as being exogenous, although this assumption is subsequently relaxed.

Prior to discussing the findings for our health measures, we comment briefly on the results in Table 6, which for both the JHPS and the KHPS are broadly similar. We report the average marginal effects, which are evaluated at the censored expected value of the outcome. Income, education, and net worth all exert a positive impact on savings and total financial assets. A greater number of adults in the household is associated with a lower level of savings and smaller overall portfolio, whilst the impact of having children is the opposite. The latter finding may be associated with families consciously saving or investing more to pay for the costs associated with childcare and other outgoings, such as university

[33] As is common in the non-linear panel data literature, given that these unobserved heterogeneity terms are (potentially) correlated with observed heterogeneity terms, the correction proposed by Mundlak (1978) is applied. We include the means of the time-varying continuous variables such as income and net wealth.

[34] The results are available from the authors on request.

and school fees.[35] Interestingly, we respectively observe negative and positive coefficients on the age and age-squared variables, suggesting a 'u-shaped' saving profile for the KHPS. These effects extend to the total size of a household's financial portfolio. Turning to the geographical and year controls, there is some variation in the size and statistical significance of the marginal effects corresponding to the seven regional coefficients. We note here that the Kantō region, which accounts for around forty percent of Japan's GDP and contains the Tokyo metropolitan area, is the omitted region. Despite the variation in the regional effects, both the KHPS and the JHPS are broadly consistent in indicating that households in Kyūshū and Tōhoku, which are among Japan's poorest regions in terms of regional domestic product per capita, are associated with lower levels of saving and smaller financial portfolios. With respect to the year controls, we omit the years 2005 and 2009 for the KHPS and JHPS datasets, respectively.[36] In the case of the KHPS, the negatively signed coefficients reflect the fact that the stock of savings has been in decline when compared to 2005. For JHPS, savings appear to be higher in the years subsequent to 2009, as captured by the positively signed coefficients.[37]

3.1 Exogenous and endogenous health

Panels A to C of Table 7 report the findings corresponding to our (exogenous) health indices, where we observe that mental and physical health exert opposing effects.[38] Panel A reports the effect of augmenting the set of benchmark controls with the mental health index. Panel B adopts an analogous approach using the physical health index. Whereas mental health exerts a statistically significant negative impact on saving and total financial assets, poor physical health is associated with higher savings and larger portfolios. In Panel C, the benchmark model is estimated with *both* of the mental and physical health indices. Evidently, the mental and physical health estimates are robust to both measures being included.[39] The reported impacts are sizable, and consistent in both size and magnitude across the KHPS

[35] It may also be the case that costs associated with raising children act to disincentivise the poorest families from having children. This implies that families with the financial means to accumulate savings and hold a financial portfolio are more likely to have children.

[36] In the case of the KHPS, the 2007 wave was omitted from our sample due to the absence of health questions. This accounts for the absence of the 2007 year dummy.

[37] Interestingly, although we might expect the 2011 Tōhoku earthquake to impact on household decisions relating to savings and total financial assets (see Hanaoka, Shigeoka, and Watanabe (2018) for a discussion of how Japanese risk preferences changed following this natural disaster), it is not immediately clear that the impact of this event is being picked up in the year dummies.

[38] Although our mental and physical health conditions variables are assigned a value of one if the head of household replies 'often' or 'sometimes' or a zero if the response is 'rarely' or 'never', our results were largely unchanged when we used indices in which a value of one was assigned to the 'often' response, and a zero to all others.

[39] To capture potential comorbidity effects associated with physical health and mental health, we also ran additional regressions (not reported here), in which these indices were interacted. For both the KHPS and JHPS, this term was found to be statistically insignificant.

and JHPS. Based on the Panel C estimates, a KHPS respondent with a mental health index value of three would, *ceteris paribus*, be expected to have savings over 15 percent lower than individuals who have a zero mental health index score. This finding is consistent with the findings in Bogan and Fertig (2018), who show that in the context of the United States, mental health problems have sizable impacts on savings held in retirement accounts. In contrast, our findings in Panel C suggest that a respondent with a physical health index score of six will have approximately 16 percent more savings than a respondent with a physical health index score of zero.[40]

The reported impacts are even greater when the total value of all financial assets is considered.[41] These findings are in a sense surprising. Whilst Edwards (2008) finds that US households accumulate safer assets as a means of hedging the risk of adverse health shocks by lowering their exposure to financial risk, we emphasise that the heavily subsidised nature of the Japanese healthcare system makes it very different to the system in the United States. The presence of such subsidies should arguably lower the precautionary savings motive, as the risks associated with very high unexpected medical costs are lowered substantially. However, as noted earlier, the nature of Japan's system of universal healthcare coverage does not completely prevent households from being confronted with high out-of-pocket expenses, which may arise due to extended stays in hospital, or may be associated with treatment for long-term medical conditions.

Panels D to H report the results of estimations using our additional (exogenous) health measures. Hospital visits have a sizable and positive impact on saving and total portfolio size (Panel D), as does health screening (Panel E, KHPS only). The sizes of the marginal effects for these coefficients are large and statistically very highly significant. Whilst being hospitalized is associated with an increase of approximately 24 percent in the natural log of real savings, the increase in total financial assets is equivalent to around 27 percent.[42] Although the corresponding effects associated with having treatment at a hospital or clinic are relatively smaller, they are still sizable.

Care has to be taken when interpreting the impact of different forms of screening, and a number of mechanisms may be driving our results. As 'Periodic screening' is free, one interpretation of the reported marginal effects, which are sizable and positive, is that individuals who attend this form of screening care more about their future health. This is consequently

[40] We also ran regressions in which separate dummy variables were used to capture each level of our respective physical and mental health indices. This was done to capture the potential non-linear effects of mental and physical health. The results for mental health confirmed the findings in Table 7 that a greater index score is associated with a lower level of savings and total financial assets. For physical health, our findings confirmed a positive association with savings and total financial assets, as reported in Table 7.

[41] For the JHPS, Panel C of Table 7 indicates that the impact of our health indices is greater for savings than for total financial assets.

[42] We note here that the effects are no longer reasonably approximated by the formula $1 + \widehat{\beta}$, where $\widehat{\beta}$ represents the estimated coefficient.

reflected in greater levels of (precautionary) savings and larger financial portfolios. This conjecture may be viewed as a variation on the arguments in Edwards (2008), in that individuals who are more predisposed to invest in future health in this way are actively seeking to guard against future health shocks. Even if such shocks do not incur excessively large health bills, they may affect future income streams from employment. Financial prudence is thus associated with prudence in health. Nevertheless, it is also plausible that individuals become more health conscious as they age, with older individuals being more likely to attend periodic screenings. In this regard, the marginal effects observed in Table 7 for periodic screening may also reflect life-cycle effects, in that such individuals may reasonably be expected to have accumulated greater savings and larger financial portfolios.

Given their association with low out-of-pocket expenses, explanations similar to those used to account for the effects of periodic screening on savings and financial portfolio size may also account for the effects reported for 'Cancer screening' and 'Other screening', although the estimated impacts are observed to be somewhat smaller. It may also be the case that even though the level of out-of-pocket expenses incurred for these forms of screening is low, some respondents with the lowest level of savings and financial assets choose not to attend screenings because of the associated costs. However, as is shown later, this conjecture appears to be overturned by the results of quantile regression analysis in Section 4.

Significantly, multiphasic screening exerts an impact that is far greater than all other screening types. Given the potential to incur large of out-of-pocket expenses with this form of screening, its uptake will be strongly associated with affordability. In this regard, the large and positive coefficients reported for multiphasic screening may be predominantly capturing the fact that wealthier households are far more likely to have higher levels of savings and larger financial portfolios.

Turning to Panels F to H (JHPS only), higher treatment costs are associated with a higher level of savings and larger financial portfolios. However, despite being highly statistically significant, the size of these effects is modest. This contrasts sharply with the effects of screening. Nevertheless, the results indicate that poorer households with lower levels of savings and financial assets are less likely to seek medical treatment if affordability is an issue; the findings may also suggest that wealthier households can afford better treatment.

BMI is observed to exert a negative impact on savings, although this effect is not strongly statistically significant.[43] Although very few papers have investigated the relationship between BMI and savings, a number of contributions have explored the relationship between BMI and other aspects of financial decision making. For example, using data from the German Socio-Economic Panel for the years 1999 to 2009, Keese and Schmitz (2014) find that

[43] We note here that when the spouse's BMI was used, the negative association between BMI and savings was found to be larger and more statistically significant. A statistically significant negative relationship between BMI and total financial assets was also found.

individuals who are overindebted "have a higher body mass index and are more likely to be overweight" (p.537). Additionally, a number of large-scale survey data sets from the United States and Europe are analysed by Addoum, Korniotis, and Kumar (2016), who test the hypothesis that overweight people will invest less in risky assets. Using BMI data to construct a measure of obesity, the authors find support for this hypothesis, which is partially explained by obese individuals having lower cognitive skills. Our findings for BMI align with Keese and Schmitz (2014), if one associates greater rates of indebtedness with lower levels of savings. BMI is found to exert a statistically significant and negative impact on savings in all subsequent regressions. By way of contrast, in Section 8, we find evidence that higher levels of BMI are associated with a slightly lower tendency to hold financial wealth in the form of savings relative to securities, which is at odds with the findings of Addoum, Korniotis, and Kumar (2016).

Insert Tables 6 and 7 **here**

Despite the robustness of the above findings, it may be the case that the relationship between savings and health is endogenous. To deal with this potential issue, and given that our interest lies in exploring the determinants of savings as the outcome variable, we model the relationship between savings and health as a recursive system. Central to the system is a Tobit specification of the form given by equation (1), in which $\mathbf{h}$ is treated as being endogenous. In using this type of framework, we follow Roodman (2011), who demonstrates that this choice of estimator is consistent for recursive systems in which all endogenous variables appear on the right-hand sides of the model equations.[44] A number of two-equation recursive systems based on expression (1), in which $\mathbf{h}$ contains a single endogenous health measure, are estimated.[45] Prior to estimation, the health indices were re-coded as zero-one binary indicator variables, where a health index score greater than zero was assigned a one, and a zero assigned otherwise. Information relating to treatment at a hospital and hospitalization in Panel D of Table 7 was similarly combined to create a single, binary zero-one variable, where a one was assigned if an affirmative response was received for either of the treatment or hospitalization questions, and a zero otherwise. For questions

[44] The estimations are performed in Stata 15 using the *conditional mixed-process* (cmp) suite of tools developed by Roodman (2011). Related approaches have been used in the literature. Lyons and Yilmazer (2005) exploit information in the US *Survey of Consumer Finances* (SCF) to explore the relationship between health and financial stress. Simultaneous two-stage probit models are estimated to account for possible endogeneity between measures of self-reported health status and financial strain. Poor health significantly increases the probability of households being affected by financial strain, whereas financial strain exerts no effect on health. More generally, widening differences in health status appear to be associated with heightened levels of financial disparity, particularly for the least affluent households who experience poor health.

[45] Three-equation recursive systems in which endogenous mental and physical health were jointly treated as being observed right-hand side variables encountered convergence problems. This may be due to our exclusion restrictions being insufficiently strong enough.

relating to hospital screening, a binary indicator was constructed whereby we assigned a one if the respondent had undergone any form of screening in the previous year, and a zero otherwise. These health equations were modelled using probits. Given the continuous nature of the BMI and treatment cost responses, OLS and Tobit models were respectively used to model these variables. The health measures were modelled using information relating to if the respondent undertakes any exercise, consumes alcohol, or smokes.[46] Having accounted for such possible endogeneity, Table 8 reports the impact of our health measures on savings and total financial assets.[47]

Insert Table 8 here

The estimated effects shown in Table 8 are consistent with the findings in Table 7, with an important exception: the impact of physical health on savings and total portfolio size (Panel B) has an impact that is not statistically different to zero for all specifications. This sharply contrasts with the findings for mental health, which in most cases suggests a strong negative impact on savings and portfolio size. Hospital visits (Panel C) have a strong and positive impact on savings and total financial assets, as does health screening (Panel D, KHPS only). Turning to Panels E to F, BMI exerts a negative impact on savings, although this effect is not strongly significant, whereas higher treatment costs are associated with greater savings and larger financial portfolios. The impact of such costs is large and highly significant.

As an alternative way of dealing with potential endogeneity, we also applied the modelling approach of Bogan and Fertig (2013, 2018) in which current investment decisions are treated as being a function of past mental health states. Accordingly, mental health measures were lagged by one wave. Bogan and Fertig (2013) justify this type of specification on the grounds that it may take time for a mental health state to influence investment decisions. Further, it reduces the possibility of reverse causality between health and investment decisions. This is in addition to using a 'financial distress' variable, also lagged one wave, to mitigate the problem of endogeneity arising between mental health and savings. Put another way, "...a household member may have mental health issues because the household was in financial distress" (Bogan and Fertig 2013, p.969). We followed this approach by first estimating the specifications based on those shown in Panels A to H of Table 7 but instead using one period lags of the health variables rather than current period realisations. This exercise was then repeated, with the additional inclusion of a lagged financial distress variable in all

[46] The health equations are identified on information relating to: whether a person exercises or not (only available for the KHPS); a binary variable indicating if the respondent drinks alcohol 1-2 times or more a week (0), or never or a few times a month (1); a set of binary indicators capturing if (*i*) the respondent smoked everyday or sometimes, or (*ii*) used to smoke. 'Never smoked' was the omitted indicator.

[47] Obtaining marginal effects for recursive systems is not currently available for the cmp module. Although marginal effects in Stata are typically obtained using the "margins" command, it is unable to recognise the way in which equations in a recursive system are linked. Specifically, it cannot take into account how one equation affects a second equation via a third equation, and so on.

specifications, constructed using the ratio of total household debt (including mortgages) to annual pre-tax income. In both sets of estimations we obtained results that were consistent with those reported in Table 7.[48] We now turn to quantile regression analysis, which enables us to gain an insight into how our health measures affect household saving at different points in the distributions of savings and total financial assets.

4 Health and healthcare utilization effects across the savings distribution

Given the censored nature of our dependent variables, a Tobit model with left-censoring was employed in Section 3. However, our attention now turns to exploring how our health and health utilisation measures affect savings and total financial assets at different points in their distributions. To do so, we use a censored quantile regression (CQR) estimator, which like the Tobit estimator, is able to handle the censored nature of our dependent variables. Our choice of estimator has rarely been used in the household finance literature, and is distinct from the Tobit estimator in a number of important ways. Most significantly, it provides an alternative to modelling the conditional mean of a dependent variable (Fitzenberger 1997), as is the case for the Tobit model. Accordingly, CQR enables us to estimate the effects of our health measures across the entire distributions of savings and total financial assets at different quantiles. As demonstrated in Powell (1986), the CQR estimator has a number of desirable features, and unlike the Tobit model, is based on assumptions that are not strictly parametric.[49] Although a number of contributions identify the steps involved in CQR estimation (Fitzenberger 1997, Chernozhukov and Hong 2002), it is instructive to briefly set these out below.

To fix ideas, denote the amount of savings held by each household as $y_{it} = \max[0, y_{it}^*]$ where y_{it}^* is an untruncated latent dependent variable which corresponds to the observed value of y_{it} reported in wave t of the KHPS or JHPS, for household i $(= 1, \ldots, N)$. To allow for the impact of our standard controls and health measures, we condition on $\mathbf{x}_{it}$ and $\mathbf{h}_{it}$ as in expression (1). This yields

$$y_{it} = f\left(\mathbf{x}_{it}, \mathbf{h}_{it}\right) = f\left(\mathbf{H}_{it}\right) \tag{4}$$

$$\mathbf{H}_i \subseteq \left\{\mathbf{x}_{it}, \mathbf{h}_{it}\right\}.$$

[48] These findings are not presented here, and are available from the authors on request.

[49] Powell (1986) demonstrates the consistency of the CQR estimator. The error term is shown to be independent, and not based on a constant variance assumption. Heteroscedasticity is subsequently not a problem, making the CQR model robust to observations with extreme values.

Following Koenker and Bassett Jr. (1978), the quantile regression model is given by

$$Q_\theta\left(y_i \mid \mathbf{H}_i\right) = \boldsymbol{\beta}_\theta^{'}\mathbf{H}_i \tag{5}$$

where time subscripts have been dropped for brevity, and where the θ conditional quantile of the dependent variable y_i is captured by Q_θ. To obtain an estimator for $\boldsymbol{\beta}_\theta$ requires minimising the expression

$$\min_{\boldsymbol{\beta}_\theta} \frac{1}{N}\left\{\sum_{y_i \geq \boldsymbol{\beta}_\theta^{'}\mathbf{H}_i} \theta\left|y_i - \boldsymbol{\beta}_\theta^{'}\mathbf{H}_i\right| + \sum_{y_i < \boldsymbol{\beta}_\theta^{'}\mathbf{H}_i} (1-\theta)\left|y_i - \boldsymbol{\beta}_\theta^{'}\mathbf{H}_i\right|\right\}. \tag{6}$$

As demonstrated in Powell (1986), solving the following expression yields the CQR estimator,

$$\min_{\boldsymbol{\beta}_\theta} \frac{1}{N}\sum_{i=1}^{N}\left\{\left[\theta - I\left(y_i < \max\{0, \boldsymbol{\beta}_\theta^{'}\mathbf{H}_i\}\right)\right]\left(y_i < \max\{0, \boldsymbol{\beta}_\theta^{'}\mathbf{H}_i\}\right)\right\}, \tag{7}$$

where I is an indicator variable which equals one if the expression holds and zero otherwise.

In all specifications, given our previous findings that exogenous and endogenous health measures yield the same pattern of results, the health measures are treated as being exogenous, and a similar estimation strategy is followed as in Table 7. All coefficients report the average marginal quantile effect for the censored dependent variable, and estimations are performed using the 'cqiv' routine in Stata with 50 bootstrap repetitions (see Chernozhukov, Fernández-Val, and Kowalski 2015).

Table 9 reports the impact of our health indices on savings and total portfolios, for both the KHPS and the JHPS. For the physical and mental health indices, we restrict ourselves to specifications based on those in Panel C of Table 7, in which our physical and mental health indices are entered together.[50] Mental health generally has a negative impact on savings and total financial assets. The KHPS indicates a 'u-shaped' relationship between mental health, savings, and total financial assets, in that the largest effects are felt at the extreme ends of the distributions. In contrast, for the JHPS, the greatest effects on savings and total financial assets are observed at the higher quantiles. In the case of physical health, the findings are mixed. Generally, savings and total financial assets are positively affected by physical health, although for some parts of the distribution, the impact is statistically insignificant.

Insert Table 9 here

The results for hospital visits and hospitalization are shown in Table 10, which follow the specification in Panel D of Table 7. Whilst our findings clearly align with those in Table

[50] Specifications in which our health measures were estimated separately, as in Panels A and B of Table 7, yielded results that are entirely consistent with results when both measures are estimated together.

7 - both health variables have a positive and statistically significant effect on savings and total portfolio size - the sizes of the effects vary considerably across quantiles, suggesting considerable heterogeneity. Interestingly, the sizes of the hospitalization and hospital treatment effects for households in the very lowest decile are greater than for households at the lower end of the distribution. This suggests that the poorest households, as measured by their stock of financial assets, have a greater disposition to accumulate savings and increase their portfolio size in response to hospitalization and treatment visits. For instance, based on the KHPS, the impact of hospitalization is to increase savings and total financial assets by approximately 80 and 58 percent, respectively.[51] These effects are clearly sizable.

Insert Table 10 **here**

Table 11 shows that screening has similarly large effects to hospitalization and hospital treatment visits. Using specifications which follow those in Panel E of Table 7, households in the lowest decile are observed to have a much greater propensity to both accumulate savings and increase the value of their total portfolios in response to health screening visits, relative to households at the lower end of the savings and total portfolio distributions. In the case of savings, we note sizable effects for 'periodic screening', the impact of which is decreasing in decile size.

For BMI and treatment costs (the JHPS only), we base estimations on Panel H of Table 7. Our findings are reported in Table 12. Whereas higher treatment costs are associated with greater savings and total financial assets, the impact on the latter variable is in most cases larger. However, the impact of BMI is consistently negative and statistically highly significant across the entire distributions of savings and total financial assets. This finding qualitatively aligns with the Tobit based estimations reported in Tables 7 and 8, which are characterised by negative, albeit less statistically significant, relationships between BMI and our financial variables. For both the KHPS and JHPS, the largest effects are observed in the lower deciles of the savings and financial asset distributions.

Insert Table 11 **here**

Insert Table 12 **here**

In this section, censored quantile modelling techniques have revealed how the distributional effects of our health measures on savings and total financial assets are characterised by considerable heterogeneity. In what follows, our focus turns to accounting for the impact of our health measures on the composition and size of a household's financial portfolio.

[51] An increase of one unit in our explanatory variable is associated with an increase of approximately $\widehat{\beta} = 0.53$ in the natural log of real savings. This implies that savings have increased by a factor of $\exp^{\widehat{\beta}}$.

5 Health, saving, and portfolio re-balancing effects

Recent theoretical work suggests that the composition of household portfolios should be of clear interest to policymakers. In particular, Bhamra and Uppal (2018) show that under-diversified portfolios at the household level can lead to lower economic growth at the macro-economic level. Encouraging greater diversification of household portfolios may consequently result in benefits that are not just restricted to improving the welfare of individual households at the microeconomic level. This finding is of direct relevance to the observation that in many countries, non-participation in risky asset holding is characterised by a 'stockholding puzzle', in which holding safer assets is observed at levels greater than predicted by finance theory (see, for instance, Haliassos and Bertaut 1995). A number of contributions suggest that Japan is also characterised by this form of under-diversification. Fujiki, Hirakata, and Shioji (2012) observe that the structures of Japanese household portfolios are clearly characterised by the 'stockholding puzzle'. This leads the authors to conclude that the government should take measures to encourage greater stockholding, which should facilitate more efficient risk-sharing among generations. We also note that given the low fertility rates and high life expectancy in Japan, holding stocks should be desirable as this will lead to more wealth accumulation. Kitamura and Uchino (2010) find that the limited stock market participation of Japanese households is attributable in large part to financial literacy, which is proxied for using data on a respondent's educational background. Individuals with at least a college education are far more likely to own risky financial assets than non-college graduates. This effect was found to hold when factors such as household income and other socioeconomic characteristics were also taken into consideration.[52,53] Given this interest in portfolio composition, attention now turns to modelling how savings as a proportion of total financial assets change in response to our health measures.

A novel aspect of our empirical approach lies in jointly estimating a fractional regression model (Papke and Wooldridge 1996) with the Tobit specifications estimated in Table 7 of

[52] Ito, Takizuka, and Fujiwara (2017) argue that one way to increase stockholding in Japan at the household level is to improve financial literacy. Here, we note that an initiative in the field of financial education which has been operating in Japan since 1983 is the *Central Council for Financial Services Information*, www.shiruporuto.jp/e. The main purpose of the council is to educate the public regarding the importance of basic financial and economic knowledge.

[53] Other contributions have used household-level data from the *Nikkei Radar* survey, which in terms of coverage is regionally limited to the Tokyo metropolitan area and surrounding prefectures (Tokyo, Chiba, Ibaraki, Kanagawa, and Saitama). Iwaisako (2009) adopts a broad definition of a household's portfolio to include assets such as real estate, as well as financial assets. Using data for the years 1987 to 1999, the author reports decreasing stock market participation in the 1990s, as well as a fall in equity holdings. This pattern is at odds with the rises in household stockholding in other major advanced economies observed for the same period. Iwaisako, Ono, Saito, and Tokuda (2017) examine the impact of housing on household stockholding in Japan. Land value appreciations (holding mortgage debt constant) increase stockholding, whereas a rise in mortgage debt (holding land value constant) reduces it. When home equity is held constant, greater land value and higher mortgage debt levels merely increase mortgage debt repayments and exert no impact on stockholding.

Section 3. This enables us to simultaneously investigate the effects of our health measures on both the composition and the size of financial assets using a two-equation system, in which the error terms are assumed bivariate normal. *Prima facie*, the logic underlying this approach is appealing: it allows for the possibility that when allocating monetary resources, households consider an overall amount that should be allocated to financial assets, as well as the proportions of their resources allocated to safe and risky assets. Here, we regard savings as 'safe' assets, and securities as 'risky' assets, thereby linking our approach to a wider literature in which the impact of health on portfolio allocation is investigated. In this regard, the total amount of financial assets owned by a household is synonymous with a financial portfolio containing two asset types.

A first strand of literature that our approach naturally aligns with considers the relationship between physical health and portfolio allocation. Here, notable contributions include Rosen and Wu (2004), Berkowitz and Qiu (2006), Edwards (2008), Cardak and Wilkins (2009), Fan and Zhao (2009), and Spaenjers and Spira (2015). These studies are typified by the general finding that poor physical health is associated with higher levels of safe asset-holding relative to holdings of riskier assets such as stocks and shares. Given our use of mental health indices, a second strand of research relevant to our approach is the more recent literature on mental health and portfolio allocation. This literature generally finds that mental health conditions reduce the likelihood of holding risky financial assets (see for instance Gambetti and Giusberti 2012, Bogan and Fertig 2013, Lindeboom and Melnychuk 2015).

To model the composition of a household's financial portfolio, recall that in the KHPS and JHPS, household $i = 1, 2, ..., N$ reports the values of all assets. These assets are classified as either savings or securities. We can denote these categories by $j \in \{savings, securities\}$,[54] such that the total value of savings for household i is denoted $Y_{i,savings}$, and the corresponding amount for securities is given by $Y_{i,securities}$. The total value of household i's portfolio can therefore be expressed as $Y_i = Y_{i,savings} + Y_{i,securities}$. Using these definitions, the share of assets s_{ij} in each category j will be given by

$$s_{ij} = \frac{Y_{ij}}{Y_i}, \tag{8}$$

where $s_{i,savings} + s_{i,securities} = 1$. Omitting the time subscripts for brevity, and following Papke and Wooldridge (1996), we let $E\left(s_{ij} \left| \mathbf{x}_i, \mathbf{h}_i \right.\right)$, where $E(\cdot)$ denotes the expected value of the term in parentheses and $\mathbf{x}_i$ and $\mathbf{h}_i$ are matrices of the standard controls and health measures, respectively. The fractional nature of the household allocation equation means

[54] Other surveys classify assets into three distinct risk classes when analysing household portfolios. See for instance (Carroll 2002).

that the model can be represented as

$$E\left(s_{i,savings}\left|\mathbf{x}_i,\mathbf{h}_i\right.\right)=G\left(\mathbf{x}_i'\boldsymbol{\beta}+\mathbf{h}_i'\boldsymbol{\gamma}\right) \tag{9}$$

and by symmetry

$$E\left(s_{i,securities}\left|\mathbf{x}_i,\mathbf{h}_i\right.\right)=1-G\left(\mathbf{x}_i'\boldsymbol{\beta}+\mathbf{h}_i'\boldsymbol{\gamma}\right)$$

where G is a known function satisfying $0\leq G(z)\leq 1\ \forall\ z=\mathbb{R}$ (Papke and Wooldridge 1996) and where $\sum_j = E\left(s_{ij}\left|\mathbf{x}_i,\mathbf{h}_i\right.\right)\equiv 1$. As Papke and Wooldridge (1996) stress, $G(\cdot)$ is typically assumed to be a cumulative distribution function (CDF) based on the logistic function or the standard normal distribution. Here, $G(z)$ is chosen to be a fractional probit model, for which it is possible to define a quasi-likelihood function $L(\cdot)$ that embeds the expressions given in (9). The associated likelihood function is given by

$$L=\prod_i\left(\Phi(\mathbf{x}_i'\boldsymbol{\beta}+\mathbf{h}_i'\boldsymbol{\gamma})\right)^{s_{i,savings}}\Phi\left(-\mathbf{x}_i'\boldsymbol{\beta}-\mathbf{h}_i'\boldsymbol{\gamma}\right)^{s_{i,securities}} \tag{10}$$

where $\Phi(\cdot)$ denotes the standard normal CDF. To estimate the univariate fractional model in isolation, we would be faced with an estimation problem identical to that associated with estimating a standard probit model (Wooldridge 2010, p.751). However, jointly estimating the fractional model described above with the Tobit model given by expression (1) requires that the error terms are bivariate normal. Full details of how this type of joint model can be estimated under this distributional assumptions are found in Roodman (2011), who relates the discussion to the more general multivariate case.

Our findings for both the KHPS and JHPS are reported in Table 13, where savings as a share of total financial assets, $s_{i,savings}$, is the dependent variable. As noted in expression (9), we assume that the determinants of household portfolio asset shares (reported in the 'share' equation columns) are driven by the same factors as for the Tobit equations. The results for the Tobit equations, which report 'size' effects, show that worsening mental health has the effect of reducing both savings and total portfolio size in both the KHPS and the JHPS. The sizes of the estimated effects on savings are almost identical to the effects of mental health in Panel A of Table 7. For both surveys, portfolio composition, as captured by the fractional regression equation, is unaffected by mental health. One exception is reported for the JHPS with respect to total financial assets in Panel C of Section B of Table 13, which suggests that for every additional increment in the mental well-being index, the share of a household's portfolio associated with savings declines by approximately 0.0056. Such a result suggests the presence of a household portfolio re-balancing effect towards riskier assets (i.e., securities) from savings as mental well-being declines. However, even though this effect is statistically significant at conventional levels, the impact on portfolio composition is still negligible. As a counterpoint to this finding, if one turns to the corresponding Tobit estimates for 'All

assets' (i.e., the household's entire financial portfolio), it is clear that despite the absence of a significant portfolio rebalancing effect, the value of total financial assets falls in the region of 18 percent for an individual with a mental health index score of three. The impact is similar when one considers the Tobit equation in the joint system corresponding to 'Savings'. Our results unambiguously indicate that the total holdings of both savings and securities, respectively, fall significantly when mental health deteriorates, but the proportions in which they are held do not. These results contrast with Bogan and Fertig (2013), who report sizable portfolio re-balancing effects in response to mental health conditions, in the form of a shift away from risky to safer assets for the United States. Naturally, these discrepancies may arise due to the different nature of our mental health variables, as well as the many differences in the Japanese and United States healthcare systems, and more generally, inherent country level differences between the United States and Japan.

For our physical health index, our findings are similar to those for mental health: in most cases, our estimates point to the complete absence of a portfolio rebalancing effect; and, where an impact is statistically significant, the rebalancing effect is negligible (see Panel C, Section B). The Tobit equation estimates for the physical health index are highly significant, and in keeping with the results reported in Table 7, indicate that physical health has a sizable negative association with savings and total portfolio size. Total holdings of savings and securities, respectively, increase significantly when mental health deteriorates, but the proportions in which they are held do not.

Insert Table 13 here

Hospital visits have a statistically significant positive impact on savings and total financial portfolio size for both the KHPS and JHPS. However, marked differences between the two surveys arise with respect to the fractional regression estimates. While the JHPS reports a very weak positive portfolio rebalancing effect for treatment at a hospital or clinic in one set of regressions ('Savings', Section B, Panel D), evidence of a portfolio rebalancing effect is completely absent for all other JHPS regressions for hospital visits. In contrast, for the KHPS, we observe that hospital visits are associated with an increase in the proportion of savings held relative to securities, for all sets of regressions. For instance, in the case of 'All assets', hospitalization increases the proportion of savings by 0.0253. Qualitatively similar effects arise with respect to screening (KHPS only, Panel D), where we note that the portfolio rebalancing impact is largest for periodic company or government screening; this type of screening is associated with the proportion of household savings being around 0.052 greater than for households that did not undergo such screening. More generally, whereas total holdings of savings and securities increase significantly due to the effects of screening, the associated changes in portfolio composition are modestly sized.

Lastly, treatment costs and BMI (JHPS only, Panel G) have opposing effects. The

Tobit estimations indicate that BMI has a large and statistically significant negative impact on the size of both savings and the total financial portfolio. Further, BMI is positively associated with holding a greater share of savings in a financial portfolio. This finding acts as a counterpoint to contributions in which support for an inverse relationship between BMI and risk-taking is found (see for instance Addoum, Korniotis, and Kumar (2016)). In comparison, the Tobit estimates indicate that treatment costs are associated with greater levels of savings and larger financial portfolios. However, the reported effects are small. In terms of portfolio composition, a positive, albeit negligible, effect on the proportion of savings held relative to securities is observed in the share equations.

6 Discussion and Conclusion

Recent years have witnessed a growing dependency on household surveys by academic researchers and Japanese policymakers (Unayama 2018). Attention has turned to such surveys in light of a number of well-documented demographic changes in Japan, most notably an aging population coupled with a sharply declining birthrate. From a policymaking perspective, the economic consequences of these trends are potentially far-reaching (see Braun et al. (2009) for a discussion of the impact of Japanese demographic trends on household saving rates).[55] Against such a backdrop of expected changes, understanding the drivers of household savings behavior is therefore of considerable interest.

In exploring how both self-reported mental and physical health, as well as healthcare utilization affect saving behavior and portfolio allocation, our investigation fills a gap in the extant literature on financial decision-making and health in Japan, and has added to it in a number of ways. First, worsening self-reported physical health is found to be associated with greater levels of both savings and total financial assets. This finding is of interest given that Japan is characterised by a system of universal health coverage. Japanese households are required to contribute to the cost of healthcare, albeit healthcare provision is heavily subsidised. Despite the high level of subsidisation, poor physical health still appears to lead Japanese households to self-insure against future health shocks. Our results for healthcare utilization also appear to fit this narrative. One explanation for the positive estimated coefficients associated with this particular set of health measures is that screening and hospital visits are regarded as mechanisms that enable individuals to invest more in their future

[55] Given the nature of these challenges, it is not surprising that these issues have received prominent media coverage, in addition to coming to the attention of policymakers and academics. The *Washington Post* set out the potential economic consequences of large scale demographic upheavals in stark terms: younger individuals "...will earn less in real terms than their parents, pay higher pensions, receive fewer social services and eventually, retire with a less-generous pension package". See: https://www.washingtonpost.com/world/asia_pacific/as-japan-strains-to-care-for-elderly-sacrifices-begin/2012/04/28/gIQAu10cnT_story.html?noredirect=on&utm_term=.8e4e85327227
Retrieved on July 19, 2012. Story published on April 28, 2012.

health. Given that such visits are associated with out-of pocket costs, this may incentivise individuals to accumulate more financial wealth to meet such expenses, however small.

Second, our focus on mental health is especially timely and relevant, particularly when placed in a broader context of mental healthcare provision in Japan. Although it is not uncommon to find contributions in which worsening physical health induces greater rates of safe asset holding such as savings, the impact of mental health has been largely overlooked in the literature on financial decision making (Bogan and Fertig 2013). To the best of our knowledge, the present contribution is the first to explore the relationship between mental health and savings behavior using micro-data on Japanese households. Our finding that worsening mental health leads to lower levels of savings, and moreover, smaller financial portfolios has potentially far-reaching public policy implications.

It is already well established that poor mental health places a large financial burden on society. In the case of Japan, Okumura and Higuchi (2011) find that major depressive disorder amongst Japanese adults over twenty years of age is associated with significant economic costs.[56] To lessen the economic burden associated with this condition, the authors argue that policymakers need to pursue strategies geared towards both the prevention and management of depression in the Japanese population.[57] Kasai et al. (2017) argue that although mental health problems are comparatively lower in Japan than other high-income countries, so too are treatment and employment rates for individuals with mental health problems. This is indicative of there being problems associated with the prevention of such conditions. In the context of our own investigation, our findings suggest that tackling mental health problems may lead to an increase in savings and larger financial portfolios at the household level. Such efforts may complement strategies aimed at encouraging portfolio diversity such as bolstering the financial literacy of households (Kitamura and Uchino 2010, Ito, Takizuka, and Fujiwara 2017).

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[56] Using data from 2008, and adopting what the authors regard as conservative assumptions, the cost of this condition to the Japanese economy is estimated to be in the region of eleven billion US dollars annually.

[57] Such detrimental effects of depression are, however, not confined to Japan. Related work by Sobocki et al. (2007) finds that for the case of Sweden, the economic cost to society of depressive illness doubled from 1997 to 2005. The main source of the cost increase is attributable to indirect costs associated with sick leave and early retirement. The authors conclude that depression has far reaching societal and economic impacts, and its effects are not confined to individuals afflicted with the condition.

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7 Tables

Table 1: Dependent variables: Savings and all financial assets

Panel A: Summary statistics (overall)				
	Mean	Std. Dev.	Min.	Max.
KHPS				
Log of real savings	4.8531	2.7920	0	10.3467
Log of all assets	4.9748	2.8453	0	10.8574
JHPS				
Log of real savings	5.0445	2.7797	0	10.6364
Log of all assets	5.1949	2.8342	0	10.9635
Panel B: Summary statistics (Conditional on holding financial assets)				
KHPS				
Log of real savings	6.1471	1.3856	0.003005	10.3467
Log of all assets	6.2709	1.4413	0.003005	10.8574
JHPS				
Log of real savings	6.2790	1.3660	0.01308	10.6364
Log of all assets	6.4255	1.4241	0.01308	10.9635
Panel C: Percentage of households with no savings or financial assets				
	KHPS		**JHPS**	
Real savings	0.22		0.19	
All assets	0.21		0.19	

Table 2: Mental and physical health questions, hospital visits, and health screening frequencies

Variable Name	Definition
Panel A: Mental and physical health indices	Do you presently experience any of the following conditions? Circle the number that applies for each item. (Circle one number for each item)
Headaches or dizziness	1 (often and sometimes), 0 (rarely and never).
Palpitations, out of breath	1 (often and sometimes), 0 (rarely and never)
Digestive problems	1 (often and sometimes), 0 (rarely and never).
Back, lower back, shoulder pain	1 (often and sometimes), 0 (rarely and never).
Tire easily	1 (often and sometimes), 0 (rarely and never).
Catch cold easily	1 (often and sometimes), 0 (rarely and never).
Find seeing people tiresome	1 (often and sometimes), 0 (rarely and never).
Dissatisfied with life	1 (often and sometimes), 0 (rarely and never).
Anxiety about the future	1 (often and sometimes), 0 (rarely and never).
Panel B: Hospital visits	Did you receive medical treatment or were you hospitalized last year? (Multiple responses permitted)
No	1 if the head of household reported (No health problems and\or Had symptoms but took no action and\or Purchased over-the-counter medicine and\or Other), 0 otherwise.
Was hospitalized	1 if the head of household reported being hospitalized, 0 otherwise.
Treatment at hospital or clinic	1 if the head of household reported treatment at hospital or clinic, 0 otherwise.
Panel C: Screening (KHPS only)	Did you receive a physical examination or cancer screening last year? (Multiple responses permitted)
No exam or screening	1 if the head of household reported no exam or screening, 0 otherwise.
Periodic screening	1 if the head of household reported having a periodic company or municipal government screening), 0 otherwise.
Multiphase health screening	1 if the head of household reported having a multiphase health screening, 0 otherwise.
Cancer screening	1 if the head of household reported having cancer screening, 0 otherwise.
Other screening	1 if the head of household reported having other screening, 0 otherwise
Panel D: BMI and treatment costs (JHPS only)	
BMI	Constructed using the household head's height and weight.
Treatment costs	Did you pay for the treatment of disease or injury last year? If you did, please write the amount of co-payment for the last year.

Table 3: Summary statistics for health and health utilisation measures

	KHPS		JHPS	
Continuous Variables	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Mental health index	1.4005	1.0617	1.2255	1.1300
Physical health index	2.5343	1.7272	2.1955	1.6882
Obesity indicator (JHPS only)			23.1681	3.2916
Treatment cost (JHPS only)			5.7489	4.0629
Hospital visits				
No health problem (Omitted)	0.45		0.45	
Treatment at hospital or clinic	0.49		0.48	
Was hospitalized	0.05		0.07	
Screening (KHPS only)				
No exam or screening (Omitted)	0.24			
Periodic screening	0.58			
Multiphasic health screening	0.12			
Cancer screening	0.11			
Other screening	0.04			
Number of observations	**30,662**		**17,690**	

Note: Treatment costs are reported by respondents in 1000 Yen units. The table reports the natural log of this variable, which is used in estimations.

Table 4: Definitions of the non-health based expanatory variables

Variable Name	Definition
Married	1 if the head of household is married or cohabiting, 0 otherwise.
Age	Age of the household head.
Male	1 if head of household is male, 0 if female.
Number of adults	Number of adults present in the household.
Number of children	Number of children (under the age of 16) present in the household.
Income	Log of real household income.
Net worth	Inverse hyperbolic sine transformation of the real total value of household financial and non-financial assets minus total debt (including mortgage). This variable includes house and plot values.
Education level ('Other' is the omitted category)	
Junior high school	1 if head of household's highest level of education is Junior high school level, 0 otherwise.
High school	1 if head of household's highest level of education is high school level, 0 otherwise.
College	1 if head of household's highest level of education is college, 0 otherwise.
University+	1 if head of household's highest level of education is university or higher, 0 otherwise.
Employment status (Currently employed is the omitted category)	
Part-time	1 if head of household is in part-time employment, 0 otherwise.
Unemployed	1 if head of household is studying, 0 otherwise.
Other work	1 if head of household is unemployed or other, 0 otherwise.
Region (Kantō is the omitted category)	
Hokkaidō	1 if head of household lives in Hokkaidō, 0 otherwise.
Tōhoku	1 if head of household lives in Tōhoku, 0 otherwise.
Chūbu	1 if head of household lives in Chūbu, 0 otherwise.
Kinki	1 if head of household lives in Kinki, 0 otherwise.
Chūgoku	1 if head of household lives in Chūgoku, 0 otherwise.
Shikoku	1 if head of household lives in Shikoku, 0 otherwise.
Kyūshū	1 if head of household lives in Kyūshū, 0 otherwise.

Table 5: Summary statistics: Baseline control variables

Panel A: Baseline variables	**KHPS**		**JHPS**	
Continuous Variables	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Log of real household income.	6.3143	0.6594	6.3124	0.6518
Log of net worth.	4.9814	5.6370	5.3613	5.5150
Age	54.8930	13.2948	56.2135	14.4557
Number of adults.	3.0212	1.3172	2.9314	1.3052
Number of children.	0.6166	0.9610	0.5505	0.9156
Binary Variables	Percent		Percent	
Married	0.83		0.82	
Male	0.87		0.85	
Employment status				
Employed (omitted)	0.77		0.7	
Part-time	0.04		0.04	
Unemployed	0.01		0.01	
Other	0.18		0.25	
Education level				
Junior high school	0.11		0.1	
High school	0.46		0.43	
College	0.08		0.08	
University+	0.29		0.35	
Other (omitted)	0.06		0.04	
Region				
Hokkaidō	0.05		0.05	
Tōhoku	0.07		0.06	
Kantō (omitted)	0.33		0.32	
Chūbu	0.17		0.18	
Kinki	0.19		0.18	
Chūgoku	0.05		0.07	
Shikoku	0.03		0.03	
Kyūshū	0.11		0.11	
Number of observations	**30,622**		**17,690**	

Note: See Table 4 for a full definition of the variables.

Table 6: Tobit estimates for control variables (mental health indices only)

	KHPS		JHPS	
	Savings	**All assets**	**Savings**	**All assets**
Married	0.0454	0.0218	0.0578	0.0445
	(0.0542)	(0.0539)	(0.0644)	(0.0639)
Age	-0.0298***	-0.0272***	-0.0158	-0.0095
	(0.0081)	(0.0080)	(0.0097)	(0.0096)
Age-squared	0.0264***	0.0243***	0.0204**	0.0159*
	(0.0073)	(0.0073)	(0.0087)	(0.0086)
Male	-0.0939*	-0.0980**	0.0093	0.0229
	(0.0492)	(0.0488)	(0.0586)	(0.0581)
Junior high school	-0.0314	-0.0631	-0.3407**	-0.3659**
	(0.1056)	(0.1054)	(0.1552)	(0.1546)
High school	0.2395***	0.2160**	-0.0660	-0.0572
	(0.0899)	(0.0897)	(0.1343)	(0.1338)
College	0.2979***	0.2777**	0.3358**	0.3405**
	(0.1096)	(0.1093)	(0.1523)	(0.1516)
University+	0.4338***	0.4239***	0.1697	0.2184
	(0.0937)	(0.0935)	(0.1385)	(0.1380)
Number of adults	-0.0644***	-0.0694***	-0.0440***	-0.0488***
	(0.0121)	(0.0120)	(0.0150)	(0.0149)
Number of children	0.0419**	0.0521***	0.0723***	0.0748***
	(0.0180)	(0.0179)	(0.0257)	(0.0255)
Part-time	-0.0148	0.0207	0.2341***	0.2461***
	(0.0603)	(0.0597)	(0.0732)	(0.0724)
Unemployed	0.1708*	0.1777*	0.0238	0.0067
	(0.0924)	(0.0914)	(0.1169)	(0.1155)
Other	0.2456***	0.2665***	0.2464***	0.2685***
	(0.0444)	(0.0441)	(0.0517)	(0.0512)
Log of real household income	0.3177***	0.3067***	0.3969***	0.4065***
	(0.0271)	(0.0268)	(0.0364)	(0.0359)
Log of net wealth	0.1117***	0.1123***	0.1128***	0.1132***
	(0.0027)	(0.0027)	(0.0037)	(0.0037)
Hokkaidō	-0.0228	-0.1322	0.0670	0.0730
	(0.1451)	(0.1458)	(0.1750)	(0.1752)
Tōhoku	-0.1935	-0.2679**	-0.2229	-0.2903**
	(0.1235)	(0.1246)	(0.1426)	(0.1429)
Chūbu	0.2383***	0.2010**	-0.0132	-0.0145
	(0.0840)	(0.0846)	(0.0970)	(0.0972)
Kinki	0.2102**	0.1883**	0.0652	0.0531
	(0.0841)	(0.0847)	(0.1011)	(0.1014)
Chūgoku	0.1681	0.1174	0.0493	0.0250
	(0.1281)	(0.1290)	(0.1482)	(0.1486)
Shikoku	0.0044	-0.0441	-0.3551*	-0.3758*
	(0.1628)	(0.1639)	(0.1978)	(0.1981)
Kyūshū	-0.1569	-0.2224**	-0.2404**	-0.2748**
	(0.1009)	(0.1017)	(0.1151)	(0.1153)
Year=2006	-0.2285***	-0.2096***		
	(0.0433)	(0.0428)		
Year=2008	-0.1256***	-0.1035**		
	(0.0421)	(0.0417)		
Year=2009	-0.1066**	-0.1115***		
	(0.0432)	(0.0428)		
Year=2010	-0.0989**	-0.0991**	0.0230	0.0374
	(0.0439)	(0.0434)	(0.0408)	(0.0403)
Year=2011	-0.1536***	-0.1497***	0.1548***	0.1723***
	(0.0447)	(0.0443)	(0.0417)	(0.0412)
Year=2012	-0.1036**	-0.1116**	0.1922***	0.1985***
	(0.0437)	(0.0434)	(0.0433)	(0.0428)
Year=2013	-0.0874*	-0.0831*	0.1521***	0.1537***
	(0.0447)	(0.0443)	(0.0444)	(0.0439)
Year=2014	-0.0111	0.0070	0.1571***	0.1893***
	(0.0454)	(0.0450)	(0.0459)	(0.0453)
Year=2015	0.0335	0.0661	0.1420***	0.1791***
	(0.0462)	(0.0457)	(0.0469)	(0.0463)
Year=2016	0.0598	0.0962**	0.1183**	0.1396***
	(0.0471)	(0.0467)	(0.0487)	(0.0481)
Observations	**30,662**		**17,690**	

Notes: (*i*) Standard errors in parentheses; (*ii*) ***/**/* denotes $p < 0.01$ / $p < 0.05$ / $p < 0.1$; (*iii*) All monetary values are expressed in 2016 prices; (*iv*) Averages of income and net worth are used as a Mundlak (1978) fixed effects correction; (*v*) The omitted categories are: 'Below high school' (for education level); 'Currently employed' (for Employment status); the Kantō region (for the regional dummies); 2005 (for the KHPS year dummy); and, 2009 (for the JHPS year dummy); (*vi*) Marginal effects are obtained using the Stata 'margins' command. (*vii*) Estimates for the mental health index variable included in the above set of specifications are reported in Panel A of Table 7.

Table 7: Tobit marginal effects estimates for mental health, physical health, and health utilization measures (exogenous health)

	KHPS		JHPS	
	Savings	**All assets**	**Savings**	**All assets**
Panel A: Mental health index				
Mental	-0.0401***	-0.0417***	-0.0517***	-0.0521***
	(0.0111)	(0.0110)	(0.0142)	(0.0140)
Panel B: Physical health index				
Physical	0.0195***	0.0198***	0.0169*	0.0132
	(0.0074)	(0.0074)	(0.0099)	(0.0098)
Panel C: Both indices				
Mental	-0.0503***	-0.0522***	-0.0648***	-0.0634***
	(0.0114)	(0.0113)	(0.0149)	(0.0147)
Physical	0.0278***	0.0284***	0.0305***	0.0264***
	(0.0076)	(0.0076)	(0.0104)	(0.0102)
Panel D: Hospital visits				
Treatment at hospital or clinic	0.1288***	0.1373***	0.1113***	0.1191***
	(0.0235)	(0.0233)	(0.0307)	(0.0303)
Was hospitalized	0.1696***	0.1747***	0.1401***	0.1397***
	(0.0451)	(0.0446)	(0.0543)	(0.0537)
Panel E: Screening (KHPS only)				
Periodic screening	0.1609***	0.1384***		
	(0.0271)	(0.0269)		
Multiphase health screening	0.2102***	0.2260***		
	(0.0412)	(0.0408)		
Cancer screening	0.0899***	0.0983***		
	(0.0346)	(0.0342)		
Other screening.	0.1142**	0.0963*		
	(0.0526)	(0.0521)		
Panel F: BMI (JHPS only)				
BMI			-0.0126*	-0.0103
			(0.0074)	(0.0073)
Panel G: Treatment cost (JHPS only)				
Treatment cost			0.0259***	0.0275***
			(0.0043)	(0.0042)
Panel H: BMI and treatment cost (JHPS only)				
BMI			-0.0137*	-0.0114
			(0.0074)	(0.0073)
Treatment cost			0.0261***	0.0277***
			(0.0043)	(0.0042)
Observations	**30,662**		**17,690**	

Notes: See notes (*i*)-(*vi*) in Table 6. The models in Panels A to H comprise different health specifications each of which uses the same control variables as in Table 6.

Table 8: Recursive Estimates for Mental Health, Physical Health, and Health Utilization Measures

	KHPS		JHPS	
	Savings	**All assets**	**Savings**	**All assets**
Panel A: Mental health indicator				
Mental	-0.0599	-0.0779*	-0.1116***	-0.1279***
	(0.0436)	(0.0440)	(0.0417)	(0.0418)
Panel B: Physical health indicator				
Physical	0.0252	0.0181	0.0521	0.0354
	(0.0354)	(0.0357)	(0.0471)	(0.0473)
Panel C: Hospitalized and treatment at hospital indicator				
Hospitalized and treatment	0.3271***	0.3374***	0.2663***	0.2901***
	(0.0346)	(0.0349)	(0.0471)	(0.0470)
Panel D: Screening indicator (KHPS only)				
Any screening	0.3281***	0.3392***		
	(0.0280)	(0.0282)		
Panel E: Treatment cost (JHPS only)				
Treatment cost			0.0905***	0.0994***
			(0.0134)	(0.0133)
Panel F: BMI (JHPS only)				
BMI			-0.0242*	-0.0212
			(0.0132)	(0.0131)
Observations	**30,662**		**17,690**	

Notes: (*i*) The relationship between savings / all assets and the health measures presented in Panels A to F are modelled as two-equation recursive systems. Specifically, a Tobit specification of the form given in equation (1) is estimated in which the health measures in Panels A to F are treated as being endogenous; (*ii*) All estimations are performed using the *conditional mixed processes* ('cmp') suite of estimation tools in Stata (Roodman 2011); (*iii*) The estimated model coefficients are presented, and not the corresponding marginal effects; (*iv*) Standard errors in parentheses; (*v*) ***/**/* denotes $p < 0.01$ / $p < 0.05$ / $p < 0.1$.

Table 9: Censored Quantile Regressions: Mental and Physical Health Indices

KHPS					**Savings**				
Quantile	10	20	30	40	50	60	70	80	90
Mental	-0.1096***	-0.0437***	-0.0373***	-0.0221***	-0.0161*	-0.0412***	-0.0487***	-0.0533***	-0.0566***
	(0.0277)	(0.0153)	(0.0083)	(0.0076)	(0.0095)	(0.0087)	(0.0082)	(0.0072)	(0.0074)
Physical	0.0275*	0.0052	0.0021	-0.0012	-0.0095**	-0.004	-0.0075	-0.0078	-0.0029
	(0.016)	(0.0081)	(0.006)	(0.0039)	(0.0045)	(0.0045)	(0.0051)	(0.0051)	(0.006)
					All assets				
Mental	-0.0928***	-0.0627***	-0.0404***	-0.0277***	-0.0207***	-0.0498***	-0.0592***	-0.0757***	-0.0652***
	(0.0264)	(0.0122)	(0.0079)	(0.0058)	(0.0062)	(0.0082)	(0.0081)	(0.0066)	(0.0086)
Physical	0.0211	0.006	-0.0013	-0.0027	-0.001	-0.0024	-0.0041	0.0016	0.0063
	(0.016)	(0.0092)	(0.0055)	(0.0034)	(0.0038)	(0.0048)	(0.0052)	(0.0039)	(0.0056)
Observations					**30,622**				
JHPS					**Savings**				
Quantile	10	20	30	40	50	60	70	80	90
Mental	-0.0511	-0.0088	-0.0026	-0.002	-0.0092	-0.0413***	-0.0543***	-0.0602***	-0.0713***
	(0.035)	(0.0179)	(0.0086)	(0.0094)	(0.0132)	(0.0113)	(0.0105)	(0.0098)	(0.0094)
Physical	0.0568***	0.0462***	0.0156***	0.0113*	0.0113*	0.0064	0.0064	0.0034	0.0114
	(0.0194)	(0.0134)	(0.0067)	(0.0066)	(0.0058)	(0.0056)	(0.0068)	(0.0073)	(0.0092)
					All assets				
Mental	-0.0449	-0.0295*	-0.0204*	-0.021**	-0.0157**	-0.0525***	-0.0678***	-0.0608***	-0.0758***
	(0.0297)	(0.0165)	(0.011)	(0.0085)	(0.0091)	(0.0106)	(0.0105)	(0.0095)	(0.0107)
Physical	0.0307	0.0355***	0.0209***	0.0161***	0.0159***	0.0069	0.0066	-0.0064	-0.0001
	(0.0199)	(0.0096)	(0.0065)	(0.0048)	(0.004)	(0.0058)	(0.0049)	(0.0055)	(0.0066)
Observations					**17,690**				

Notes: (*i*) All coefficients report the average marginal quantile effect for the censored dependent variable; (*ii*) Standard errors in parentheses; (*iii*) ***/**/* denotes $p < 0.01$ / $p < 0.05$ / $p < 0.1$; (*iv*) Estimations are performed using the 'cqiv' routine in Stata with 50 bootstrap repetitions (see Chernozhukov, Fernández-Val, and Kowalski 2015); (*v*) All specifications use the same control variables as in Table 6.

Table 10: Censored Quantile Regression: Hospitalization and Hospital Treatment

KHPS					**Savings**				
Quantile	10	20	30	40	50	60	70	80	90
Treatment at hospital	0.5848***	0.2731***	0.1825***	0.1315***	0.1597***	0.2058***	0.2054***	0.158***	0.1527***
	(0.0806)	(0.0363)	(0.0249)	(0.0202)	(0.0216)	(0.0183)	(0.0143)	(0.0163)	(0.0157)
Was hospitalized	0.5334***	0.2637***	0.1701***	0.1076***	0.1236***	0.2002***	0.1946***	0.2111***	0.1769***
	(0.1248)	(0.0478)	(0.0289)	(0.0215)	(0.0375)	(0.0307)	(0.0294)	(0.0322)	(0.0291)
					All assets				
Treatment at hospital	0.5067***	0.2903***	0.2052***	0.1357***	0.1587***	0.2123***	0.2219***	0.185***	0.1652***
	(0.0952)	(0.0332)	(0.0225)	(0.0154)	(0.0211)	(0.0181)	(0.0191)	(0.0184)	(0.0161)
Was hospitalized	0.4424***	0.2797***	0.2096***	0.1303***	0.1669***	0.2443***	0.2128***	0.2508***	0.2166***
	(0.1048)	(0.0508)	(0.0299)	(0.024)	(0.0369)	(0.0327)	(0.0327)	(0.0279)	(0.0389)
Observations					**30,622**				
JHPS					**Savings**				
Quantile	10	20	30	40	50	60	70	80	90
Treatment at hospital	0.4368***	0.2869***	0.175***	0.1185***	0.1218***	0.1371***	0.1308***	0.0988***	0.0959***
	(0.0754)	(0.0425)	(0.024)	(0.0231)	(0.0248)	(0.0183)	(0.0212)	(0.0229)	(0.0295)
Was hospitalized	0.4188***	0.2458***	0.1297***	0.079**	0.1005***	0.1477***	0.1987***	0.1914***	0.1454***
	(0.1144)	(0.0595)	(0.0423)	(0.034)	(0.0359)	(0.0297)	(0.0366)	(0.0348)	(0.0423)
					All assets				
Treatment at hospital	0.3911***	0.3079***	0.2223***	0.135***	0.0908***	0.1582***	0.1528***	0.0948***	0.0835***
	(0.0807)	(0.0371)	(0.0247)	(0.0176)	(0.0237)	(0.0271)	(0.0273)	(0.0222)	(0.0221)
Was hospitalized	0.3869***	0.277***	0.2169***	0.11***	0.0685***	0.1629***	0.2426***	0.1687***	0.1161***
	(0.089)	(0.0533)	(0.0332)	(0.0288)	(0.0385)	(0.0363)	(0.0467)	(0.0403)	(0.0387)
Observations					**17,690**				

Notes: (*i*) All coefficients report the average marginal quantile effect for the censored dependent variable; (*ii*) Standard errors in parentheses; (*iii*) ***/**/* denotes $p < 0.01$ / $p < 0.05$ / $p < 0.1$; (*iv*) Estimations are performed using the 'cqiv' routine in Stata with 50 bootstrap repetitions (see Chernozhukov, Fernández-Val, and Kowalski 2015); (*v*) All specifications use the same control variables as in Table 6.

Table 11: Censored Quantile Regressions: Screening Effects (KHPS only)

					Savings				
Quantile	10	20	30	40	50	60	70	80	90
Periodic screening	0.7763***	0.4529***	0.2437***	0.1587***	0.2363***	0.2045***	0.1448***	0.0904***	0.0678***
	(0.0922)	(0.041)	(0.0189)	(0.0299)	(0.0298)	(0.0224)	(0.0196)	(0.0236)	(0.0231)
Multiphase health screening	0.729***	0.3936***	0.2192***	0.1571***	0.2292***	0.2257***	0.1988***	0.1391***	0.1462***
	(0.0885)	(0.0441)	(0.0279)	(0.0336)	(0.0383)	(0.0264)	(0.0249)	(0.0248)	(0.0223)
Cancer screening	0.2158***	0.1062***	0.1032***	0.1012***	0.1431***	0.1822***	0.1893***	0.2066***	0.1873***
	(0.0717)	(0.0324)	(0.0305)	(0.0252)	(0.0241)	(0.028)	(0.0266)	(0.0285)	(0.0254)
Other screening	0.3764**	0.2189***	0.1312***	0.0941**	0.1707***	0.1406***	0.1077***	0.0936**	0.0905*
	(0.1722)	(0.0768)	(0.0408)	(0.0423)	(0.0337)	(0.0419)	(0.039)	(0.046)	(0.048)
					All assets				
Quantile	10	20	30	40	50	60	70	80	90
Periodic screening	0.6995***	0.4107***	0.2255***	0.1319***	0.1747***	0.1977***	0.1317***	0.079***	0.0694
	(0.0905)	(0.0346)	(0.019)	(0.0144)	(0.0288)	(0.0248)	(0.0236)	(0.0231)	(0.0224)
Multiphase health screening	0.7707***	0.4151***	0.2384***	0.1689***	0.2079***	0.2596***	0.2252***	0.1798***	0.1702***
	(0.07)	(0.0407)	(0.0265)	(0.02)	(0.0323)	(0.0268)	(0.0245)	(0.0281)	(0.0262)
Cancer screening	0.1971***	0.1902***	0.1557***	0.1307***	0.1718***	0.2141***	0.2255***	0.2066***	0.1823***
	(0.0556)	(0.0287)	(0.0234)	(0.0171)	(0.028)	(0.0289)	(0.0285)	(0.0269)	(0.0312)
Other screening	0.2647*	0.206***	0.1262***	0.0557**	0.078*	0.146***	0.1106***	0.0795**	0.1575***
	(0.1562)	(0.0797)	(0.0329)	(0.0247)	(0.043)	(0.0474)	(0.0346)	(0.0373)	(0.0458)
Observations					**30,662**				

Notes: (*i*) All coefficients report the average marginal quantile effect for the censored dependent variable; (*ii*) Standard errors in parentheses; (*iii*) ***/**/* denotes $p < 0.01$ / $p < 0.05$ / $p < 0.1$; (*iv*) Estimations are performed using the 'cqiv' routine in Stata with 50 bootstrap repetitions (see Chernozhukov, Fernández-Val, and Kowalski 2015); (*v*) All specifications use the same control variables as in Table 6.

Table 12: Censored Quantile Regressions: BMI and Treatment Costs (JHPS only)

					Savings				
Quantile	10	20	30	40	50	60	70	80	90
Treatment cost	0.0516***	0.0279***	0.0185***	0.0137***	0.0115***	0.0155***	0.018***	0.0161***	0.0173***
	(0.0094)	(0.005)	(0.0025)	(0.0024)	(0.0025)	(0.0022)	(0.0027)	(0.0025)	(0.0025)
BMI	-0.0609***	-0.0337***	-0.0193***	-0.0164***	-0.0122***	-0.0158***	-0.016***	-0.0143***	-0.0122**
	(0.0103)	(0.0073)	(0.0053)	(0.0028)	(0.0035)	(0.0032)	(0.0035)	(0.0031)	(0.0049)
					All assets				
Quantile	10	20	30	40	50	60	70	80	90
Treatment cost	0.0404***	0.0298***	0.0234***	0.0145***	0.0102***	0.0202***	0.0199***	0.0183***	0.0161***
	(0.0055)	(0.0041)	(0.0023)	(0.0019)	(0.0026)	(0.0025)	(0.0024)	(0.0031)	(0.0036)
BMI	-0.0508***	-0.0257***	-0.0173***	-0.0119***	-0.0088***	-0.015***	-0.016***	-0.011***	-0.0071
	(0.0124)	(0.0068)	(0.0046)	(0.0032)	(0.0031)	(0.0032)	(0.0031)	(0.0028)	(0.005)
Observations					**17,690**				

Notes: (*i*) All coefficients report the average marginal quantile effect for the censored dependent variable; (*ii*) Standard errors in parentheses; (*iii*) ***/**/* denotes $p < 0.01$ / $p < 0.05$ / $p < 0.1$; (*iv*) Estimations are performed using the 'cqiv' routine in Stata with 50 bootstrap repetitions (see Chernozhukov, Fernández-Val, and Kowalski 2015); (*v*) All specifications use the same control variables as in Table 6.

Table 13: Health, Savings, and Household Portfolio Re-balancing Effects: Marginal Effects

	Section A: KHPS			
	Savings		All assets	
	Tobit	Share	Tobit	Share
Panel A: Mental health conditions				
Mental	-0.0402***	0.0001	-0.0423***	-0.0004
	(0.0129)	(0.0026)	(0.0129)	(0.0026)
Panel B: Physical health conditions				
Physical	0.0164*	0.0009	0.0173**	0.0011
	(0.0086)	(0.0017)	(0.0086)	(0.0017)
Panel C: Both indices				
Mental	-0.0495***	-0.0005	-0.0521***	-0.0012
	(0.0131)	(0.0027)	(0.0131)	(0.0027)
Physical	0.0245***	0.0011	0.0259***	0.0014
	(0.0087)	(0.0018)	(0.0087)	(0.0018)
Panel D: Hospital visits				
Treatment at hospital or clinic	0.1558***	0.0234***	0.1638***	0.0227***
	(0.0269)	(0.0055)	(0.0267)	(0.0055)
Was hospitalized	0.1811***	0.0253***	0.1886***	0.0240**
	(0.0494)	(0.0095)	(0.0492)	(0.0095)
Panel E: Screening (KHPS only)				
Periodic company or Gov. screening	0.2143***	0.0526***	0.1848***	0.0527***
	(0.0324)	(0.0064)	(0.0324)	(0.0064)
Multiphase health screening	0.2333***	0.0292***	0.2522***	0.0276***
	(0.0421)	(0.0087)	(0.0423)	(0.0087)
Cancer screening	0.1010**	0.0141**	0.1108**	0.0125*
	(0.0333)	(0.0070)	(0.0326)	(0.0071)
Other screening.	0.1424**	0.0286**	0.1211**	0.0282**
	(0.0558)	(0.0116)	(0.0553)	(0.0116)
Observations	**30,662**			
	Section B: JHPS			
	Tobit	Share	Tobit	Share
Panel A: Mental health conditions				
Mental	-0.0472***	-0.0029	-0.0484***	-0.0032
	(0.0159)	(0.0032)	(0.0159)	(0.0032)
Panel B: Physical health conditions				
Physical	0.0179	0.0032	0.0139	0.0031
	(0.0112)	(0.0022)	(0.0110)	(0.0022)
Panel C: Both indices				
Mental	-0.0617***	-0.0055	-0.0608***	-0.0056*
	(0.0164)	(0.0033)	(0.0163)	(0.0033)
Physical	0.0312***	0.0046**	0.0270**	0.0045**
	(0.0115)	(0.0023)	(0.0114)	(0.0023)
Panel D: Hospital visits				
Treatment at hospital or clinic	0.1337***	0.0120*	0.1408***	0.0105
	(0.0330)	(0.0069)	(0.0325)	(0.0069)
Was hospitalized	0.1439**	0.0007	0.1442**	-0.0005
	(0.0566)	(0.0111)	(0.0570)	(0.0110)
Panel E: BMI (JHPS only)				
BMI	-0.3927**	-0.0891**	-0.3123	-0.0895**
	(0.1999)	(0.0371)	(0.2019)	(0.0369)
Panel F: Treatment cost (JHPS only)				
Treatment cost	0.0258***	0.0021**	0.0279***	0.0020
	(0.0047)	(0.0009)	(0.0047)	(0.0009)
Panel G: BMI and treatment cost (JHPS only)				
BMI	-0.4220**	-0.0943**	-0.3420*	-0.0944**
	(0.1997)	(0.0371)	(0.2017)	(0.0369)
Treatment cost	0.0263***	0.0022**	0.0284***	0.0022**
	(0.0048)	(0.0010)	(0.0047)	(0.0009)
Observations	**17,690**			

Notes: See notes (*i*)-(*vi*) in Table 6. The above table reports the results based on jointly estimating a fractional regression model (Papke and Wooldridge 1996) with the Tobit specifications in Table 7. Errors are assumed to be bivariate normal. For the fractional regressions (denoted 'Share'), the dependent variable in each share equation is the value of savings expressed as a proportion of a household's total financial assets (i.e., the total value of a household's financial portfolio). The models in Panels A to H comprise different health specifications each of which uses the same control variables as in Table 6. All estimations are performed using the cmp suite of estimation tools in Stata (Roodman 2011).

8 Figures

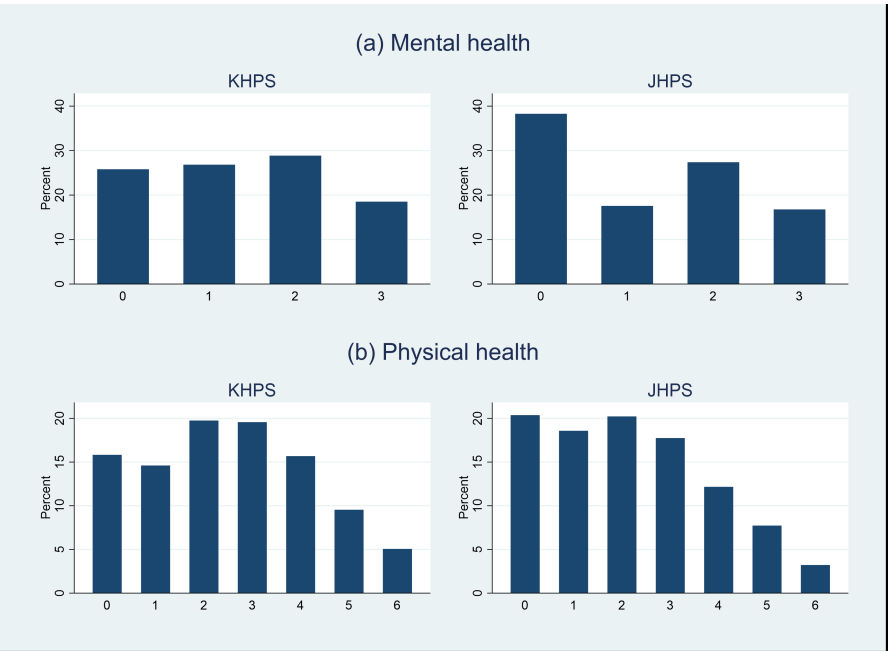

Figure 1: Indices based on KHPS and JHPS responses to mental and physical well-being questions

Notes: Part (a) of the figure shows the distribution of scores associated with the four-point mental health index for the KHPS and JHPS, respectively. Part (b) of the figure shows the distribution of scores associated with the seven-point physical health index for the KHPS and JHPS, respectively.

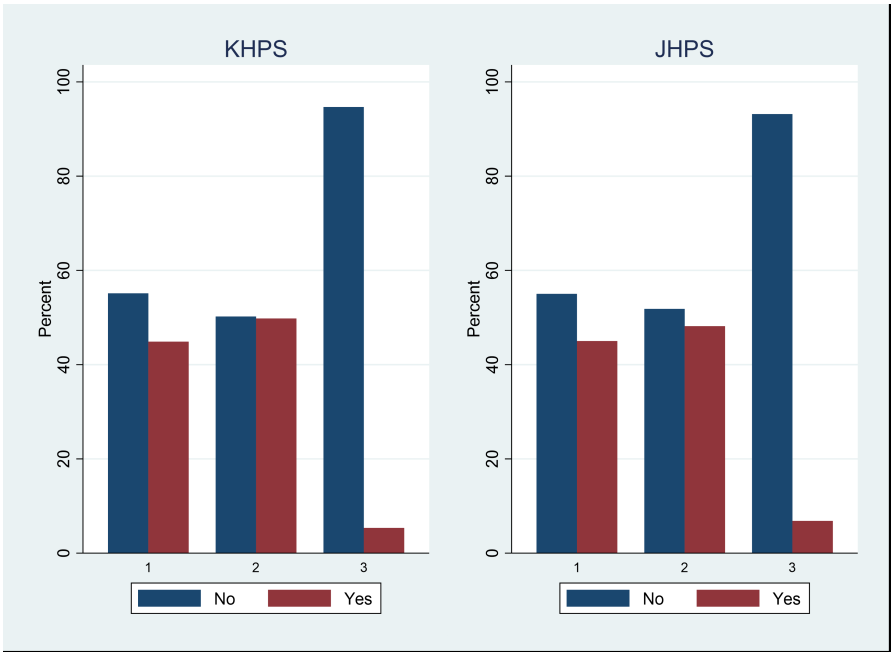

Figure 2: Hospitalization and hospital visits

Notes: The horizontal axis labels correspond to health measures constructed using the possible responses to the question "Did you receive medical treatment or were you hospitalized last year?" This question appears in both the JHPS and the KHPS. The available responses were collapsed to create three measures corresponding to whether an individual reported: **1**: *No health problems*; **2**: *Received treatment at a hospital or clinic*; and **3**: *Was hospitalized*. All responses to these questions assumed the form of 'no' or 'yes' answers, and are based on a respondent's experience in the previous year. The responses not mutually exclusive.

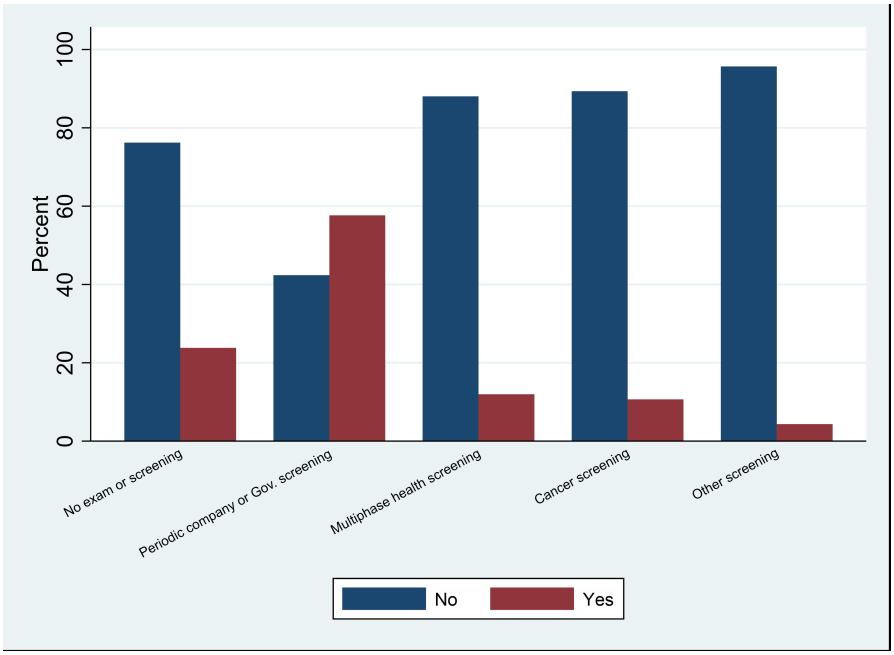

Figure 3: Screening - KHPS only

Notes: The above figure shows the distributions of responses relating to the different forms of health screening that a respondent underwent in the previous year. This information is only reported in the KHPS. Responses to all screening questions assume the form of 'no' or 'yes' answers.

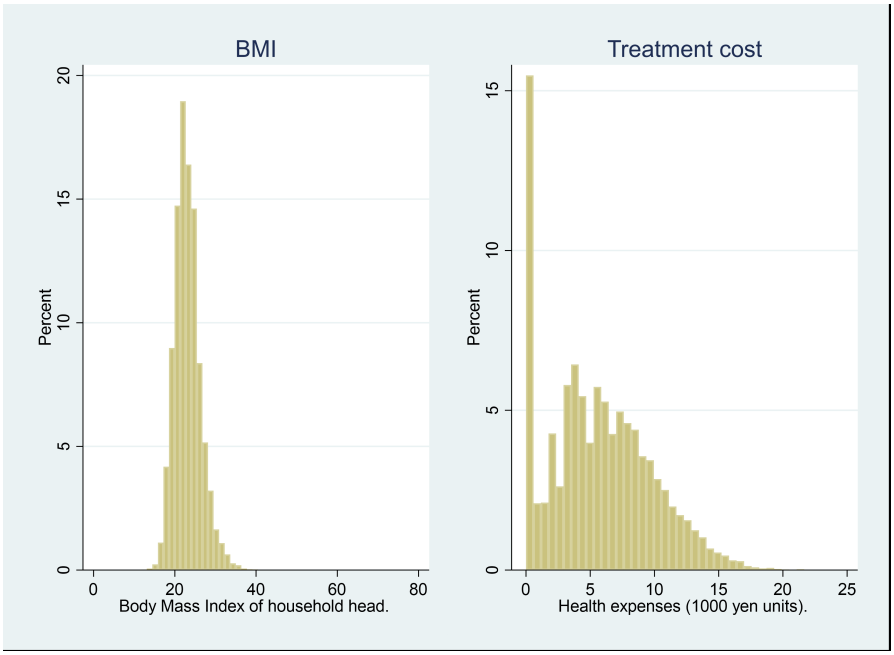

Figure 4: Treatment Costs and Body Mass Index (BMI), JHPS only

Notes: This above figure shows the distribution of responses for treatment costs and BMI. The information used to construct both charts is only reported in the JHPS. BMI is an objective measure of health defined as an individual's weight in kilograms divided by their height in metres squared. Our measure of BMI is based on the authors' own calculations using respondents' self-reported height and weight.