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ABSTRACT

Japanese annual time series data covering the period 1951 to 1982 reveals that changes in the program of social security retirement benefits have substantial influence on personal saving and retirement behavior. The empirical results show that social security retirement benefits depress personal saving by approximately 13.5 thousand yen per capita in real terms from 1951 to 1982. However, declining labor force participation of the elderly (i.e., earlier retirement), stimulates personal saving by an estimated .5 thousand yen over the same period. The study finds that the benefit effect dominates the retirement effect. The net effect is consequently a downward impact on personal saving. The parameter estimates indicate that the retirement behavior induced by social security retirement benefits tends to become more sensitive and responsive to a rise in the benefits. In addition, this study has identified a negative interdependency between the personal saving and labor retirement behaviors; that is, an individual saves more before retirement if he expects to stay a shorter time in the labor market, and vice versa. Moreover, personal saving influenced by retirement behavior tends to become less and less responsive, though the results indicate a relatively large response, and although very small, the retirement behavior gradually becomes more responsive to change in personal saving.

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I. Introduction

In the debate over high Japanese personal saving, the Japanese saving and consumption behavior have come under fire. In spite of conceptual differences in saving between Japan and the United States and other nations[1] personal saving rates in Japan remain higher than that of the United States. The ratio of personal saving to disposable income has been markedly high since World War II. It was sometimes over twenty percent and is currently about sixteen or seventeen percent. Although a relatively large public debt-to-GDP ratio (26 percent) exists, the excess saving over investment in Japan creates a huge pool of savings which flow out to foreign nations. Researchers have focussed increasing attention on the high Japanese saving rate. Despite the number of recent studies, there is still no consensus among researchers, nor a full understanding of Japanese saving behavior. This paper sheds light on Japanese personal saving from the different aspects related to social security retirement benefits and to elderly labor force behavior.

The previous studies on saving have attempted to explain various aspects of Japanese saving behavior. In the National Survey of Family Income and Expenditure (micro data in 1974 and 1979), Ando, Yamashita, and Murayama (1986) remark that one of the reasons for a high saving rate stems from a high growth rate. In the macroeconomic framework, Hayashi (1986) concludes that the growth rate does not explain the high saving rate in Japan. Dekle (1986), Hayashi (1986), and Hayashi, Ito and Slemrod (1987) emphasize a bequest motive of saving in a life-cycle model. Ishikawa and Ueda (1984) find bonus payments exert positive effects on personal saving and simulated results show three percentage points of contribution to the saving on average. However, the bonus hypothesis does not provide a dominant explanation of Japanese saving. Sato (1987) uses a theoretically sound target wealth hypothesis in an attempt to explain Japanese personal saving behavior when it is not adequately explained by the permanent income hypothesis and the life-cycle hypothesis. His empirical arguments CCSP/BOJ Survey[2] mainly focus on inflation, demand for labor and demand for housing as exogenous variables. These exogeous variables give theoretically robust results. However, the major shortcoming in Sato (1987) is that a treatment of welfare pension is ignored, although evidence of welfare pension effects on personal saving are inconclusive in Japan.

Despite many theoretical and empirical U.S. studies on the effect of social security retirement benefits on saving,[3] there are few on this issue for Japan. By analyzing a substitution between expected retirement payment and preretirement wealth accumulations, and using time series data (from the Family Saving Survey, and the Family Income and Expenditure Survey, 1968-1980), Noguchi (1983) does not draw decisive conclusions about the effect of social security retirement benefits on wealth accumulation. Estimated coefficients are not sensitive to the choice of age groups and are negative. However, the coefficients do not provide statistically significant robust results. Sasaki and Tachibanaki (1985) use the same data with a different period (1966-1982) than Noguchi (1983) uses. Unlike Noguchi, Sasaki and Tachibanaki conclude that the effect of social security retirement benefits on household saving is significant with cohort classification. They report that the substitutability between social security retirement benefits and household saving increases as age cohort rises.

In the studies on Japanese saving, arguments overlook the importance of an increase in aging population. Ando, Yamashita and Murayama (1986) suggest that early retirement induces a high saving rate with a life-cycle hypothesis. They, however, introduce the question whether prolonged retirement raises or lowers the saving in Japan, and conclude that an increase in aging population may lower the saving rate.[4] Seike (1982) examines the influence of social security retirement benefits and household saving on elderly labor supply using individual data in 1974 from Zenkoku Shohi Jittai Chosa (ZSJC) and Chingin Kozo Kihon Chosa (CKKC). The ZSJC is household survey data and does not provide labor supply information. The CKKC is labor supply data and does not contain nonlabor income, i.e., social security retirement benefits data. In spite of the restriction of data, Seike skillfully manipulates the data and demonstrates the impact of social security retirement benefits on labor supply. The impact is statistically significant, though moderately small. The coefficients for the stock of saving variables are somewhat embarrassing and positively significant. His theoretical explanation of income preference by elderly labor supply behavior seems to be unsound. The micro data in Japan provide little evidence of saving behavior in terms of a change in retirement and an increase in aging population in Japan. Even though Horioka (1990) surveys the literature and comprehensively discusses various factors which have been suggested as possible causes of the high saving rate in Japan, further studies are required to understand behavioral patterns concerning high personal saving in order to guide policy actions.

Previous studies in Japan frequently neglected the relationship between personal saving and retirement, and their behavioral simultaneity. Cross-country tests by Modigliani and Sterling (1983) show robust evidence that the labor force participation of the elderly and an insufficient welfare pension in Japan have a negative influence on the saving rate. Feldstein (1980) treats the labor force participation rate of older men as endogeneous and finds that an earlier retirement raises the saving rate in the 12 industrial country sample. The determination of saving and retirement habits seems to be endogeneous decisions. To demonstrate a simultaneity of personal saving and retirement, this study employs personal saving and labor force participation of the elderly as endogenous in the framework of an extended life cycle model.[5]

The empirical work of this study, using Japanese time-series data, also attempts to explain the impact of social security retirement benefits on personal saving and the labor force participation of the elderly in Japan. Such a study is necessary for predicting behavior patterns concerning saving and retirement, and for guiding policy actions. This study will attempt, as well, to provide theoretical and empirical explanations of saving and retirement behavior, and their behavioral interdependency. Horioka (1990) addresses an advantage of a time-series data application. He explains traditional and cultural influences on the high Japanese saving rate, and the difficulty of empirical tests for traditional and cultural aspects. In this respect Horioko implies that the time-series approach is better than a cross-sectional one. Since tradition has presumably weakened over time, the saving rate should show a long-term downward trend if the saving behavior is attributed to tradition. Therefore, the empirical relationship between personal saving and

labor force participation of the elderly, namely the proxy index of retirement, deserve more careful attention and clarification in the context of social security retirement benefits.

This paper is organized as follows. Section II contains a brief review of the social security program in Japan. Section III describes an analytical framework and a theoretical argument of variables. The empirical results are presented in Section IV. In Section V the study concludes by mentioning the potential importance of issues in relation to behavioral contexts of personal saving and labor force participation of the elderly, and to social security retirement benefits.

II. A Brief Review of the Social Security Program

Japan has dual and partially funded public welfare pension schemes. The Employee's Pension Insurance Plan (EPI) covers a majority of Japanese workers. These workers are employees of firms in industry and commerce with five or more employees. An employee in a non-corporate firm, even though it employs less than five employees, is still qualified for a voluntary coverage subject to approval. At age 60, EPI provides a labor earning related benefit financed by equal employer and employee payroll tax contributions. The EPI receives a payment from the general budget for one-third the amount transferred from the EPI to the NPI (the National Pension Insurance). A flat tax rate of 12.4% is applied to monthly labor earnings up to a maximum 710 thousand yen, the minimum being 68 thousand yen for male workers. The other is the National Pension Insurance plan (NPI) which covers any economically active Japanese workers not otherwise insured and self-employed. At age 65, NPI provides a universal flat basic benefit financed by the self-employed, non-employed adults, students (age 20 years and over), and contributions from the EPI which also includes contributions on behalf of nonemployed wives. NPI receives a subsidy from the general revenues amounting to one-third of benefit costs less transfers from EPI. The lump sum amount, 6,800 yen in 1986, is contributed monthly by the self-employed, nonemployed adults and students. The contribution will be gradually raised every year and employed persons and their spouses are exempted from the contributions. Benefits under both EPI and NPI are automatically adjusted for changes of 5% or more in consumer prices during a year or two years and more. Both require 25 years of contributions.

In addition to the two major public welfare pension schemes, a special system (mutual aid associations) covers local and national government employees, employees of agricultural and fishery cooperative associations, and private school teachers. There is also a special program for seamen. As shown in Table 1, both members and beneficiaries of EPI have constantly been increasing compared to other plans.

The receipts of the welfare pension tax (social security tax) are deposited in special treasury accounts (Trust Fund Bureaus) and the fund is managed by the Treasury Investment and Loans Division. As of 1985, the accumulated pension fund was 27,983 billion yen. The EPI and NPI reserves serve a public function. For the purpose of improving living conditions, the fund is used for housing, living environment improvements, small enterprises, culture, education, agriculture, forestry, fisheries, etc. The interest rates were fixed by the government at rates below market. The rate is now based on market rates after 1987 legislation. The proceeds of the interest payments are used for part of the administrative costs of the social security program.

The Employee's Pension Insurance plan was promulgated in 1941 and implemented in 1942 while the National Pension Insurance plan was promulgated in 1959 and implemented in 1961. Both EPI and NPI are partially funded public pension schemes. Since its inception, the EPI has evolved and implemented these programs: an introduction of minimum guarantee for survivors permanent disability benefits, an introduction of eligibility for social security retirement benefits while remaining on the job and an increase in benefits in

1965, an introduction of automatic price adjustment for benefits due to the 1973 oil crisis, and relaxations of qualifying conditions in 1976, 1978, 1979 and 1980. The benefits of EPI have increased markedly in 1965, 1973, 1974, 1975 and 1982. The NPI has also involved: an introduction of automatic price adjustment for benefits in 1974, a special payment of pension insurance for uninsured adult residents in 1978, a guarantee of minimum pension benefits for survivors and orphans in 1979, and an abolition of requirement of nationality in 1982. The benefits of NPI were greatly raised in 1974, 1975 and 1977 after the oil crisis.

The Japanese government made a major reform of the public welfare pension scheme (shown in the Appendix) in 1985 and implemented it in April 1986. The catalyst for this reform came from the inception and implementation of EPI in 1942 and of NPI in 1961. There are several reasons for the reform. While the estimated number of persons 65 and over is currently at 10% of the population, the government expects this number to rise to 17% by the beginning of the 21st century. The ratio of elderly to working-age population will sharply increase from 7 working persons for an elderly person who is 60 and over, to 3.5 working persons. Because of this concern, the future financial health of the public welfare pension program is threatened by drastically rising costs in the aging population. Because of increasing life expectancy, retirement years for beneficiaries are prolonged. Changes in the nuclear family and dwindling job opportunities cause financial hardships for the elderly. The Ministry of Health and Welfare has estimated that an ideal benefit amount should equal 68 percent of the average wage among workers. Unless the public welfare pension scheme changes, the combined employer-employee contribution for male workers would have risen from 12.4 percent in 1985 to above 40 percent in the 21st century. A reverse situation occurs when calculating an average net income between a beneficiary and a worker. In an effort to eliminate the redundancy of benefits and schemes of EPI and NPI (including four other mutual aid associations and a special program for seamen), the public welfare pension plan now covers all segments of the working-age population. The seamen's insurance system was merged with the EPI program in 1986. The dual public welfare pension program provides uninsured protection to all Japanese residents.

III. Analytical Framework

The empirical model of the paper is based on the extended life-cycle framework. Studies by Feldstein (1980), Hamermesh (1984), Mitchell and Fields (1984), Ando et al. (1986), Bernheim (1987), Moffitt (1987) and Modigliani (1988) demonstrate that this approach is the most common and useful framework for applied analysis to examine saving and retirement behavior. Saving and retirement behavior involve lifetime utility maximization with certainty. This study assumes that lifetime utility is intertemporally separable and that the interest effect exceeds the time preference effect. These simplifying assumptions are helpful and fairly innocuous to the life-cycle framework. Killingsworth (1986) thoroughly discusses the approach and the advantages of these assumptions.

Many recent applied analyses of life-cycle behavior have focused on saving and retirement behavior separately. Feldstein (1980) explicitly develops the extended life-cycle model treating the labor force participation rate of older men endogenously. Hamermesh (1984) addresses jointness in decisions about consumption and retirement. Consider a population group of elderly whose average labor force participation rate is 30 percent. This does not mean that 30 percent of the individuals among the elderly are almost always in the labor force and that the remaining 70 percent are almost completely retired individuals. Rather, it means that the same individuals (within this cohort) are sometimes in and sometimes out during the transitional period. Their participation rate tends to decline gradually as the individuals age. Therefore, one possible hypothesis is that within a sex, a population group of elderly has equal tastes and desires to offer the same amount of labor at any given wage rate and wealth. Its rate represents the behavior of market activity in a lifetime labor supply (i.e. the proportion of time spent in the labor force during the lifetime). Although the retirement decision is an individual decision, an analysis of the labor force participation of elderly workers is an analysis of retirement behavior (Boskin 1977). Although labor force participation of the elderly depends on other factors such as the proportion of people in the labor force, the aggregate data approach mitigates the difficulties in controlling for individual taste, computing a wage for nonworking population, and measuring an individuals health status (Duggan 1984, and Breslaw and Stelcner 1987). The eligibility age for social security retirement benefits was sixty before the reform of 1986 (as shown in the Appendix). This study uses the labor force participation of elderly aged 60 and over as a proxy measure of retirement in the population of those who expect to spend their lifetime economic activity in the labor force. Although there are other ways of using the labor force participation of the young or workers of all ages, the measurement biases are less severe if an implication regarding only retirement behavior is made by using the labor force participation of the elderly.

The extended life-cycle theory predicts that late retirement reduces personal saving during the preretirement period for consumption during a shortened retirement period, and vice versa. Higher social security retirement benefits reduce personal saving and induce earlier retirement, and vice versa.[6] The annuity value of the benefits does not change with the age of acceptance

because there is not a delayed retirement credit in Japan. Therefore delayed retirement time does not affect the amount of benefits. Needless to say, personal saving does not affect the social security retirement benefits. Burkhauser (1979) demonstrates that such a system will not cause a labor-leisure distortation. A choice of labor force participation of the elderly aged 60 and over becomes less of a selection problem as a variable of retirement behavior. The implication is that the amount of saving and social security retirement benefits exerts different influences on the quantity of lifetime labor supply. Conversely, labor supply and social security retirement benefits affect life-cycle saving. Consequently, a model should reflect not only the effects of social security retirement benefits upon the personal saving and labor force behavior of the elderly, but also the interactions between the two behaviors, i.e., saving and labor supply.[7] Saving and labor supply choices generally are represented by an individual i at time t,

$$S_i = f(LF_i, SS_i, SE_i) + e_{i1} \quad (8)$$

and

$$LF_i = z(S_i, SS_i, SE_i) + e_{i2} \quad (9),$$

where S_i is personal saving, LF_i is the labor force participation rate of men ages 60 and over to be a proxy variable to measure a retirement behavior of the elderly,[8] SE_i is a vector of socio-economic characteristics. SS_i represents social security wealth with two different techniques[9] for capitalizing benefit streams. The first one is actuarial valuation employing net social security wealth (SSN), gross social security wealth (SSG) and social security tax contribution (SST). The second is simple valuation employing present value method with non-constant interest rate by accumulating and discounting social security retirement benefits (SSAB), and social security tax contribution (SSAC). The e_{ij} in (8) and (9) are stochastic error terms, because there are components of personal saving and labor force participation of the elderly that are affected by unmeasured factors.

There are five aspects for capital resources: personal saving (household saving), corporate saving, government saving, private saving (the sum of personal and corporate saving) and national saving (the sum of private and government saving). There are various factors which influence behaviors of different types of saving. Each specialized study uses a different model and makes specific assumptions. To characterize Japanese high saving rate, personal saving is the most salient feature of saving behavior. Graham (1987) demonstrates a better description of personal saving behavior than the national one and he proves the consistency of statistical results with the life-cycle hypothesis. Thus personal saving seems to be a more behaviorally meaningful concept suggested by Ando (1986) than other types of saving.

In spite of finding the negative relationship between elderly labor force participation and saving by Feldstein (1980) and Modigliani and Sterling (1983), Ishikawa (1987) addressed the high labor force participation rate of the elderly in Japan as a major positive factor of the high saving rate. Horioka (1990), however, argues that it does not necessarily raise the overall personal saving rate from the views of life-cycle saving, and that the retirement age has a significant negative impact on personal saving. A high labor force participation of the elderly (i.e. later retirement) implies less need

for retirement assets and therefore a lower saving rate is a characteristic clue of the generalized life-cycle model. As for retirement, the elderly workers can not be characterized in terms of a simple dichotomy: full-time labor force commitment versus full retirement. Generally, a transitional period is closely associated with reduction in hours of work, weeks worked during the year, and labor force commitment. A declining labor force commitment is another sign of retirement commitment. If the retirement age in a population group is not specified, the labor force participation rate of the aged is measured as a proxy variable of a retirement rate of the aged.

The anticipated social security retirement benefits in old age are not only an important factor in household wealth, but also the major component of wealth in most retirement portfolios. With its compulsory government-directed saving program, the social security tax payment system produces future social security retirement benefits for retired workers during their retirement period and until dealth. The studies on effects of social security retirement benefits on saving in the United States has developed in the literature of Feldstein (1974), Barro (1978), Darby (1979), Leimer and Lesnoy (1982), Modigliani and Sterling (1983), Blinder, Gordon and Wise (1983), Modigliani (1986, 1988) and Kotlikoff (1988). The significant progress in the Japanese social security retirement program since the Second World War has not yet clearly revealed its influence on the behavioral pattern of personal saving. But everyone seems to agree that personal saving will be reduced by the availability of expected future social security retirement benefits by providing income for consumption during the retirement period, i.e., the "benefit effect," and personal saving will be increased by inducing earlier retirement caused by expected future social security retirement benefits. The earlier retirement means a longer period of retirement under a given life span. This requires an accumulation of saving during the working period: the "retirement effect." Thus, the net effect of social security retirement benefits on personal saving depends on the relative strength of these offsetting effects.

It is interesting to note that before April 1986, the Japanese social security system underwent a few major and a few minor institutional changes shown in Section II. An introduction of eligibility for social security retirement benefits while remaining on the job and a leap in benefits in 1965, and an indexation of benefits to the price level in 1973 were major changes. The variable SS (SSN or SSG or SST or SSAB or SSAC shown definitions of variables in Table 3) denotes a social security wealth variable. The variable SS*D1 reflects 1965's development of the program and is used to estimate a different slope of the segments before and after 1965. SS*D2 indicates the social security wealth variable multiplied by two dummy variables such as DX = 1 for 1965 through 1982 and zero otherwise, and DY = 1 for 1973 through 1982 and zero otherwise and observes the slope of the regression line after 1973. Needless to say, incorrectly omitting a reflection from the institutional change term will lead to a specification bias.

Personal disposable income or labor, nonlabor income and tax would measure the current flow of resources available to the household sector for consumer expenditures and saving in addition to financial assets by households.[10] Boskin and Kotlikoff (1985) point out that the strict life-

cycle model is not enough to explain the United State's saving behavior. Therefore, this study expands the life-cycle model by employing additional explanatory variables.

One aspect of the variable of life expectancy is that public opinion surveys find that preparation for illness and other unexpected emergencies are the motives for saving in Japan. Risk aversion and precautions are Japanese characteristics demonstrated by Horioka (1988). An increase in life expectancy is a proxy measurement of healthiness, i.e. less illness and it would reduce personal saving. A similar line of argument is provided by Horioka (1990) that the ratio of the population of the aged to the working-age population has a significant negative impact on the saving rate. An increase in life expectancy which stems from healthiness, contributes to the aging population. Thus the life expectancy would have a negative influence on saving. One may argue that an increase in life expectancy will increase the period of retirement and necessitate more saving for the prolonged retirement period. This view of the argument is an interesting theoretical consideration but the argument is a weak one, which is proved theoretically by Graham (1987). As for an influence of life expectancy on labor force participation Hamermesh (1984) observes that an increasing life expectancy does not lead to a lengthening of the average person's work life. In his U.S. study on the jointness of leisure and goods consumption in household production, he found that the extra years of life are consumed as leisure. Seike (1982) finds similar results in his empirical study on Japan. For these studies we can conclude that an increase in life expectancy has a negative influence on the labor force participation of the elderly. Life expectancy as a proxy measurement of healthyness may have a positive influence on working life, namely, late retirement, although the health variables used by Hausman and Wise (1985), Honig and Hanoch (1985) and Burtless (1986) are the self-assured health report from individual survey data on the U.S. studies.

Financial assets are characterized by great divisibility, namely, great liquidity. More recently, in Japan, financial assets have been creating additional wealth in household portfolios. It seems that the lower- and middle-income classes are stimulated and motivated to enter the liquid assets market formerly targeted exclusively for the higher income class, as well as for corporations preferring to deploy their holdings in more speculative investments. In particular, the amount of financial assets held by households has more than tripled in Japan since 1975. Noland (1988) analyzes Japanese portfolio allocation behavior and finds substitutes between financial assets, and money and time deposits. Unlike non-liquid assets, such as expected social security retirement benefits for the retirement period, financial assets may exert a negative effect (see Burtless 1986) and a different magnitude on the labor force participation of the elderly, i.e., the retirement decision. For the variable of education, the more general argument is that investments in human capital raise the return to additional years of work. The more educated tend to retire later and to save more. The empirical evidences on the U.S. studies show the positive relationship between educational attainment and the elderly labor force behavior (Ouggan 1984, Housman and Wise 1985, Honig and Hanoch 1985, and Slade (1987).

Unlike the United States, housing acquisitions stem from non-pecuniary motives in portfolio allocation by households and housing is less liquid in

Japan. Evidence from the U.S. study by Hayashi, Ito and Slemrod (1987) shows that just the opposite seems to occur in the United States. Housing acquisition behavior and financial assets should separately be analyzed to see an influence on saving behavior. Japanese housing conditions are still inadequate, and people want to own a house within their lifetime (Takayama, 1982 and Shinohara, 1983). This desire stems from a basically agricultural, national characteristic which has historically influenced the behavior of holding physical assets by households. In Japan, physical assets such as housing, are usually held for life and for the purpose of bequests in the life cycle framework rather than for the speculative purpose of wealth accumulation, as often occurs in the United States.[11] This bequest purpose of obtaining one's own house seems to stimulate personal saving and then the saving declines at acquisition or purchase time. Modigliani (1986) points out that the consideration of bequest motives in the life-cycle framework is consistent, although during the retirement period assets decline and reach zero in the basic life-cycle hypothesis.[12]

Retained earnings are business saving in the private sector and proxies for current and future capital gains. They are treated as exogenous with respect to the personal saving decision because there are separate incentives governing the behavior of household and corporate sectors (Auerbach, 1982). Retained earnings can be considered a measure of saving whether or not they arise from pension plan contributions. They represent an additional investment in corporate equity by stockholders. Looking at retained earnings another way, we might find that retained earnings imply a substitution for personal saving (Modigliani and Sterling, 1983). Business firms accumulate retirement pension allowances for their employees and transfer retirement pension allowances into retained earnings in Japan. Increased retirement pensions undertaken by business firms for their workers tend to discourage workers from personal saving because of an increase in anticipated retirement pensions provided by the firm in the future. Therefore the effect by retained earnings on personal saving is ambiguous.[13]

The labor force participation rate of elderly women has been growing over the past decade.[14] The question is whether the increase affects the elderly male labor force participation or not. It is important to understand the issues of the elderly labor market and the cost of social security retirement benefits. Retirement studies by Honig and Hanoch (1985) and Hurd (1988) find that wives in the labor force positively affect the male labor force participation, namely later retirement in the United States. The effect of the total level of agricultural employment on labor force participation of the elderly takes several possible forms. High agricultural employment is often believed to encourage high labor force participation of the elderly because self-employment allows a varying choice of work hours and work intensity, and it has no mandatory retirement age or company pension system to encourage retirement at a specific age. Alternatively, retirement from full-time agricultural employment may be easier because it is less costly to care for the aging period on a farm than in urban settings.

Households are very concerned with not only current but also future inflation. A surge in inflation will reduce a real value of household wealth and induce households to increase their saving to maintain the real value of

wealth. This view is explained by Sato's (1987) wealth target hypothesis. On the other hand, inflationary expectations will reduce a real rate of return on saving and in turn induce households to reduce their saving (Horioka, 1987). Rampant inflation causes an increase in uncertainty about the future. This phenomenon may raise a precautionary purpose for saving. The foremost external factors were factors such as the oil crisis of 1973-74 and 1979-early 1980s. The first oil crisis of 1973-74 raised the personal saving rate and the second oil crisis did not raise the rate but rather saving declined in Japan. The relation between inflation and personal saving seems to be a short-term factor as Sato (1987) discusses. Sato gets positive results in the analysis of financial-asset wealth target. The influence of inflation on household saving is theoretically ambiguous and leads to a qualitative and quantitative conclusion. Therefore, this analysis includes a dummy variable to distinguish an inflationary period. To differentiate the oil crisis from the rest of period D3 = 1 is used for observations from 1973 to 1982 and zero otherwise.

The main data used to estimate the model are annual data from Annual Report on National Account covering the period from 1951 to 1982. Since national income series are revised a few times, the series before 1951 is poor in quality, and the next series starting from 1951 runs into the 1970s, the data of analysis start at the year of 1951. The latest version is very extensive and goes back to 1965. Therefore, the study includes a dummy variable to identify and to treat the data series as D4 = 1 for 1965 through 1982 and D4 = 0 otherwise. Other data have been taken from the Labor Force Survey for labor force participation, Social Insurance Agency Annual Report for social security wealth, Vital Statistics of Japan for life expectancy, Economics Statistics Annual for price index and interest rates, Educational Statistical Survey for educational attainment. All data are annual observations, and the time period of analysis is from 1951 to 1982. A list of variables used and their summary statistics are given in Table 3 and Table 4, respectively. The data of personl saving, male labor force participation aged sixty and over, disposable income and social security wealth variables are in Table 5.

IV. Empirical Results

The data used to estimate the model is an annual time series covering the period from 1951 to 1982. The simultaneous equation model consists of an equation for personal saving and an equation for labor force participation of men ages 60 and over. Tables 2-1 and 2-2 present the results obtained from two-stage least squares (2SLS) with correction for serial correlation.[15] In order to compare the results of two different techniques for capitalizing social security wealth streams, model I (SSN), model II (SSG) and model III (SST) in Table 2-1 pertain to actuarial valuation and model I (SSAB) and model II (SSAC) in Table 2-2 pertain to simple valuation. An overview of the results in Tables 2-1 and 2-2 indicates that all the estimated coefficients of saving and labor force have the anticipated signs. The coefficients of primary interest, that of saving and labor force, confirm that an increase in labor force participation of the elderly, i.e., later retirement, reduce personal saving and an increase in personal saving induces earlier retirement, namely, lower labor force participation of the elderly. In most cases the magnitude and significance levels of the the saving and labor force coefficients do not vary dramatically between the two specifications. The results support the arguments of Feldstein (1980), Ando, Yamashita and Murayama (1986), Bernheim (1987), and Horioka (1990) that the determination of the saving and retirement decisions certainly seem to be endogeneous. The estimated coefficients on personal saving and the labor force participation rate of the elderly are statistically significant and support the hypothesis of interdependency of personal saving and retirement. One percentage point decrease in the the labor force participation rate, namely earlier retirement, tends to stimulate the the personal saving rate from .4 to .6 percentage points. The coefficients in the saving equations ranging between -.4 and -.6 imply very meaningful sensitivity of personal saving to this measure of retirement behavior. The cross-county study by Graham (1987) shows statistically insignificant and smaller positive coefficients with ordinary least-square estimates. The similar study by Feldstein (1980), however, indicates the negative impact on personal saving ranging from -.3 to -.6 with two-stage least-squares estimates. Horioka (1989) finds the range between -.4 and -.6 by parameter estimate based on data for 1976-1982 period of the 21 OECD countries. The point elasticities evaluated at the sample means are -2.5 (1951-1964), -1.9 (1965-1972), and -1.4 (1973-1982) on average. Although the elasticities are elastic, declining elasticities show that personal saving behavior tends to become less and less responsive to changes in retirement behavior. In the columns of labor force in Tables 2-1 and 2-2 one percentage point increase in the the average personal saving rate encourages the elderly to leave the labor market in the range between .26 and .69 percentage points. A decrease in the labor force participation of the elderly means earlier retirement. In terms of elasticity with different periods, the point elasticities of labor force participation of the elderly with respect to personal saving at the sample means range from -.05 to -.13 between 1951 and 1964, from -.07 to -.18 between 1965 to 1972, and from -.09 to -.23 between 1973 to 1982. In general, an increase in elasticities implies that although very small, the retirement behavior gradually becomes more responsive to change in personal saving.

The estimated coefficients of social security wealth variables are one of principal interest in this analysis. Estimated coefficients in both saving and labor force equations are generally qualitatively consistent with both actuarial valuation in Table 2-1 and simple valuation in Table 2-2. The estimated coefficients of Model III SST in Table 2-1 and Model II SSAC in Table 2-2 are normally larger than SSN, SSG and SSAB. However, quantitative differences based on actuarial and simple valuations are quite similar between SSN and SSG measurement and SSAB measurement, and between SST measurement and SSAC measurement. The results of this study provide that two different techniques for capitalizing social security wealth streams possibly have similar depressive effects on personal saving. With respect to the effect of social security variables on saving the estimated coefficients of the time-series analysis are smaller than the studies done by Noguchi (1983): .010 ~ .148, and Sasaki and Tachibanaki (1985): .14 ~ .291, using the data of Family Saving Survey in Japan. For the studies of cross-section of countries, Feldstein (1980) reports .21 ~ .37 and Graham (1987) shows .02 ~ .09. U.S. studies on the effect of saving is in the range between .03 and 0.117 by Munnell (1974) by using time-series data, and in the range between .695 and .941 for individuals and .773 ~ 1.37 for couples by Bernheim (1987) by using Longitudinal Retirement History Survey. The results in this study cannot be simply compared with those previous results done by Japanese and U.S. researchers shown in Table 2-3 because the units of value are different. Evidence presented in this study suggests that a 1 percent increase in social security retirement benefits depress personal saving during 1973 and 1982 from 2 percent to 3.7 percent. Personal saving in Japan is very sensitive to a change in the social security retirement benefits.

What is of special interest in the regression results is to examine the implications for personal saving. Before the introduction of eligibility for social security retirement benefits while remaining on the job and a large leap of the benefits in 1965, the social security retirement benefits had a positive effect on personal saving, shown by the SS variables in the saving equations in Tables 2-1 and 2-2. During the period of 1951 through 1964, personal saving increased approximately 2.3 thousand yen per capita in the saving equation of Model I SSN. The major change in the program in 1965 negatively affected saving behavior which is represented by the SS*DI variable in the saving equations. With the similar calculation in Model I SSN, the increase in SSN over the period of 1965 through 1972 resulted in approximately a 2.8 thousand yen reduction on personal saving per capita in real terms. The next wave of change was the introduction of automatic price adjustment for benefits in 1973, because of the oil crisis, and the benefits also increased in that year. The personal saving per capita in real terms decreased by approximately 13.0 thousand yen during the period of 1973 through 1982. The net reduction of benefits during the period of 1951 through 1982 was approximately 13.5 thousand yen per capita.

Saving equations in Tables 2-1 and 2-2 show that a reduction in labor force participation, (i.e., earlier retirement), makes individuals in the preretirement period save more for consumption during a prolonged retirement period. The estimated impact on personal saving by earlier retirement was about a 21.2 thousand yen increase in personal saving per capita in real terms

from 1951 to 1964, a 55.6 thousand yen increase from 1965 to 1972, and a 97.8 thousand yen increase from 1973 to 1982. Hence, during the period from 1951 to 1982, the absolute amount of the upward impact on personal saving was a 174.6 thousand yen increase, which was about thirteen times of the amount of upward impact of the social security retirement benefits in saving equation Model I SSN. However, as shown in footnote 7, to discuss a retirement effect the estimated coefficients on social security variables in the labor force equation should be examined to avoid downward bias. The retirement effect from 1951 through 1982 is aproximately .5 thousand yen per capita. The net impact on personal saving during the year of 1951 through 1982 was a reduction in personal saving by 13.0 thousand yen per capita (SSN). Similar calculations for the net impacts from the statistical results provides a 10.7 thousand yen reduction (SSG), a 59.4 thousand yen (SST), a 12.1 thousand yen (SSAB), and a 86.4 thousand yen (SSAC). The downward impact of SST and SSAC models are about five or seven times as great as SSN, SSG and SSAB models. Unlike the assertion by Bernheim (1987), the results of this study find that actuarial valuation compared to simple valuation does not tend to overstate the incentive effects of social security retirement benefits on personal saving. In Japan, the benefit effect outweighs the retirement effect and the net effect is consequently a downward pressure on personal saving.

The coefficients of SS*D1 (an introduction of eligibility for benefits while remaining on job and other developments in the program in 1965) and SS*D2 (an introduction of automatic price adjustments for benefits in 1973) in labor force equations in Tables 2-1 and 2-2 are negative as expected. The coefficients are small and similar to Saike's (1982) finding (-.002 ~ -.003) in a Japanese study. Using the method of actuarial valuation, Slade (1987) has -.001 and Burkhauser (1979) shows a range from -.002 to -.011 in the U.S. studies. In this study, an increase in social security retirement benefits by one thousand yen induced the elderly to retire in the range between .001 and .03 percentage points during 1965 through 1972, and in the range between .002 and .08 during 1973 through 1982. The impact seems to be small. Put differently the point elasticities of labor force participation of the elderly with respect to personal saving at the sample means are in the range between -.05 and -.1 during 1965 through 1972 and -.2 to -.6 during 1973 through 1982. A one percent rise in the benefits induced the elderly to leave the labor market by a .2 percent to a .6 percent after 1973. An increase in the elasticity from the period of 1965-1972 to 1973-1982 implies that the retirement behavior becomes more sensitive and responsive to a rise in the social security retirement benefits, though the results indicate a quantitively small response.

The estimated coefficients on the variable indicates that the disposable income is negative in the saving equations. The negative sign shows that the elasticity of the average personal saving rate with respect to disposable income is smaller than one. Two saving equations in Table 2-2 have only statistically significant coefficients. The negative coefficients of disposable income in the labor force equation in Table 2-2 suggests a decrease in labor force participation, namely life time labor supply, as income level rises.

An overview of the results in Tables 2-1 and 2-2 indicates that all estimated coefficients of Life as a proxy measurement of healthyness have the

anticipated signs. In most cases the magnitudes and significance levels of the coefficients do not vary dramatically among the saving equations. Although motivations for saving are interchangeable within the range of lifetime planned saving, motivations come from several sources, such as precautionary purposes, speculative purposes and life-cycle purposes. The precautionary motive for illness would weaken as health status improves. The relative importance of motives for household saving is seen in Horioka (1988) and this econometric empirical result is congruent with his survey data demonstration. The point elasticities evaluated at the sample means are in the range between -1.88 and -2.16. One percent increase in life expectancy, namely healthiness, reduces personal saving from a 1.88 to a 2.16 percent. One way to gauge the magnitude of estimation is to assume 40 years of accumulated personal saving lower by from 91 to 104 thousand yen per capita at the sample means by the age of sixty. The recent figures will be much larger using current data than the statistical sample means. For labor force equations the result of the life variable is consistent with the hypothesis of the jointness of leisure and consumption in the life-cycle context formulated by Hamermesh (1984). The estimated negative coefficients show that a one percentage point increase in life expectancy reduces labor force participation of the elderly by the range of from 1.3 to 2.1 percentage points. An increasing life expectancy alone does not lead to substantial postponing of economic activity in the labor market. Seike (1982) also finds the negative effect of increase in aging on labor supply in the Japansese study. The elderly tend to change from income preference to leisure preference as they age. Put differently, the extra years of life are consumed as leisure.

Financial assets have a negative effect on labor force participation and a one percentage point increase in the average financial asset rate causes about a .5 percentage point decrease in the labor force participation in Table 2-2. The effect is significant in Japan. The study on the U.S. by Burtless (1986) also finds that the average retirement age is 1.1 years earlier among the elderly who have assets of $25,000 and more than the wealth holder with less than $25,000. The estimated coefficients of education are theoretically consistent and positive in saving and labor force equations as expected but almost always insignificant unlike the study on the U.S. done by Hausman and Wise (1985), Honig and Hanoch (1985), and Slade (1987).

The negative coefficients of housing are congruent with the study done by Noland (1988). Noland finds the substitute between saving and housing in his portfolio analysis of Japanese households. Looking at average personal housing expenditure rate another way, the results in Table 2-1 means that a one percentage point increase in housing expenditure rate lowers the personal saving rate between 2 and 2.5 percentage points. An increase housing expenditure is also partly a reflection of the growth of the housing stock. Therefore it implies less need for saving for bequest purposes (Modigliani 1986). The negative coefficient suggests that the point elasticity of the average personal saving rate with respect to the personal housing expenditure rate is less than one. As for retained earnings, the extended life-cycle saving in this study reflects the impact of the average rate of corporate retained earnings on personal saving. As proxies for current and future capital gains, retained earnings have a short-run effect on personal saving in

addition to their long-run wealth effect. The coefficients are qualitatively consistent in Tables 2-1 and 2-2. The positive coefficients in Table 2-1 show that a one percentage point increase in retained earnings raises the average saving rate about .5 percentage point. However, the retained earnings variable is likely to be an underestimate of net corporate saving. The qualitative results seem to show a complementarity between personal saving and retained earnings.

Turning attention to the female labor force, the estimated coefficients on the variable indicating the female labor force in the labor force equations are statistically significant and positive for all models. The magnitude of coefficients implies that a one percentage point increase in female labor force participation, aged 60 and over, would lead to a rise in the male labor force participation, aged 60 and over, by from .5 to .8 percentage points. The elderly tend to retire later. The results suggest ideas similar to those posited in U.S. studies. Honig and Hanoch (1985), and Hurd (1988) analyze elderly male workers' retirement behavior and how a wife in the labor force affects the retirement of male counterparts and joint retirement of the elderly. The probability of retirement decreases by from .3 to .4 when a wife is in the labor force in the U.S. (Honig and Hanoch). The effect in a similar study on the U.S. by Hurd is .47. Although the explanatory power in this study is different from the U.S. studies, the implication suggests the complementarity of leisure by male and female elderly workers in Japan. Agriculture's coefficient is positive and statistically significant in the labor force equation in Table 2-2. This suggests that the decline in the agricultural sector reduces the labor force participation of the elderly.

The ratio of personal saving to personal disposable income was above 21% from 1973 through 1978 after the unexpected oil crisis that caused higher inflation in the 1970s and early 1980s. The variable D3, a dummy variable, distinguishes an inflationary period from the rest of the period. The estimated positive coefficients on an inflationary period, D3, in both the personal saving and labor force participation equations indicate that the deviation of real saving and income from its normal position will make the individual anxious about future prospects. Therefore an increase in uncertainty caused by high inflation makes the individual motivated to increase personal saving, and to stay in the labor market. Horioka (1989) also finds a positive effect of inflation on the private saving rate by using the data of the 21 OECD countries for 1976-1982. The coefficients on D3 in the labor force equations are positive and statistically significant. The results imply that an increase in a price level, namely, higher inflation, has an effect on labor force attachment among the elderly. As for D4, it is a dummy variable denoting the Annual Report on National Account for New SNA data as explained in Section III. The results indicate a positive effect of New SNA data on the interpretation of personal saving and labor force participation by treating the series of data for New SNA. The results are in the range between 16 and 22 percentage points in saving equations and 8 and 9 percentage points in labor force equations in Table 2-1.

V. CONCLUSIONS

The paper examines the impact of social security retirement benefits on personal saving and the labor force participation of the elderly, and also on the interdependency between saving and retirement behaviours. The results underscore the qualitative and quantitative importance of the social security retirement benefits. Calculations based on actuarial and simple valuations (two different techniques for capitalizing the streams of social security retirement benefits) provide quantitatively similar depressive effects on personal saving. Considering the two major changes in institutional programs in 1965 and in 1973 the benefit effect outweighs the retirement effect between 1951 and 1982. The results indicate substantial evidence of the downward net impact on personal saving; approximately a 11.9 thousand yen per capita reduction resulted from the wealth measurement (SSN, SSG and SSAB) and about a 72.9 thousand yen per capita reduction on average resulted from tax contribution measurement (SST and SSAC). Moreover, the point elasticities evaluated at the sample means are elastic and quite large. The finding implies that the personal saving is very responsive to changes in the social security retirement benefits. The study also presents evidence with respect to the potential importance of the effects of social security retirement benefits on life-cycle labor supply. The eligibility of the benefits induce the elderly to leave their jobs or to restrict market work and thereby reduce the labor force participation of the elderly, which results in earlier retirement of older workers.

One of the important conclusions of the analysis is that there exists interdependency between personal saving and labor force participation of the elderly. Saving behavior became less and less responsive to change in labor force participation of the elderly between 1951 and 1982, while the labor force participation of the elderly, i.e., retirement behavior, came to be more responsive to change in personal saving. However, the results of personal saving behavior influenced by social security retirement benefits and labor force participation of the elderly (proxy indication of time of retirement) reveal higher sensitivity with elastic elasticity than the results of labor force participation of the elderly influenced by the social security retirement benefits and personal saving with inelastic elasticity.

It is interesting to note that an increase in life expectancy, i.e., an improvement in healthiness, reduces emergency funds which stems from the Japanese characteristic of saving motivated by precaution. However, an increase in life expectancy does not encourage the elderly to remain in the labor force. They prefer to enjoy leisure in the extra years of life rather to than earn income from economic activity. Although far from explicit, the results provide an explanation of joint retirement. Because a rise in elderly female labor force participation does not expel the elderly male from the labor market, but rather complements it. The estimated coefficients on inflation have a positive effect on both personal saving and labor force participation of the elderly. An increase in uncertainty and deviation of real saving from its normal position stimulate personal saving. A rampant inflation also causes a strong labor force attachment among the elderly.

Individuals contemplate the amount of their own future social security retirement benefits for the retirement period. The motivation for saving is much more complex than simply for purposes of retirement. And many factors also influence retirement behavior. However the recent development of a social security program in Japan substantially depresses personal saving and induces an earlier retirement of older workers. The policy implications of the findings are clearly visible. For instance, a rise in eligibility and the amount of social security retirement benefits and a rise in the social security retirement tax which is closely linked to the future retirement benefits, would vastly reduce personal saving and clearly induce later retirement. The policies would make the elderly stay in the labor market because the results in this study signify a relatively small response of retirement behavior to a change in personal saving and social security retirement benefits. Moreover, to mitigate the fears of the elderly for their financial problems during their retirement period, an increase in the retirement benefits is fundamental. A gap between the eligibility of age for the benefits and actual retirement among the elderly may require an initiative of the government and the private sector's cooperation in terms of an employment policy for the elderly.

FOOTNOTES

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1. Hayashi (1986), Horioka (1990), and Ohmae (1988) explicitly discuss personal saving in terms of valuing depreciation, capital transfer, interest paid by household, housing investment, and capital gains and losses in the case of the United States and Japan.
2. CCSP/BOJ Survey is done by the Central Council for Savings Promotion (Chochiku Zokyo Chuo Iinkai), a private but government-encouraged organization, with the assistance of the Bank of Japan.
3. Feldstein (1974; 1982), Feldstein and Pellechio (1979), Munnell (1974), and Darby (1979) find a significant negative effect of social security retirement benefits on personal saving, whereas Barro (1978), Blinder, Gordon and Wise (1983), Leimer and Lesnoy (1982), Lesnoy and Leimer (1985), and Modigliani and Sterling (1983) find it to be insignificant. A cross-country test by Graham (1987) also finds an insignificant impact of social security upon private saving unlike Feldstein (1980)'s findings.
4. Horioka (1990) suggests that a high labor force participation, namely the late retirement in Japan, may have a negative influence on personal saving.
5. Graham (1987) conducts an interesting econometric test by using the labor force participation rate of females as an endogeneous variable with two-

stage least squares.

6. Boskin (1977) stresses that social security retirement benefits influence the elderly to leave the job or to restrict market work, thereby reducing the labor supply of the elderly (see Pellechio 1979, Burtless and Moffitt 1984 and 1985, Hurd and Boskin 1984, Mitchell and Fields 1984, and Burtless 1986, which support this induced retirement effect).

7. The omission of a LF variable from the model would cause the estimated coefficient on the SS variable to be biased towards zero. To be specific consider the following variables model:

$S = \alpha_0 + \alpha_1 SS + \alpha_2 LF$ 1,

where S is personal saving, SS is social security retirement benefits and LF is labor force participation variables. $\alpha_1 < 0$, and $\alpha_2 < 0$.

If we omit LF, the estimate is

$S = \hat{\alpha}_0 + \hat{\alpha}_1^* SS$ ..... 2.

From equation 1,

$\Sigma S.SS/\Sigma SS^2 = \alpha_1 + \alpha_2 \Sigma LF.SS/\Sigma SS^2$ ..... 3.

Fron equation 2, we get

$\Sigma S.SS/\Sigma SS^2 = \hat{\alpha}_1^*$ ..... 4.

Based on the omitted variable formula we have

$\hat{\alpha}_1^* = \alpha_1 + \alpha_2 b$ ..... 5.

Where $\alpha_1 < 0$, $\alpha_2 < 0$, $b < 0$, and $\alpha_2 b > 0$. b is the regression coefficient of LF on SS ($LF = b_0 + bSS$).

If magnitudes of α_1 and $\alpha_2 b$ are equal, both offset each other. $\hat{\alpha}_1^* \approx 0$.

$\hat{\alpha}_1^*$ tends to bias toward zero, if F is omitted from the saving function.

8. Individual private pensions are still at an early stage in Japan and the data are not available to integrate the variable into the model. The

expected influence of this factor on retirement and on saving behavior may be clearly visible. Difficulty to reconstruct the variable and to verify the influence empirically stems from inadequate data.

9. The social security wealth variable in this study employs gross social security wealth (SSG) constructed as follows: the SSG of the typical individual of age a is defined as

$$SSG_a = \int_{K(\geq 60)}^{T} \lambda b_t (K-Z) Y_t L_{t|a} e^{-r(t-a)} dt,$$

where T is a maximum life time, K is a retirement age, 60 is an eligible age for social security retirement benefits, λ is a growth rate of per capita income, b is a base rate of retirement benefit which is assumed to be same for each person with same income level, Z is an age of beginning to work, Y is an annual disposable income, $L_{t|a}$ is probability of an individual of age a surviving until t, and r is the discount rate. Social security tax contribution (SST) of an individual of age a is defined as:

$$SST_a = \int_{Z}^{a} R_t Y_t e^{-r(t-a)} dt + \int_{a}^{K(\geq 60)} R_t Y_t L_{t|a} e^{-r(t-a)} dt,$$

where R is a ratio of social security tax per covered worker of age a to per capita disposable income. The net social security wealth (SSN) of an individual age is obtained as:

$$SSN = \int_{K(\geq 60)}^{T} \lambda b_t (K-Z) Y_t L_{t|a} e^{-r(t-a)} dt - \int_{Z}^{a} R_t Y_t e^{-r(t-a)} dt - \int_{a}^{K(\geq 60)} R_t Y_t L_{t|a} e^{-r(t-a)} dt.$$

In constructing the social security wealth variable, Leimer and Lesnoy (1982) and Lesnoy and Leimer (1985) suggest modifying the original social

security wealth variable used by Feldstein (1974) and Munnell (1974). This study takes into account the suggestion by Leimer and Lesnoy (1982).

10. Hall (1978) intensively discusses the lagged level of disposable income, namely past income, which has lack of predictive power for consumption, namely saving, in the context of the life cycle-permanent income hypothesis.

11. In 1983, 72.2 percent of the declared value of bequests were in the form of housing which includes land (Dekle 1986).

12. Horioka (1988) emphasizes that a household which obtains a house within five years has a higher saving rate because of a housing loan than other households. Japanese banks require about 32% (a relatively high down-payment) for the purchase of a house, compared with the 10% to 20% typically required by U.S. banks. Thus Japanese households have to save in advance to purchase a house due to the uneasiness of consumer credit. It is quite possible that the recent increasing availability of housing loans would also decrease a housing purpose saving in the life cycle framework in Japan.

13. The data for business firms' accumulated retirement pensions for workers and individual private pensions are not available to integrate the variable into the model for this study. The expected influence of these factors on the labor force participation and on the saving behavior may seem obvious. It is, however, extremely difficult to reconstruct and verify the influence empirically because of inadequate data.

14. The Labor Force Participation of Women Fujin Rodo no Jitsujo. The Department of Labor, 1982, 1984, 1987 and 1988.

15. In the model of simultaneous equations in this study, in order for the equation to be identified, the order and the rank conditions of identifiability was examined. The equations are overidentified and the rank condition is satisfied. Therefore, a choice of consistent estimation in the study is two-stage least squares (2SLS). For detail, see Damodar N. Gujarati, Basic Econometrics, McGraw-Hill, 1988, pp. 577-607, and Jan Kmenta, Elements of Econometrics, Macmillan, 1986, pp. 660-689.
The study controlled for the National Pension plan by using a dummy variable beginning in 1961. The coefficient was statistically insignificant, with little qualitative and quantitative changes. The reason being the functional characteristics of the program (explained in section II and Appendix). The dummy variable was deleted from the regression analysis.

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Appendix

The Reform of Employees Pension Insurance (EPI)
and National Pension Insurance (NPI) in 1986

	EPI	
	Before April 1986	After April 1986
COVERAGE	* Employees of private firms in commerce and industry with 5 or more employees * Firms less than five employees with voluntary coverage subject to approval	* Employees of private firms in commerce and industry * Non-corporations less than five employees with voluntary coverage subject to approval
QUALIFYING CONDITIONS	* Age 60 (men) * Age 55 (women and miners) * 20 years contribution (15 years under special condition) * 35 scales of average standard remuneration * Age 60-64 Pension reduced 20% of labor earnings between 45 and 97 thousand yen a month Pension reduced 50% of labor earnings between 98 and 133 thousand yen a month Pension reduced 80% of labor earnings between 134 and 159 thousand yen a month Pension reduced 100% of labor earnings beyond 160 thousand yen a month * Age 65- Pension reduced 20% of labor earnings more than 160 thousand yen a month	* Age 65 (men) * Age 60 (women) Gradual increase from 55 to 60 by the year 2000 * Age 55 (miners and seamen) * 25 years contribution * 39 scales of average standard remuneration * During the transitional period Pension reduced 20% of labor earnings between 70 and 95 thousand yen a month Pension reduced 50% of labor earnings between 95 and 155 thousand yen a month Pension reduced 80% of labor earnings between 155 and 210 thousand yen a month Pension reduced 100% of labor earnings beyond 210 thousand yen a month * Age 65- Pension reduced 20% of labor earnings more than 210 thousand yen a month

Appendix (continued)

	EPI	
	Before April 1986	After April 1986
RETIREMENT BENEFITS	* = 2,050 yen x months of contribution x 1.183 + average standard renuneration per month x 10/1000 x months of contribution x 1.183. (The months of contribution are 240 months for contribution periods less than 240 months and are 420 months for contribution periods more than 420 months in the first part of equation before + sign)	* = Average standard remuneration per month x (10/1000 ~ 7.5/1000) x months of contribution. (Average standard remuneration is revalued average lifetime monthly earnings.) (A 20-year phase-in period for part of (10/1000 ~ 7.5/1000) during the transitionary period)
	* Dependents supplements: 15 thousand yen a month for spouse, 5 thousand yen a month for each 1st and 2nd child, 2 thousand yen a month for each other child up to age 18 or invalid child.	* Dependents' supplements: 15 thousand yen a month for spouse up to age 65, 15 thousand yen a month for each 1st and 2nd child, 5 thousand yen a month for additional children up to age 18 or invalid child. (50 thousand yen for spouse after age 65)
	* Automatic cost-of-living adjustment for consumer prices.	* Automatic cost-of-living adjustment for annual changes of 5% or more in consumer prices.
SOURCES	* 6.2% (men since 1985)	* 6.2% (men)
	* 5.65% (women since 1985)	* 5.6% (women) (Rate for women to increase gradually until it reaches the same level as that of men in 1993)
	* 6.8% (miners since 1985)	* 6.8% (miners)
	* Same as for insured persons (employers)	* Same as for insured persons (employers)
	* 20% of benefit costs from the general budget subsidy	* A payment from the general budget for one-third the amount transferred from the EPI to the NPI

Appendix (concluded)

	NPI	
	Before April 1986	After April 1986
COVERAGE	* All residents in Japan aged 20-59 * Except for the insured by other programs and those spouses	* All adult residents in Japan, regardless of nationality, ages 20-59 * Option available for aged 60-64 * Option available for Japanese nationality aged 20-64 in foreign countries
QUALIFYING CONDITIONS	* Age 65 * 25 years (a sum of contribution and exemption periods) (A reduction in qualifying period subject to a birth date) * Pension payable between age 60-70 with actual deductions and increases by law 26, clause 2. Deductions 60(48%), 61(35%), 62(28%), 63(20%) and 64(11%). Increases 66(12%), 67(26%), 68(43%), 69(64%) and 70(88%).	* Age 65 * 25 years (a sum of contribution and exemption periods) (a reduction in qualifying period subject to a birth date) * Pension payable age 60-70, same as before April 1986 by the law.
RETIREMENT BENEFITS	* = 1680 yen x months of contribution x 1.183 + 1,680 yen x months of exemption x 1/3 x 1.183). (There is a special benefits calculation for beneficiary who contributes for a short period) * Automatic cost-of-living adjustment for consumer prices.	* 50 thousand yen a month * Beneficiary who contributes less than 480 months (600 thousand yen x (months of contribution + months of exemption x 1/3) ÷ 480 months) * Automatic cost-of-living adjustment for annual changes of 5% or more in consumer prices.
SOURCES	* 6,740 yen a month * the general budget subsidy amounting to 1/3 of benefit costs.	* 6,800 yen a month (a gradual increase in every year) * The general budget subsidy equal to 1/3 of NPI benefit cost less transfer EPI.

Table 1

Coverage and Beneficiary of Public Welfare Pension in Japan
(thousands)

	1977		1981		1984		1986	
	Member	Beneficiary	Member	Beneficiary	Member	Beneficiary	Member	Beneficiary
EPI	23,847	2,803	25,239	4,618	26,363	6,141	27,068	7,246
NPI	26,469	8,812	27,596	10,417	25,727	10,805	25,090	11,373
Government employees	4,962	1,025	5,165	1,391	5,184	1,533	5,076	2,167
Agricultural and fishery cooperative associations	444	54	473	86	485	128	488	152
Private school teachers	270	18	310	37	334	57	346	69
Seamen	237	60	205	86	185	114	166	138

Source: Health and Welfare White Paper, 1977-1987 (Kosei Hakusho in Japanese), Ministry of Health and Welfare, Tokyo, Japan.

The figures of government employees include local and national government employees.

Table 2-1

Regression Results of the Impact of Social Security on Personal Saving and Labor Retirement of the Elderly (2SLS)

Independent Variable	Model I SSN (2SLS)		Model II SSG (2SLS)		Model III SST (2SLS)	
	Saving	Labor Force	Saving	Labor Force	Saving	Labor Force
Saving	--	-.264[b] (-2.37)	--	-.262[b] (-2.36)	--	-.277[b] (-2.491
Labor force	-.476[c] (-1.89)	--	-.445[c] (-1.73)	--	-.392 (-1.55)	--
Disposable income	-.016 (-.40)	.004 (.20)	-.012 (-.28)	.007 (.34)	-.032 (-.53)	.022 (.58)
SS	.037E-1[c] (2.06)	.001E-1 (.14)	.029E-1[c] (1.77)	.005E-3 (.005)	.022 (1.47)	-.021E-1 (-.21)
SS * D1	-.030E-1[a] (-3.72)	-.013E-1[b] (-2.25)	-.023E-1[a] (-3.37)	-.011E-1[b] (-2.21)	-.011[b] (-2.53)	-.056E-1 (-1.70)
SS * D2	-.063E-1[a] (-4.80)	-.018E-1[b] (-2.58)	-.052E-1[a] (-4.56)	-.016E-1[b] (-2.62)	-.035[a] (-4.00)	-.015[a] (-3.87)
D3	9.720E+1[a] (4.60)	2.291E+1[b] (2.32)	9.675E+1[a] (4.41)	2.403E+1[b] (2.37)	1.095E+2[a] (4.04)	4.126E+1 (4.26)
D4	2.233E+1[a] (3.26)	9.164[c] (1.88)	2.035E+1[a] (2.91)	9.156[c] (1.83)	1.664E+1[c] (2.06)	7.620 (1.27)
Life	-2.033[b] (-2.31)	-1.322[b] (-2.42)	-1.997[b] (-2.21)	-1.332[b] (-2.44)	-2.223[b] (-2.31)	-1.522[b] (-2.77)
Financial Assets	-.034 (-.12)	-.186 (-1.05)	.008E-1 (.003)	-.187 (-1.06)	-.004 (-.014)	-.124 (-.69)

(continued)

Table 2-1 (concluded)

Independent Variable	Model I SSN (2SLS)		Model II SSG (2SLS)		Model III SST (2SLS)	
	Saving	Labor Force	Saving	Labor Force	Saving	Labor Force
Education	.371 (1.04)	.380 (1.55)	.295 (.82)	.363 (1.48)	.205 (.51)	.148 (.54)
Housing	-2.559[a] (-2.88)	--	-2.459[b] (-2.73)	--	-1.991[b] (-2.29)	--
Retained earnings	.583[b] (2.43)	--	.558[b] (2.31)	--	.460[c] (1.88)	--
Female labor force	--	.523[a] (3.06)	--	.532[a] (3.12)	--	.642[a] (3.70)
Agriculture	--	-.063 (-.21)	--	-.056 (-.18)	--	-.008 (-.02)
Intercept	7.335E+1[b] (2.71)	7.478E+1[a] (4.48)	7.035E+1[b] (2.54)	7.435E+1[a] (7.45)	6.636E+1[b] (2.40)	7.210E+1[a] (4.15)
R^2	0.93	0.98	0.93	0.98	0.92	0.98
D.W.	2.27	2.34	2.20	2.34	2.14	2.37
S.E.	1.19	.79	1.21	.79	1.28	.80

[a] Indicates statistical significance at the 1% level.

[b] Indicates statistical significance at the 5% level.

[c] Indicates statistical significance at the 10% level.

Note: t-statistics are in parentheses below the estimated coefficient.
D.W. is the Durbin-Watson statistics and first-order serial correlation is corrected by Beach and McKinnon method.
S.E. is the standard error of the regression.

Table 2-2

Regression Results of the Impact of Social Security on Personal Saving and Labor Retirement of the Elderly (2SLS)

Independent Variable	Model I SSAB (2SLS)		Model II SSAC (2SLS)	
	Saving	Labor Force	Saving	Labor Force
Saving	--	-.475[a] (-3.20)	--	-.698[a] (-5.01)
Labor force	-.610[b] (-2.25)	--	-.489[c] (-2.06)	--
Disposable income	-.049[b] (-2.10)	-.036[b] (-2.45)	-.067[a] (-3.00)	-.065[a] (-5.17)
SS	.050E-1[a] (3.27)	.086E-1[a] (3.97)	.038[a] (3.95)	.064[a] (5.50)
SS * D1	.011E-1 (.74)	-.031E-1[c] (-1.91)	-.079E-1 (-1.25)	-.033[a] (-4.34)
SS * D2	-.079E-1[b] (-2.11)	-.098E-1[a] (-2.97)	-.058[a] (-3.37)	-.081[a] (-4.41)
D3	7.243E+1[b] (2.26)	7.000E+1[b] (2.80)	9.507E+1[a] (3.38)	1.089E+2[a] (4.21)
D4	-6.760 (-.99)	1.263E+1 (1.69)	3.895 (.73)	2.293E+1[a] (4.03)
Life	-2.267[b] (-2.38)	-1.362[b] (-2.29)	-2.157[b] (-2.48)	-2.128[a] (-4.22)
Financial Assets	.100 (.29)	-.530[b] (-2.11)	-.036 (-.11)	-.411[b] (-2.43)

(continued)

Table 2-2 (concluded)

Independent Variable	Model I SSAB (2SLS)		Model II SSAC (2SLS)	
	Saving	Labor Force	Saving	Labor Force
Education	.044	.259	.272	.675[b]
	(.11)	(.87)	(.72)	(2.72)
Housing	.173	--	-.404	--
	(.21)		(-.56)	
Retained earnings	.016	--	.222	--
	(.08)		(1.13)	
Female labor force	--	.732[a]	--	.850[a]
		(3.67)		(4.99)
Agriculture	--	1.664[b]	--	1.966[a]
		(2.47)		(3.49)
Intercept	9.275E+1[a]	3.813E+1[c]	8.664E+1[a]	4.586E+1[b]
	(3.36)	(1.87)	(3.37)	(2.61)
R^2	0.91	0.98	0.93	0.99
D.W.	1.86	1.88	2.03	2.37
S.E.	1.39	.91	1.22	.73

[a] Indicates statistical significance at the 1% level.
[b] Indicates statistical significance at the 5% level.
[c] Indicates statistical significance at the 10% level.

Note: t-statistics are in parentheses below the estimated coefficient.
D.W. is the Durbin-Watson statistics and first-order serial correlation is corrected by Beach and McKinnon method.
S.E. is the standard error of the regression.

Table 2-3

Author	Time Period	Estimation Method	Data Source	Estimated Coefficient
Noguchi (1983)	1968 ~ 1980 (Japan)	OLS expected present value of gross future benefit	Family Saving Survey and Family Income Expenditure Survey (Japan)	-.010 ~ -.148
Sasaki and Tachibanaki (1985)	1966 ~ 1982 (Japan)	OLS expected present value of future benefit	Family Saving Survey and Family Income Expenditure Survey (Japan)	-.14 ~ -.291
Feldstein (1980)	Average value over 1969 ~ 1975 (12 OECO countries)	TSLS and OLS benefit-earnings replacement ratio	National Accounts of OECD Countries, Yearbook of National Account Statistics, Demographic Yearbook and Year Book of Labor Statistics (OECO)	-.21 ~ -.37
Graham (1987)	Average value over 1970 ~ 1980 or 1975 (24 OECO countries)	2SLS and OLS social security pension benefit per person divided by per capita income	Oemographic Trends, Labor Force Statistics, National Accounts, and Others (OECD).	-.02 ~ .09
Munnell (1974)	1929 ~ 1971 (U.S.A.)	OLS gross social security wealth and net social security wealth	Economic Report of the President, Long Term Economic Growth, Manpower Report of the President and others (U.S.A.)	-.03 ~ -.117
Bernheim (1987)	1969 (U.S.A.)	Two Stage Method capitalized value of future benefits for actuarial and simple valuation	Longitudinal Retirement History Survey (U.S.A.)	-.7 ~ -1.37

Table 3

Definitions of Variables

Variable Name	Definition
Saving	average personal saving rate. (μ = 17.006, σ = 3.715)
Labor force	labor force participation rate of males aged 60 and over. (μ = 66.898, σ = 5.270)
Social security wealth	SSN is the capitalized value of future net benefits in 1,000 yen, based on DASDI program (old-age, survivors and disability insurance under the welfare pension program). (See footnote 7). (μ = 12141.8, σ = 7487.11)
	SSG is the capitalized value of future gross benefits in 1,000 yen, based on OASDI program (old-age, survivors and disability insurance under the welfare pension program). (See footnote 7). (μ = 14409.2, σ = 8707.04)
	SST is the capitalized value of social security tax contribution in 1,000 yen, based on OASDI program (old-age, survivors and disability insurance under the welfare pension program). (See footnote 7). (μ = 2267.47, σ = 1223.18)
	SSAB is the accumulated past real social security retirement benefits (adjusted for the price level) and discounted future real social security retirement benefits using a current real discount rate, in 1,000 yen, as of 1975. (μ = 4943.41, σ = 2570.23)
	SSAC is the accumulated past real social security tax contribution (adjusted for the price level) and discounted future real social security tax contribution using a current real discount rate, in 1,000 yen, as of 1975. (μ = 944.428, σ = 573.506)

Table 3 (concluded)

Variable Name	Definition
Disposable income	real per capita personal disposable income, in 1,000 yen (μ = 614.423, σ = 333.501)
Life	remaining life expectancy at male age of sixty. (μ = 16.198, σ = 1.363)
Financial assets	average personal net liquidity wealth rate: stocks, bonds, trusts and life insurance at the beginning of year. (μ = 6.411, σ = 2.071)
Education	ratio of the number of graduates from junior college, senior college and university to people who completed at least the nine-year compulsory education of elementary school and junior high school. (μ = 17.117, σ = 11.102)
Housing	average personal expenditure rate of personal residential construction in private sector, at the beginning of year. (μ = 7.663, σ = 2.501)
Retained earnings	average rate of corporate retained earnings. (μ = 6.411, σ = 2.071)
Female labor force	labor force participation rate of females aged 60 and over. (μ = 30.863, σ = 4.067)
Agriculture	ratio of the number of male workers in agriculture and forestry to total workers. (μ = 10.778, σ = 5.424)

Note: The sources are listed in Table 4. The symbols μ and σ denote mean and standard deviation, respectively.

Table 4

Sources of Data

Saving

Saving (1951-1982): "Economic Statistics Annual," 1960-1988, Bank of Japan.
"White Paper of National Income," 1930-1960, and "Annual Report on National Account" (the latest name), 1951-1988, Economic Planning Agency.

Labor Force Participation Rate

Labor force participation rate (1951-1982): "Labor Force Survey," 1950-1983, Statistics Bureau, Prime Minister's Office, Department of Statistical Information in Ministry of Labor, and Department of Population Census in Prime Minister's Office.

Social Security

Social Security retirement benefits (1951-1983): "Social Insurance Agency Annual Report," 1965-1983, Social Insurance Agency, Japanese Government.
Social Security tax (1951-1983): "Social Insurance Agency Annual Report," 1965-1983, Social Insurance Agency, Japanese Government.
Mr. Matsue in Suri Chosa Shitsu of Social Insurance Agency, Japanese Government.

Income

Personal income (1951-1982): "Annual Report on National Account" (the latest name), 1951-1988, Economic Planning Agency.
"White Paper of National Income," 1930-1960, Economic Planning Agency.
"Economic Statistics Annual," 1965, Bank of Japan.

Taxes

Income tax (1951-1982): "Annual Report on National Account (the latest name), 1951-1988, Economic Planning Agency.
"White Paper of National Income," 1930-1960, Economic Planning Agency.
"Economic Statistics Annual," 1965, Bank of Japan.

Price Index

Consumer price index (1951-1982): "Economic Statistics Annual," 1960-1988, Bank of Japan, and Department of Statistical Consultation in Bank of Japan.
GNP deflator (1951-1983): "Economic Statistics Annual," 1960-1988, Bank of Japan, and Department of Statistical Consultation in Bank of Japan.

Table 4

Sources of Data (continued)

Population

Population (1951-1983): "Vital Statistics of Japan," 1960-1983, Ministry of Health and Welfare.

Life Expectancy

Life Expectancy (1951-1983): "Life Table," 1935-1983, Japanese Insurance Organization.

Interest Rate

Market and discount rates, and yield of 10 years long term bond (1951-1983): "Economic Statistics Annual," 1960-1988, Bank of Japan, and Department of Statistical Consultation in Bank of Japan.

Retained Earnings

Retained earnings (1951-1983): "Economic Statistics Annual," 1960-1988, Bank of Japan.
"White Paper of National Income," 1930-1960, and "Annual Report on National Account" (the latest name), 1951-1988, Economic Planning Agency.
Messrs. Ikoma and Kisaichi in the Department of Statistics and Income in Economic Planning Agency.

Agriculture and Forestry

"Labor Force Survey," (1951-1983), Statistics Bureau, Prime Minister's Office, and Messrs. Ando and Yokomizo in Department of Labor Force Statistics in Statistics Bureau, Prime Minister's Office.

Education

Education 1951-1982: "Educational Statistical Survey," 1980-1983, Department of Education.

Wealth, Physical Assets, and Liquidity Assets

"Economic Statistics Annual," 1950, 1955 and 1960-1988, Bank of Japan.
"Annual Report on National Accounts" (the latest name), 1951-1988, Economic Planning Agency. Mr. Iwamura in the Bank of Japan in New York Office.
Mr. Ikoma in Department of Income Statistics in Economic Planning Agency.

Table 5

Value of Dependent Variables and Social Security Benefits Variables
Thousands of Constant (1975) Yen (except for columns of %)

Year	Disposable income (YD)	Personal saving(S)	S/YD %	Labor force participation %	SSN	SSG	SST	SSAB	SSAT
1951	132.299	22.991	17.378	66.030	2446.88	3010.84	563.955	283.188	35.644
1952	182.494	19.385	10.622	68.520	2805.85	3452.55	646.691	563.080	70.168
1953	194.582	13.411	6.892	73.500	3052.43	3755.95	703.524	811.247	97.558
1954	203.371	18.096	8.898	72.880	3189.06	3924.07	735.009	1082.10	137.553
1955	227.748	29.723	13.051	74.990	3858.47	4693.10	834.634	1459.03	194.360
1956	244.300	31.965	13.084	74.120	4164.37	5065.17	900.804	1850.50	253.672
1957	262.788	39.719	15.115	73.750	4485.56	5455.82	970.282	2187.24	306.475
1958	277.072	40.075	14.464	74.250	4748.39	5775.55	1027.13	2625.81	375.721
1959	302.611	49.095	16.224	69.890	5179.46	6299.86	1120.39	3038.67	439.659
1960	333.974	59.084	17.691	70.880	5827.25	7075.32	1248.06	3391.48	509.995
1961	369.583	72.186	19.532	71.380	6428.33	7805.08	1376.79	3685.48	576.762
1962	392.328	70.721	18.026	72.130	7022.63	8500.42	1477.80	3894.49	634.327
1963	416.693	74.488	17.876	69.400	7757.11	9343.60	1586.50	4054.61	683.838
1964	452.481	81.297	17.967	69.300	8516.21	10243.9	1727.63	4337.75	755.998
1965	508.927	80.250	15.769	69.550	9059.18	10916.8	1857.65	4726.46	840.863
1966	548.482	82.552	15.051	69.250	10060.2	12066.8	2006.58	5151.95	942.418
1967	603.776	94.115	15.588	68.200	11254.3	13467.7	2213.41	5627.20	1057.10
1968	656.805	109.565	16.682	67.000	12319.8	14729.5	2409.63	6004.88	1156.35
1969	716.471	124.038	17.313	66.750	13499.9	16129.1	2629.22	6544.12	1263.16
1970	769.006	140.195	18.231	65.450	14430.6	17251.6	2821.07	6885.90	1355.81
1971	806.058	144.685	17.950	64.700	15738.5	18704.5	2966.05	7318.89	1470.00
1972	874.136	159.384	18.233	63.600	17359.6	20578.8	3219.17	7829.30	1612.77
1973	965.841	201.924	20.907	63.850	19350.0	22910.6	3560.60	8134.26	1652.00
1974	962.092	228.219	23.721	62.950	19518.1	23069.6	3551.57	7472.73	1522.95
1975	962.744	212.920	22.116	61.900	19885.6	23445.1	3559.41	7798.90	1586.81
1976	985.025	220.597	22.395	61.550	20608.5	24255.8	3647.31	7573.20	1544.00
1977	1003.72	218.434	21.763	60.350	21017.7	24673.0	3655.32	7382.47	1516.43
1978	1042.78	216.717	20.783	59.950	22110.6	25919.3	3808.77	7452.92	1539.92
1979	1064.97	193.321	18.153	59.100	22956.7	26864.3	3907.74	7497.62	1557.54
1980	1058.07	189.446	17.905	59.400	22824.5	26748.4	3923.90	7216.39	1506.99
1981	1063.27	194.513	18.294	58.750	23243.1	27168.9	3925.81	7130.32	1501.65
1982	1077.04	177.923	16.520	57.400	23818.4	27794.3	3975.89	7176.80	1523.22

Table 5 (concluded)

SOURCES

Personal income: "Annual Report on National Account" (the latest name), 1951-1988, Economic Planning Agency.

Saving: "Annual Report on National Account" (the latest name), 1951-1988, Economic Planning Agency.

Labor force participation rate: "Labor Force Survey," 1950-1983, Statistics Bureau, Prime Minister's Office, Department of Statistical Information in Ministry of Labor, and Department of Population Census in Prime Minister's Office.

Social Security retirement benefits: "Social Insurance Agency Annual Report," 1965-1983, Social Insurance Agency, Japanese Government.
Social Security tax: "Social Insurance Agency Annual Report," 1965-1983, Social Insurance Agency, Japanese Government.
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