ジニ係数$Gini(x)=\frac{1}{2n^2\bar{x}}\sum_{i=1}^{n}\sum_{j=1}^{n}|x_i-x_j|$

ただし、所得分配　$x=(x_1,\cdots\cdots,x_n)$

$\bar{x}$＝平均値

所得再分配効果を見る指標として、本研究ではジニ係数の改善率（所得移転のない場合のジニ係数から所得移転のある場合のジニ係数を引いた値が所得移転のない場合のジニ係数に占める割合）を用いる。

『中国統計年鑑』によれば、家計収入とは賃金、経営収入、財産収入、移転収入の和である。『中国統計年鑑』の統計データの区分では、移転収入は、年金給付、価格補助金、寄贈収入、扶養収入、その他に区別されているため、家計収入は年金給付を含む所得再分配後の家計収入である。ただし、移転収入の内、年金給付を時系列的に把握できるのは次の11カ省（市）である。北京、広西、広東、江西、福建、江蘇、黒龍江、山東、海南、陝西、安徽。そこで、この11カ省の同『年鑑』記載の年金給付データを公的移転所得として扱い、家計収入から公的所得移転を差し引くことにより公的移転所得なし家計収入を計算し、公的所得移転のない場合（再分配前）のジニ係数を推計した。

——— 表1　変数の定義 ———

変数名	データの出所	変数の定義
再分配による改善度	中国統計年鑑	（公的移転所得なし家計収入ジニ－公的移転所得あり家計収入ジニ）／移転所得なし家計収入ジニ
各省高齢者一人当たり年金給付	中国労働社会保障年鑑	各省高齢者一人当たり年金給付＝各省年金基金支出／年金に加入した退職者数
各省社会保障への支持度	中国労働社会保障年鑑	各省社会保障への支持度＝各省社会保障への支出／各省の財政総支出
各省GDPの成長率	中国統計年鑑	（今年度各省のGDP－前年度各省のGDP）／前年度各省のGDP
一人当たり各省社会保障への支出	中国統計年鑑・中国労働社会保障年鑑	一人当たり各省社会保障への支出＝各省社会保障への支出／各省の総人口
各省社会保障への支出／各省GDP	中国統計年鑑	各省社会保障への支出／各省GDP
各省の失業率	中国統計年鑑	失業者数／（在職者数＋失業者数）

注:データ範囲は都市部である。
各省高齢者一人当たり年金給付、各省社会保障への支持度は張　光・陽　晶晶(2007)を参考にした

5．推計結果とインプリケーション

上記の省別データを用いて、まず公的所得移転のない場合の家計収入、所得移転のある場合の家計収入それぞれのジニ係数を推計し、これらの推計を用いて所得移転によるジニ係数の改善率を推計した。その結果、江蘇、黒龍江、山東、海南、陝西、安徽は所得移転によるジニ係数の改善は見られないのに対して、北京、広西、広東、江西、福建は所得移転によるジニ係数の改善が見られる。2006 年山東、陝西、安徽 3 省以外、ほかの 8 省の所得移転によるジニ係数の改善度はよくなった。この結果から、2005 年中国年金改革を含む近年の年金制度の整備・拡充は所得再分配の効果を発揮し始めていることが分かった。

——— 表2　ジニ係数の比較 ———

	北京	江蘇	黒龍江	山東	広西	広東	海南	陝西	安徽	江西	福建
1998年ジニ1	0.206	0.234	0.250	0.220	0.232	0.252	0.234	0.245	0.204	0.207	0.229
1998年ジニ2	0.199	0.225	0.237	0.204	0.229	0.251	0.218	0.237	0.181	0.194	0.230
再分配による改善度	(0.040)	(0.041)	(0.053)	(0.074)	(0.011)	(0.003)	(0.075)	(0.032)	(0.125)	(0.068)	0.005
1999年ジニ1	0.200	0.257	0.254	0.215	0.238	0.249	0.274	0.243	0.222	0.215	0.227
1999年ジニ2	0.211	0.249	0.228	0.201	0.232	0.256	0.269	0.242	0.203	0.196	0.225
再分配による改善度	0.051	(0.034)	(0.113)	(0.069)	(0.023)	0.024	(0.019)	(0.004)	(0.098)	(0.098)	(0.006)
2000年ジニ1	0.216	0.271	0.277	0.224	0.256	0.263	0.327	0.273	0.260	0.243	0.247
2000年ジニ2	0.228	0.268	0.251	0.222	0.263	0.274	0.315	0.268	0.238	0.232	0.249
再分配による改善度	0.053	(0.011)	(0.106)	(0.005)	0.025	0.039	(0.037)	(0.019)	(0.091)	(0.046)	0.009
2001年ジニ1	0.231	0.291	0.288	0.238	0.278	0.268	0.306	0.284	0.255	0.253	0.260
2001年ジニ2	0.240	0.289	0.269	0.239	0.301	0.281	0.293	0.299	0.228	0.249	0.260
再分配による改善度	0.041	(0.006)	(0.073)	0.005	0.077	0.046	(0.042)	0.049	(0.121)	(0.014)	0.002
2002年ジニ1	0.243	0.363	0.340	0.323	0.357	0.399	0.433	0.316	0.328	0.331	0.268
2002年ジニ2	0.246	0.346	0.320	0.314	0.368	0.415	0.414	0.317	0.304	0.334	0.253
再分配による改善度	0.013	(0.052)	(0.060)	(0.026)	0.030	0.038	(0.045)	0.002	(0.078)	0.007	(0.063)
2003年ジニ1	0.233	0.342	0.311	0.292	0.365	0.406	0.378	0.268	0.300	0.283	0.275
2003年ジニ2	0.231	0.333	0.292	0.281	0.382	0.423	0.369	0.262	0.277	0.291	0.263
再分配による改善度	(0.007)	(0.029)	(0.064)	(0.039)	0.044	0.041	(0.026)	(0.026)	(0.084)	0.027	(0.047)
2004年ジニ1	0.261	0.361	0.321	0.298	0.296	0.380	0.376	0.271	0.295	0.283	0.271
2004年ジニ2	0.270	0.360	0.310	0.288	0.300	0.393	0.377	0.268	0.267	0.292	0.261
再分配による改善度	0.032	(0.003)	(0.036)	(0.033)	0.012	0.032	0.001	(0.010)	(0.106)	0.032	(0.035)
2005年ジニ1	0.254	0.352	0.364	0.315	0.334	0.369	0.401	0.269	0.288	0.285	0.271
2005年ジニ2	0.267	0.365	0.368	0.294	0.352	0.386	0.391	0.268	0.264	0.284	0.267
再分配による改善度	0.046	0.034	0.012	(0.069)	0.051	0.044	(0.024)	(0.003)	(0.092)	(0.004)	(0.016)
2006年ジニ1	0.247	0.350	0.354	0.308	0.327	0.366	0.378	0.268	0.274	0.277	0.274
2006年ジニ2	0.262	0.364	0.358	0.289	0.347	0.385	0.379	0.264	0.254	0.282	0.280
再分配による改善度	0.059	0.037	0.011	(0.063)	0.056	0.052	0.003	(0.016)	(0.081)	0.017	0.020
(注:ジニ1は公的移転あり家計収入ジニ、ジニ2は公的移転なし家計収入ジニ係数である。)											

出典：筆者推計

——— 表3　推定結果 ———

重回帰

①		再分配による改善度
	説明変数	個別固定効果
	定数項	−0.058835 (−5.212209)
	各省高齢者1人当たり年金	2.40E−06 (1.413883)
	各省社会保障への支持度	0.492599 (2.974092)
	調整済みR^2	0.657619
②		再分配による改善度
	説明変数	個別固定効果・時間固定効果
	定数項	0.128975 (2.941236)
	各省高齢者1人当たり年金	−1.19E−05 (−3.431007)
	各省社会保障への支持度	0.109872 (0.549638)
	各省失業率	−0.019148 (−2.311221)
	調整済みR^2	0.732786
③		再分配による改善度
	説明変数	個別固定効果・時間固定効果
	定数項	0.139537 (3.556071)
	各省高齢者1人当たり年金	−1.24E−05 (−3.687327)
	各省失業率	−0.019667 (−2.400190)
	調整済みR^2	0.735177
④		再分配による改善度
	説明変数	個別固定効果・時間固定効果
	定数項	−0.054106 (−4.676490)
	各省高齢者1人当たり年金	3.64E−06 (2.100906)
	各省GDPの成長率	0.081449 (1.613730)
	調整済みR^2	0.633502
⑤		再分配による改善度
	説明変数	個別固定効果・時間固定効果
	定数項	−0.034734 (−2.654545)
	各省社会保障への支持度	0.299006 (1.426695)
	各省GDPの成長率	0.027305 (0.464879)
	調整済みR^2	0.686542

——— 表3　推定結果（つづき）———

⑥

	再分配による改善度
説明変数	個別固定効果
定数項	−0.054969 (−5.042247)
各省高齢者1人当たり年金	1.93E−06 (1.172557)
各省社会保障への支出／各省GDP	0.000364 (3.717597)
調整済みR^2	0.674684

⑦

	再分配による改善度
説明変数	個別固定効果・時間固定効果
定数項	0.014756 (0.516697)
各省社会保障への支出／各省GDP	0.000262 (2.189688)
各省失業率	−0.015097 (−1.773551)
調整済みR^2	0.707025

出典：筆者推計

次に、上の節で示した経済変数、社会変数を説明変数として、ジニ係数の改善の要因を調べるために、単回帰分析と重回帰分析を行った。なお、ここで用いるデータはプールされたクロスセクションデータであるため、2005年中国年金改革以前、各省の政府が年金制度を運営する際に自主決定権を持つことを考慮して、固定効果モデルによって推定した。その推定結果は表3の通りである。この推定結果によれば、各省高齢者1人あたり年金、GDP の成長率、各省社会保障への支出／GDP、各省の失業率は、被説明変数（再分配によるジニ係数の改善度）と相関関係があることが分かる。他方、各省の社会保障への支持度、各省の一人当たり社会保障への支出は被説明変数との因果関係は弱い。

以上の結果から、各省の所得格差の程度、ジニ係数が各省間で異なるように相違するが、ジニ係数の改善度を指標として所得格差の是正を図るとすれば、各省は、年金給付の増加、各省の経済活動に対する社会保障の役割・重要度を示す各省社会保障支出割合（対 GDP 比率）の増加、失業率の低下を政策的に実施することによって、ジニ係数は低下し、不平等を正是することができると考えられる。

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The studies on the design of social security benefit and contribution schemes with attention to the relations between income, assets, consumption and the burdens of social security premium and tax:
Report for Fiscal 2008 (Study Supported by the Health Science Research Grants from the Ministry of Health, Labour and Welfare
(Study Project for Promotion of Policy Sciences))

The effects of the 1999 pension reform on household asset accumulation in Japan: A test of the Life-Cycle Hypothesis

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Abstract

This paper tests the Life-Cycle Hypothesis, based on household-level data, utilizing the change of pension benefits deriving from the 1999 pension reform in Japan. This exogenous change enables substitutability between pension and household assets, which is observed if LCH holds, to be identified separately from the inherent positive correlation between them. In this paper, this phenomenon is found particularly in middle-aged households; moreover, the magnitude is reasonable. Also, the findings reveal that less altruistic households behave more consistently under the LCH than altruistic households, implying that the estimates of substitutability reflect the actual households' responses to the reform.

1 Introduction

Today, in Japan, the sustainability of social security financing in an aging society depends on the balance between the magnitude of the benefits and the choice of base on which social security burdens (taxes and social security contributions) are levied. Future revenues for social security rely on the economic growth of Japan's economy, which is influenced by the effects of changes to social security benefits on household consumption-savings behavior. Hence, it is very important to investigate the effects of social security reform on household asset accumulation. In particular, this paper puts more effort into clarifying the intertemporal saving behavior of households utilizing the effects of social security reform, especially the 1999 public pension reform in Japan.

With regard to household consumption-savings behavior, many researchers have examined whether households behave consistently according to the Life-Cycle Hypothesis (hereafter referred to as LCH) or the Altruistic Bequest Motive Hypothesis (hereafter referred to as ABMH) since Feldstein's pioneering literature (Feldstein [1974]). In Europe and the United States, a number of studies indicate that households behaved consistently in accordance with LCH (e.g. Feldstein and Pellechio [1979], King and Dicks-Mireaux [1982], Diamond and Hausman [1984], and Gale [1998]). In particular, Attanasio and

Brugiavini (2003) and Bottazzi *et al.* (2006) recently examined the extent to which changes in pension wealth are offset by household assets as predicted by LCH, exploiting exogenous changes in pension benefits that resulted from Italian pension reforms in the 1990s. They found evidence indicating a substantial offset between pension and private wealth.

By contrast, Japanese literature has not yet arrived at a clear consensus on this issue although many studies have addressed it. Japanese studies that use household-level data can be divided into three major groups according to viewpoint and strategy of analysis.[1] First, Ando *et al.* (1986), Takayama *et al.* (1990), and Aso and He (2001) estimated a consumption function or an asset demand function to investigate the relationship between consumption (or asset) and pension wealth. Second, Ando *et al.* (1986), Hayashi *et al.* (1988), Takayama *et al.* (1989), Ohtake (1991), and Yashiro and Maeda (1994) considered whether households dissaved in their old age, which is a necessary requirement for LCH. Third, Aso and Kamiya (1998), Horioka *et al.* (1996a, 1996b, 2002) and Horioka (2002) evaluated the degree of coherence of saving purpose with LCH using the results of a household questionnaire survey that includes various questions on savings and bequest motive. Although most studies in the third group concluded that a large proportion of Japanese households had a bequest motive consistent with LCH, the studies in the other groups yielded a range of results that are both consistent with and contradictory to LCH. In the first and second groups, only Takayama *et al.* (1990) and Yashiro and Maeda (1994) found evidence that supports LCH. Many other studies obtained a result that is partially or solely contradictory to LCH. [2]

In particular, Aso and He (2001), which is one of the few studies based on the asset demand equation in Japan, found a significantly positive relationship between net pension benefits and household financial assets, contrary to Attanasio and Brugiavini (2003) and Bottazzi *et al.* (2006). They then suggested that this result might corroborate ABMH. However, their result would merely reflect a spurious positive correlation between pension and private wealth, which is attributable to the positive relation between the benefits of employees' pension and before-retirement earnings. Thus, this spurious correlation has to be avoided when attempting to estimate the causal relationship between private and pension wealth.

This paper attempts to rigorously estimate this relationship by utilizing the exogenous reduction of pension benefits driven by the 1999 pension reform in Japan. This reform greatly decreased pension benefits in several ways. If Japanese households behaved consistently with LCH, this decrease would be compensated through their asset accumulation. To assess the degree of substitutability between net pension benefits and household assets,

[1]Recently, Hori and Shimizutani (2007) also tested LCH in another way by examining the reactions of households to anticipated income changes. They suggested that Japanese household behavior is consistent with LCH.

[2]The Annual Report on the Family Income and Expenditure Survey shows that elderly people dissave after retirement. This evidence is consistent with LCH. Although this phenomenon should have investigated carefully, several existing studies tested whether or not dissaving was found for older households (including not only retired households but working households).

I estimate the asset demand function that has net pension benefits as one of the explanatory variables. I use household-level data of NEEDS-RADAR (provided by *Nihon Keizai Shinbun Inc.*) for this estimation, which contains rich data on the assets and characteristics of Japanese households. The estimation results suggest that households offset the decrease in net pension benefits with asset accumulation in a manner that is consistent with LCH. In particular, substitution effects are found for the middle-aged households, and the magnitude is fairly reasonable.

Further, I test whether substitutability differs in terms of significance and magnitude between altruistic and less altruistic households. It is assumed to be likely to find a more significant or larger substitution effect for less altruistic households if the estimates correctly reflect a substantial response by households to the 1999 pension reform rather than other irrelevant factors. This additional estimation gives a more significant substitution effect for less altruistic households, as one would expect. This result indicates that the estimates of substitutability correctly reflect variations in household assets resulting from the pension reform.

The remainder of this paper is organized as follows. Section 2 explains the 1999 pension reform in Japan. Section 3 presents a simple theoretical model that provides a framework to specify and interpret empirical results. Section 4 describes the data set and sample selection criteria employed in this paper. Section 5 reports the baseline estimation results of the household's asset demand equation. Section 6 tests whether substitutability differs between altruistic and less altruistic households in a manner that is consistent with LCH. Section 7 presents the conclusion of this paper.

2 The 1999 pension reform in Japan

This section describes the 1999 pension reform to provide the calculation procedure for net pension benefits in Section 4. Pension benefits were greatly reduced by this pension reform to maintain the sustainability of social security system with an aging population. Pension benefits were reduced in several ways. In what follows, I explain the contents of the pension reform after giving a brief outline of the Japanese employees' pension system. Then, I discuss the timing of the announcement of the pension reform to identify the before- and after-reform periods.

In Japan, salaried workers of private companies have to join the employees' pension system, whose benefit plan consists of the following two parts: (1) old-age basic pension and (2) old-age employees' pension. Workers pay premiums in proportion to their wages, and they then receive pension benefits after retirement. The old-age basic pension differs in the calculation formula among the elderly aged 60 to 64, for whom the Fixed Amount Part (*Teigaku Bubun* in Japanese) has been provided, and the elderly aged 65 or over, the Basic Pension (*Kiso Nenkin*) has been provided (see Appendix B). Also, the benefits given by the old-age employees' pension are proportional to earnings while in active service; therefore, the old-age employees' pension is called the earnings-related component (*Hoshu Hirei Bubun* in Japanese). The spouses of workers are exempt from paying premiums if

their annual income is less than 1.3 million yen.

Next, I explain the reduction of pension benefits. Based on the 1999 pension reform, the national government has implemented a reduction of pension benefits in the following four ways. The first is a five percent reduction in the benefit level of the earnings-related component. This is done by lowering the multiplication number for each household in the calculation formula of pension benefits (e.g. 0.0075 to 0.007125). The second is abolition of the sliding pay scale after 65 years old for the basic pension and employees' pension, with only price indexation remaining after that age.[3] The third is a gradual increase in the starting age for receiving benefits of the earnings-related component from 60 to 65 for men. This is to be conducted during the period from 2013 through 2025.[4] The fourth is introduction of an old-age pension for active employees aged 65 to 70. This paper focuses on the first to third benefits reduction plans, which have a particularly large effect on pension benefits.

Next, I explain the reform of the premium payment system of employees' pension. The 1999 pension reform introduced a total remuneration system, which imposes premium burdens on both monthly wages and annual bonuses at a uniform rate. After introduction in April 2003, pension benefits became proportional to the total amount of wages and bonuses (not only to wages before introduction of that system). At the same time, the national government lowered the premium rate from 17.35% to 13.58% to make the premium burdens on insured persons unchanged before and after 2003. As a result, the upper limit of the effective premium rate hardly changed.

It is necessary to specify the timing with which people are informed about the contents of the 1999 pension reform to identify the before- and after-reform periods. The Pension Council officially started to discuss pension reform in May, 1997. However, the leaven of a drastic pension reform had already been proposed in the early part of 1997, triggered by the newly-released Population Projection (in January 21, 1997 by National Institute of Population and Social Security Research), which revealed the rapid future aging beyond the previous projection. In January 1997, several newspaper articles had already reported the possibility of a drastic pension reform in 1999. In January 28, *Nihon Keizai Shinbun* reported that the Ministry of Health and Welfare started to consider raising premium burdens and lowering pension benefits.[5] Hence, people would have expected a decrease of net pension benefits before discussions officially started. The questionnaire survey of the Central Council for Financial Services Information supports this conjecture. Table 1 shows the results of this survey, which tells that the ratio of respondents that save for their retirement gradually increased in the late 1990s. Moreover, the ratio of respondents that felt anxious about their old age largely increased after 1997. A major reason for their

[3]The sliding pay scales for the basic pension and the employees' pension are, respectively, called *Seisaku Kaitei* and *Chingin Suraido* in Japanese. This paper does not consider the former indexation due to the difficulty of reflecting it with a simple algorithm. This paper, therefore, considers only *Chingin Suraido* in calculations of present values of benefits in 1996 and 2000. This simplification, however, might not greatly bias the estimation results because *Seisaku Kaitei* was very small in the late 1990s.

[4]An identical policy will also be applied to women five years later than men.

[5]In February 20, *Nihon Keizai Shinbun* also reported that the Minister of Health and Welfare announced that a certain decrease of pension benefits was unavoidable.

anxiety is inadequacy of pension and insurance provisions.

It follows from what has been said thus far that in 1996 people did not know about the implementation of a large pension reform in the near future.[6] Hence, I can regard 1996 and 2000 as before- and after reform years, respectively.

3 Model and empirical specification

3.1 Model

This section describes the theoretical model on which the empirical analysis below is based, following the model of Aso and He (2001). Let me first explain the case of LCH. If households know that a pension reform will be carried out in the near future, the households' budget constraint for their remaining life could be revised. The change to the budget constraint occurring at age x alters the subsequent consumption stream. Then, the relationship between the change of consumption at t years of age (Δc_t, $x \leq t$) and the change of the present value of net pension benefits evaluated at x years of age (ΔNPB_x) can be described as follows:

$$\Delta NPB_x = \sum_{t=x}^{D-1} \frac{\Delta c_t}{(1+r)^{t-x}}, \tag{1}$$

where D denotes the age of death and r is interest rate. If households smooth consumption in a manner that is consistent with LCH, Δc_t becomes Δc, and Δc can be written as follows:

$$\Delta c = \frac{r}{1+r} \cdot \left[1 - \frac{1}{(1+r)^{D-x}}\right]^{-1} \cdot \Delta NPB_x. \tag{2}$$

Thus, the change of household wealth at the beginning of age $t+1$ (ΔA_{t+1}) is given by

$$\Delta A_{t+1} = -\left[\frac{1 - 1/(1+r)^{t-x+1}}{1 - 1/(1+r)^{D-x}}\right] \cdot \Delta NPB_x \cdot (1+r)^{t-x}. \tag{3}$$

where $t+1$ is before-retirement period.[7] On the other hand, if ABMH holds, households do not change their consumption ($\Delta c = 0$) because the change in their benefits can be cancelled out by an increase or decrease of their descendants' social-security burden under

[6] More precisely, people could already know in 1996 that a fiscal recalculation would be conducted in 1999 because a recalculation had been done at five-year intervals. However, they probably did not expect a large reduction of pension benefits.

[7] Eq. (3) ignores changes in insurance premiums because the premium burden is hardly altered by the 1999 pension reform.

the hypothesis. Thus, the coefficient of $\Delta NPB_x \cdot (1+r)^{t-x}$ in Eq. (3) equals zero under ABMH.

In the following empirical analysis, this paper examines a null hypothesis that the coefficient of net pension benefits equals zero. The estimated coefficient is described as follows:

$$\beta(t,x) = -\left[\frac{1-1/(1+r)^{t-x+1}}{1-1/(1+r)^{D-x}}\right]. \tag{4}$$

More concretely, this paper estimates $\beta(x+3,x)$, which denotes the effect of the reduction of net pension benefits announced in 1997 on the amount of household assets in 2000. This value is identified by a pension benefits variation in each age group between before- and after-reform periods. In fact, this paper assumes that households of the same age at two different time points would have the same level of assets if conditions other than the pension reform are identical. However, since this paper compares the household assets of different cohort groups, the cohort effect possibly biases the results. Therefore, this paper adds birth cohort dummies in the estimation equation. The cohorts are classified by the period of birth as follows: [1] 1972 to 1975, [2] 1967 to 1971, [3] 1962-1966, [4] 1957-1961, [5] 1952-1956, [6] 1947-1951, [7] 1942-1946 and [8] 1937-1941. $\beta(x+3,x)$ is estimated to be significantly negative when households accumulate assets in response to the reform.

Figure 1 provides the theoretical values of $\beta(x+3,x)$ for individual ages (x). These values indicate that roughly 18 to 28 percent of a reduction of net pension benefits is offset through a household asset accumulation during the period from 1997 to 2000. The downward sloping curve in Figure 1 reflects the higher speed of asset accumulation by older households to offset the reduction of pension benefits over a shorter period until death. This paper addresses differences in substitutability among age groups by adding interaction terms of net pension benefits and age-group dummies to the asset demand equation.

Nevertheless, there are several factors that lead to a deviation from the values in Figure 1. It is likely that the degree of substitutability can be expected to be lower than the theoretical number for young households because their ability of accumulating assets might be inadequate. In addition, if households distrust the sustainability of the public pension system, the substitution rate might be lower than the values in Figure 1. Because younger households are probably more anxious about sustainability than older ones, the substitution rates for younger households might be smaller than predicted values. Therefore, the estimates of substitutability for younger households are expected to be small both from the viewpoints of theory and practice. Thus, even if younger households behave consistently with LCH, it might not be possible to obtain a statistically significant estimate of their substitutability.

This paper estimates the following equation:

$$(PW/DI) = \alpha + \sum_{i=1}^{4}(NPB/DI) \times age_i \times \beta_i + X\gamma + \epsilon, \tag{5}$$

where PW is the amount of private wealth, DI is disposable income, NPB is net pension benefits, age_i is a dummy variable that takes unity if household head (i.e. working man) belongs to age-group i ([1] 25-29 years, [2] 30-39 years, [3] 40-49 years, [4] 50-59 years), and X is a vector of other household characteristics. The equation is estimated by the median-regression model in order to address the outliers of PW, as will be explained in Section 4.4. This paper employs two definitions of PW in the following analysis: (1) total amount of financial and real assets, and (2) amount of financial assets.

3.2 Identification issue

I have to consider a potential bias in the coefficient of net pension benefits (β_i) driven by macroeconomic factors, some of which might lead to a spurious correlation between household assets and pension benefits. For example, the permanent tax reductions of personal income tax and inhabitant tax, determined in the 1999 tax reform, could induce a false negative relationship between household assets and pension benefits. These tax reductions permitted households to subtract 20 percent of personal income tax (the ceiling is 250 thousand yen) and 15 percent of inhabitant tax (the ceiling is 40 thousand yen) from each tax payment after fiscal year 1999. Hence, it might appear that household assets increased during the period from 1996 to 2000 due to those tax reductions even if the households did not react to the 1999 pension reform and accumulated no assets. Also, the amount of tax credits generally increases with age because older households earn more.[8] Thus, the estimates of β_i are likely to be biased downward for older households.

This paper tries to ascertain whether β_i correctly captures the effects of the 1999 pension reform by comparing the magnitude and significance of β_i between altruistic and less altruistic households. If households in fact accumulate assets in response to the pension reform, β_i can be estimated to be more significantly negative for less altruistic households, which are assumed to behave more consistently with LCH, than altruistic households. By contrast, if the spurious negative correlation between net pension benefits and household assets is the primary reason for negative estimates of β_i, substitutability will be found both for altruistic and less altruistic households.

Attanasio and Brugiavini (2003) and Bottazzi *et al.* (2006) identified the effects of pension reforms on the saving behavior of households by employing a natural experiment approach. They exploited the differential effect of the Italian pension reforms on the pension wealth of different groups. They applied the difference-in-difference (DID) method to the estimation of the pension wealth equation in the first-stage regression of the instrumental variable method. However, I cannot apply this approach to my analysis because the 1999 pension reform did not have such a differential effect that can be utilized for DID.[9]

[8] Based on RADAR in 2000, the mean values of total tax credit for seven age groups are computed to be 40 thousand yen (for 25-29 years), 48 thousand yen (for 30-34 years), 83 thousand yen (for 35-39 years), 99 thousand yen (for 40-44 years), 117 thousand yen (for 45-49 years), 165 thousand yen (for 50-54 years), and 165 thousand yen. (for 55-59 years).

[9] Although self-employed workers, who were not affected by the 1999 pension reform, are candidates

4 Data description

4.1 NEEDS-RADAR

This paper uses Japanese micro-data of NEEDS-RADAR (hereafter referred to as RADAR) for 1996 and 2000, compiled by *Nihon Keizai Shinbun Inc.* This survey randomly chose 5000 (4500 for the year 2000) men and women aged 25 to 69 (25 to 74 for the year 2000) from the Tokyo metropolitan area, which included Tokyo, Saitama prefecture, Chiba prefecture, and Kanagawa prefecture (Ibaraki prefecture was also included in the year 2000). The numbers of effective respondents were 2759 for 1996 and 2510 for 2000. This survey asked a large number of questions on asset holdings and household demographics.

It must be noted that I do not necessarily obtain the same results as this study when using the nationwide survey. Because RADAR covers only the Tokyo metropolitan area, saving behavior could be different from that in other areas. To examine this possibility, I compare the mean values of household income and annual saving in RADAR with those in nationwide surveys. Table 2 provides the mean values of annual income and saving (in nominal terms) of RADAR, Family Saving Survey (hereafter referred to as FSS), Japanese Family Income and Expenditure Survey (hereafter referred to as JFIES), National Survey of Family Income and Expenditure (hereafter referred to as NSFIE), and Public Opinion Survey on Household Savings and Consumption (hereafter referred to as POSHSC).[10] FSS, JFIES, and NSFIE are conducted by Bureau of Statistics, Office of the Prime Minister (formerly Management and Coordination Agency). POSHSC is conducted by the Central Council for Financial Services Information (formerly the Central Council for Savings Information).[11] [12] According to Table 2, the mean values of annual income and saving in RADAR are slightly larger than those of other surveys.[13] Therefore, the sample households in RADAR might have had a somewhat greater ability to accumulate assets, and they could have more strongly responded to the 1999 pension reform than households in other areas.

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for a control group, their age bracket and pension system are entirely different from the treatment group (private-sector employees). In addition, the saving behavior of self-employed workers might also differ greatly. Therefore, I do not apply the DID method using them as control group households.

[10]This paper uses NSFIE for 1994 and 1999 instead of 1996 and 2000 because the survey is not conducted every year but is conducted at five-year intervals.

[11]The mean values of FSS, NSFIE and POSHSC are calculated for all households, whereas those of JFIES are calculated for all working households.

[12]Because the 1996 RADAR asked not only the amount of ordinary annual household income but also annual extra income, I present the mean value of total pretax annual household income (7.26 million yen) and annual extra income (0.64 million yen) in the upper row of Table 2. In contrast, the mean value of the 2000 RADAR is calculated only for pretax annual household income because annual extra income is not available. This differential is responsible for the smaller value of income in 2000 than in 1996. The mean values of FSS, JFIES, and NSFIE also include annual extra income. For POSHSC, I cannot know whether household income includes extra income.

[13]The larger income in RADAR probably reflects regional differences in income level. The above-mentioned nationwide surveys indicate that the mean values of household income in the Kanto district (FSS: 82.8 [77.1], JFIES: 10.7 [10.3], NSFIE: 74.3 [69.1], and POSHSC: 64 [60.1] in the year 1996 [2000]) are larger than the national averages in Table 2.

4.2 Sample selection

This paper uses two types of household in the empirical analysis below: (1) single-income households whose head (aged 59 or younger) works for a private company and (2) double-income households whose head (aged 59 or younger) works for a private company and his spouse works as a part-timer or has a side job. Because the individual annual incomes of husband and wife are not available, I cannot calculate the net pension benefits for double-income households separately. Hence, this paper confines its scope to the sample to households corresponding to (1) and (2) in which only the household head works full-time.

This results in the exclusion of several types of household. First, this paper drops households whose head is aged 60 or over because the estimates of net pension benefits, calculated on the basis of income drawn after the mandatory retirement age of 60, are likely to deviate from the true value of benefits computed from before-retirement income.[14] Second, this paper excludes households whose heads work for public offices. Public employees join either of two different union pension plans depending upon whether they work for the national or local government; however, I cannot identify their plan from RADAR. Third, this paper drops households in which only the household head's spouse or an unmarried single woman works. In most of the former cases, the household head would already have retired; therefore, it is inappropriate to calculate net pension benefits based only on the spouse's annual income. In the latter case, because a portion of female workers are likely to leave full-time employment after marriage[15] and to be the third insured person of an employee's pension, saving behavior would not be continuous before and after marriage. As a result, the numbers of households used in my analysis are 1057 and 846 for the years 1996 and 2000, respectively.

4.3 Household characteristics

This subsection compares the household characteristics of the 1996- and 2000-year samples to check for similarities. If households have a considerably different distribution of characteristics between these two years, it cannot be identified whether the estimates of β_i reflect the responses of households to the pension reform or merely indicate differences in asset accumulation behavior that come from the differences in the characteristics of households.

Table 3 presents descriptive statistics of household characteristics. In this table, "Part-timer" is a dummy variable that takes unity if the wife works as a part-timer or has a side

[14]The elderly aged 60 or over are usually not regular worker in Japan even if they are employed. According to the Annual Report on the Labor Force Survey, conducted by the Statistics Bureau, Ministry of Public Management, Home Affairs, Posts and Telecommunications (formerly Management and Coordination Agency), the rates of regular employees in 1996 and 2000 (defined as a percentage of regular employees [in non-agricultural industries] in the population over 15 years of age) among those aged 50-54, 55-59, 60-64, 65-69, and 70 or over were 77.1% (75.4%), 70.4% (70.9%), 40.0% (37.1%), 22.2% (20.4%), and 8.1% (7.1%), respectively (the values for the year 2000 are in parentheses).

[15]This phenomenon is well known in Japan as the M-shaped employment rate curve.

job. "Plan a housing loan" is a dummy variable that takes unity if a household plans to purchase a home by getting a housing loan from a bank or public financial institution or their workplace. "Expect a retirement allowance" is a dummy variable that takes unity if a respondent or his/her spouse expects to receive a retirement allowance in the future. "Private life annuity" is a dummy variable that takes unity if a respondent or his/her spouse joins a private pension plan, and it provides whole-life benefits.

Table 3 suggests that mean value and standard deviation of most household characteristics do not differ greatly between 1996 and 2000, thus household characteristics are distributed similarly in these two years. Hence, households in 1996 and 2000 could be homogeneous and their asset accumulation behavior could also be similar.

4.4 Household asset holdings

This subsection explains a calculation of the household assets and provides a summary of asset-holding status. The following products are included in financial and real assets.

Financial assets:
Ordinary bank deposits, postal savings, fixed-amount postal savings, time deposits, large time deposits, saving deposits, trust deposits, bonds,[16] stocks, MMF, MRF, midterm government bond funds, investment trusts, in-house savings deposits, worker's asset-building savings, mortgage securities, commodity funds, gold savings, amount of money received at maturity date of single premium endowment life insurance policy, and amount returned at maturity of accident insurance policy

Real assets:
Residential land, other land (land for second house, apartment, condominium, building, etc.), other real assets (studio apartment, co-owned real estate, gold, golf course membership, and resort club membership)

The products that are contained in the data of 1996 and 2000 years should be the same. To achieve this, I exclude foreign currency deposits from financial assets because the 1996 RADAR did not collect information on the amount of such assets.[17] In addition, life insurance policies are eliminated because the 2000 RADAR did not ask about them.[18] Thus, the amounts of financial assets in 1996 and 2000 do not differ due to differentials

[16]Bonds include discount bank debentures, interest-bearing bank debentures, government bonds, convertible bonds, warrant bonds, corporate bonds, and housing bonds.

[17]According to POSHSC, the amount of foreign currency deposits dramatically increased from 0.12 million yen to 1.32 million yen during the period from 1998 to 2000 (0.78 million yen in 1999, and the values for 1996 and 1997 are not available). Hence, the exclusion of foreign currency deposits does not negatively bias the estimate of β_i, implying that exclusion is unfavorable to a rejection of ABMH.

[18]National Survey of Life Insurance, conducted at three-year intervals by Japan Institute of Life Insurance, shows a slight decrease (from 5.0 to 4.6 in the period between 1994 and 1999) in the average number of life insurance policies held. Therefore, in contrast to the foreign currency deposits, the exclusion of life insurance policies might bias β_i downward.

in asset type included.

When equalizing the types of real assets between these two years, I have to pay attention to differences among questions. The 1996 RADAR asked the market value of three real assets: (1) residential land, (2) land for second house, apartment, condominium, building, etc., and (3) other real assets, including studio apartment, co-owned real estate, gold, golf course membership, and resort club membership. Hence, real assets for this year do not include residential housing. Thus, the amount of net real assets can be obtained by deducting the amount of housing loan only for residential land from the total amount of real assets (amount of gross real assets).[19] [20]

On the other hand, the 2000 RADAR asked about the amount of real assets in the slightly different form from the 1996 RADAR. Real assets are divided into three groups: (1) residential land, (2) "apartment, condominium, and building," "second house," "land for parking lot," "farmland," and "other land," and (3) other real assets, including the same assets as in the 1996 RADAR. Because the 2000 RADAR asked about the amount represented by "apartment, condominium, and building" in (2), households that own condominium and live in it probably reported those assets as a component of (2).[21] Due to the absence of a question on residential housing in the 1996 RADAR, the amount of real assets in 2000 could be larger than that in 1996 by the amount of condominiums. This differential in the questionnaire might downwardly bias the estimate of β_1. To avoid this bias, I exclude 83 households that have "apartment, condominium, or building" and "live in their own condominium" from the sample households of year 2000.[22] This sample exclusion makes the types of real assets included in the sample of year 2000 equivalent to that of 1996. Also, this paper eliminates households that report a larger amount of annual repayments than annual income when calculating the amount of net total assets. Due to this elimination, the numbers of observations for net total assets in Tables 7, 12 and 13 are slightly smaller than that for gross total assets.

Tables 4-1 and 4-2 provide quartiles of the amount of financial and real assets, respectively. Net financial assets are calculated by subtracting loan on deed, which is used for an education loan, car loan, and free loan, from gross financial assets. Net real assets are obtained by subtracting housing loans for residential land from gross real assets. Tables 4-1 and 4-2 show that the median values of financial and real assets do not differ greatly between 1996 and 2000 although they slightly decrease during my sample period. The

[19] Appendix A explains the way of estimating the amount of housing loan for residential land separately from that for residence.

[20] Some households might purchase a studio apartment (for rent) using a housing loan; however, I do not deduct the loan for it because the amount of the housing loan for this asset is not available. Moreover, because only about 10 households own a studio apartment in each year, the estimation results are hardly biased even if the loan for this asset is not deducted.

[21] It was possible that the questionnaire-maker wanted respondents to answer not the "building price" of "apartment, condominium, and building" but rather the "land price," as did the 1996 RADAR. The respondents, however, might answer with the "building price" because the wording of the questionnaire was confusing.

[22] This paper keeps households that have a condominium but do not live in it (20 households) because the 1996 RADAR might also include households that have a condominium for rent.

decreasing trends in real and financial assets are also found in NSFIE.[23] In contrast to the median values, a substantial difference is found between the mean values of financial assets. The mean values are 88.7 and 76.0 hundred thousand yen in 1996 and 2000, respectively. This difference is probably because several outliers are included in my sample. Hence, I estimate Eq. (5) by the median-regression method.

In Table 4-2, the real assets of the youngest age group greatly increased from 1996 to 2000 though such a trend is not found for other age groups. Since only a few households own the real assets in this group, I may happen to have more households that own a large amount of real assets in 2000 than 1996. Another possibility is an acceleration of home purchases in the late 1990s due to low mortgage rates and several preferential tax treatment policies. Table 5 reports the ownership rate of detached houses, and it indicates that the ownership rate for the youngest age group rises significantly from 34.4% to 45.0%.[24] In fact, however, few households of the youngest age group in this paper repaid a housing loan. Hence, I cannot ascribe the large amount of real assets in this age group to a low mortgage rate and preferential tax treatments. Nevertheless, the increase of the house ownership rate might be one of the reasons. When estimating Eq. (5), the youngest age group is excluded to avoid a downward bias to β caused by the increase of real assets that might be unrelated to the pension reform. This constraint can also be justified by the reason that unmarried young respondents who lived with their parents over-reported the amount of real assets because they might include the parents' house among their real assets.[25]

4.5 Net pension benefits

This subsection describes the change of net pension benefits between before and after the 1999 pension reform.[26] Table 6 presents the discounted present values of net pension benefits (pension benefits minus insurance premiums) and its normalized values (by disposable income). The calculation of pension benefits and insurance premiums is summarized as

[23] NSFIE shows that the mean value of real assets in the Kanto district decreased from 44.8 million yen in 1994 to 34.2 million yen in 1999. Net financial assets in the Kanto district also decreased in NSFIE. However, the amount of gross financial assets did increase in the late 1990s, contrary to the trend in Table 4-1.

[24] An increasing trend of the house ownership rate is found in FSS as well. FSS shows that the house ownership rate of the age group of 25 to 29 rises from 9.0% in 1996 to 21.7% in 2000. Moreover, the house ownership rate in the Kanto district rises from 61.9% to 68.4%. Thus, the increase in house ownership rate in the late 1990s is not specific to the sample households in this paper.

The house ownership rate of the youngest age group is larger than that of the second-youngest group. This is probably because many unmarried respondents lived in their parents' house.

[25] Although the households of other age groups would also include parents' assets, the deviation from the true asset amount can be large, particularly for young unmarried households.

[26] In reality, the factor in affecting household asset accumulation would not be the objectively-estimated amount of net pension benefits but each person's subjective valuation of that. This paper cannot use the subjective valuations because RADAR does not provide such information. However, Horioka and Oku (1999) used people's expectations of social security benefits, which were collected by the Institute for Posts and Telecommunications Policy, in order to consider the importance of retirement saving and of the determinants thereof.

follows.[27] As the first step in obtaining pension benefits, this paper calculates the initial-year benefits of individual households based on the mean value of monthly remuneration over the whole working life (the average monthly standard remuneration). Next, the pension benefits paid after the first entitlement are computed by multiplying the initial-year benefits with the expected inflation rate and appreciation of remuneration. Meanwhile, the insurance premiums of each age are obtained by multiplying the annual income with the employee's contribution rate. Then, multiplying the benefits and premiums with the survival rate of each age yields the expected values of them. Finally, this paper discounts the expected values by interest rate in order to obtain the present value.

In Table 6, the amount of net pension benefits decreases considerably after the reform by approximately 1.5 million yen to 6 million yen.[28] Further, the amount of net pension benefits is smaller in the younger age group, and it has a negative value for the age group of 40-44 years or younger in 2000.

Figure 2 shows the ratio of benefits to insurance premiums according to household head's age. This ratio falls after the pension reform for all ages.[29] In the next section, I estimate the effect of this reduction on household asset accumulation.

However, the variability of net pension benefits is not only derived from a dynamic variation before and after the pension reform but also from a cross-sectional variation between high and low income households, which mainly results from variations in the earnings-related component of pension benefits. If the estimate of β_i reflects the latter variation, it would be underestimated due to a positive correlation between household assets and net pension benefits, which is also controversial among previous studies. To avoid this, net pension benefits and household assets are normalized by disposable income. The positive correlation, however, might remain even after this manipulation. Nevertheless, the underestimation does not support LCH falsely, but instead favors ABMH. Hence, one can conclude that households behave consistently with LCH if β_i is significantly negative. At the same time, acceptance of ABMH needs careful consideration.

[27] Appendix B explains in more detail how to estimate the amount of net pension benefits.

[28] The changes of net pension benefits are also attributed to variations between 1996 and 2000 of inflation rate, wage growth rate, and investment yield, which are used for calculating the discounted present values of benefits.

[29] The ratios of benefits to contributions in Figure 2 are larger than in other studies on Japan (e.g. Hatta and Oguchi, 1999; Wakazono, 2002) because this paper considers only (nominal or statutory) employee contributions as the perceived burden of households. If an employer's burden were to be transferred to the employees in the form of a wage reduction and employees recognize that, an employer's contributions should be included in the employee's own burden. However, as shown in Iwamoto and Hamaaki (2006), an employer's contributions might not be completely shifted back on to wages in Japan. Furthermore, it seems that most people do not regard an employer's contribution as their own burden because the concept of payroll-tax incidence is unknown to ordinary people. Consequently, the household budget constraint might not include the employer's contributions. Thus, this paper assumes that only employee contributions are the perceived burdens of households.

5 Baseline empirical results

This section discusses the estimation results (of Eq. [5]) for all sample households chosen in Section 3.2. In the estimations below, I do not use the variables on educational status and firm size of household head as explanatory variables because they may absorb the effects of net pension benefits.[30]

Table 7 presents the estimation results of Eq. (5) using the total amount of financial and real assets as PW. Columns (A) and (B) report the result of gross and net total assets, respectively. Column (A) provides insignificant coefficients of net pension benefits (NPB/DI) for all age groups. On the other hand, column (B) shows that the coefficients of net pension benefits are significantly negative for two older age groups. These negative coefficients are corroborated with LCH though they are rather smaller than the theoretically predicted values in Figure 1.

Next, I estimate Eq. (5) using financial assets as PW. Because households can buy and sell these assets at a lower transaction cost than real assets, they might have accumulated financial assets (in the short run at least) to offset a decrease in net pension benefits. If this inference is true, one can obtain significantly negative estimates of β_i using only financial assets. Table 8 reports the results of this estimation and shows that β_i is significantly negative only for the 40s. The negative estimates are fairly reasonable in magnitude compared to the theoretically predicted values. Thus, this result implies that households were likely to accumulate financial assets in response to the pension reform. At the same time, however, β_i is insignificant for other age groups. Further, the pattern of β_i that is largest in absolute value in the 40s is not corroborated with theory but with Attanasio and Brugiavini's (2003) "somewhat puzzling U-shaped age pattern" though the reason for this pattern remains unclear in this paper.

A compositional change in household portfolio could lead to a significantly negative estimate of β_i in Table 8. If sample households sold real assets and purchased financial assets to offset losses of real assets in the late 1990s, the use of financial assets as a dependent variable can generate negative estimates even in case assets were not accumulated. However, the ratio of real assets to total household assets hardly declines between 1996 and 2000 in my sample.[31] Furthermore, a significant increase in the ownership rate of detached houses, shown in Table 5, also indicates that middle-aged households did not sell real assets, but rather purchased them.

Finally, I summarize the results of other independent variables in Tables 7 and 8. Higher age households are likely to own a larger amount of financial assets. Also, the older cohorts have more assets. Then, the positive coefficients of marital status indicate that marriage entails the acquisition of residential housing in many cases. The coefficients of the part-timer dummy might well be significantly negative because dual-income house-

[30] The pension benefits and insurance premiums are calculated based on individual wage profiles, which are prepared according to educational status and firm size. Hence, net pension benefits are correlated with those characteristics.

[31] The ratio of real assets is 35.2% in 1996 and 34.7% in 2000. Also, the ratio of the 40s is 43.0% and 42.8% for those years, respectively.

holds do not have to prepare a large amount of assets to buffer their income fluctuations. Further, home ownership increases the total amount of real and financial assets. Meanwhile, a housing loan and loan on deed both decrease financial assets. This might imply that the burden of loan repayment has a negative effect on accumulating financial assets. Moreover, planning to have a housing loan increases assets probably because households have to make a down-payment before taking out a loan. In addition, planning to receive a retirement allowance reduces the total amount of assets. The positive coefficients of "private life annuity" might spuriously reflect the positive relationship between the probability of holding a private annuity and the amount of assets.

6 Altruistic bequest motive and household saving behavior

In this section, Eq. (5) is estimated using split samples obtained by dividing households on the basis of the degree of altruistic bequest motive. Because less altruistic households are assumed to behave more consistently with LCH, I can expect that ABMH is rejected more significantly with this group. If this pattern can be seen in split-sample estimations, I can ascertain that the response of households to the 1999 pension reform is the main source of the negative estimates of β_i in Tables 7 and 8. In other words, their negative sign does not merely reflect an increase in household assets caused by a change in other irrelevant factors (e.g. macroeconomic conditions).

6.1 The proxies for altruistic bequest motive

This paper utilizes the following two proxies for the degree of altruistic bequest motive. First, households are divided on the basis of the degree of desire to leave assets to children. The 1996 RADAR asked the question: "Do you want to leave financial assets to your children?" with the five-grade evaluation of "1. Yes, 2. Yes if anything, 3. Yes and no, 4. No if anything, and 5. No." On the other hand, the 2000 RADAR asked the question: "Do you want to use your assets to enrich your retired life rather than to leave assets to your children?" with the five-grade evaluation of "1. Yes, 2. Yes if anything, 3. Yes and no, 4. No if anything, and 5. No." I classify as altruistic the households that replied "Yes" or "Yes if anything" to the question in 1996 and "No if anything" or "No" to the question in 2000, while other households are regarded as less altruistic.[32] [33]

The second criterion is whether households have children because households with no children are assumed to have a very weak or no altruistic motive in relation to their chil-

[32]Even if households answer that they want to leave assets to their children, some of them may not have an altruistic bequest motive but have the one that is consistent with other selfish motives (e.g. strategic bequest motive). Therefore, LCH may be applicable to the altruistic households of this paper.

[33]The wording of the questions about bequest is substantially different between 1996 and 2000, though the contents are almost the same. The difference may prejudice the estimation result. This remains an issue.