
Evasion of National Pension Contributions and Hyperbolic Time Discounting: Evidence and Rationale for Public Pensions*

Kohei KOMAMURA**

(Professor, Faculty of Economics, Keio University)

Atsuhiko YAMADA***

(Associate Professor, Faculty of Economics, Keio University)

1. Introduction

The non-contribution (evasion) rate of the National Pension remains high and has reached 37%¹⁾, according to the latest Annual Report by the Social Insurance Agency (2006). As revealed by Maruyama and Komamura (2005), the main driving factor behind the evasion is the recent change in the labor-market, i.e., an increase in the number of non-regular workers led by long-term economic recession and deregulation of temporary employment contracts. This change has narrowed the coverage of Employees' Pension Insurance, which insures basically regular workers, while non-regular workers have to join the National Pension Scheme. Because contributions to the National Pension Scheme are paid, *de facto*, on a voluntary basis, non-regular workers can evade this at will. The effective way, therefore, of avoiding such evasion by non-regular workers would be to expand the coverage of Employees' Pension Insurance, because these contributions are compulsorily deducted from their wages by employers.

In the first place, however, there have been no explicit discussions on the rationale for compulsory participation in the Public Pension scheme, while there is always much debate around why the government provides a public pension (i.e., the issue of privatization of public pensions). According to the standard lifecycle model in economics, it is assumed that people maximize their lifetime utility through their present and future consumption. This means that a person will voluntarily build up assets to an appropriate level to prepare for their retirement, and may also allocate some portion of such assets to buying a private pension from which he or she can receive an adequate level of benefits until death. In other words, under the assumption of a rational individual, the rationale for compulsory participation in pension systems is not self-evident.

It is noteworthy that there is often some confusion between two aspects of public pensions. Needless to say, the public pension is a system that people are required to join (compulsory participation) whereby a pension benefit is provided by the public system (public provision). However, the rationale for the former could be different from that for

* Acknowledgements: This paper is a result of the Research Project on the Pension System to Accommodate Diversified Modes of Employment (chief researcher: Kohei Komamura) implemented by the Research Institute for Policies on Pension and Aging (formerly The Pension Center) with the support of Health and Labor Sciences Research Grants (in the framework of Research on Policy Planning and Evaluation). The authors wish to thank the fund suppliers, all those involved in the project, and all the respondents to the questionnaires who we refer to in this paper for their help and cooperation.

** Left Keio University's Graduate School of Economics, in 1995 part way through a doctorate. Became a research fellow at The (Former) Social Development Research Institute in 1993, then a professor at the Faculty of Economics, Toyo University in 2005, and has been a professor at Keio University since 2007, and also a guest research fellow at the Research Office for the Welfare and Labor Committee of the House of Councilors since 2002. Wrote *Economic Analysis of Pension and Households* (2000) Toyo Keizai Inc., *Social Security in Developed Countries 1: The United Kingdom* (1999) University of Tokyo Press, *Social Security in Developed Countries 5: Sweden* (1999) University of Tokyo Press, *General Policies for Welfare, third ed.* (2005) Soseisha, *How Will Pension Change?* (2003) Iwanami Shoten, and *New Design of Social Security System: from Safety Net to Spring Board* (2005) Keio University Press.

*** Worked as a research fellow for The National Institute of Population and Social Security Research, then as an economist for the Social Policy Division, The Organization of Economic Co-operation and Development (OECD), and so on, and has been an associate professor at Keio University since April 2005. His main piece of writing is *The Economics of Older Workers* (2004) co-authored, Nikkei Inc.

¹⁾ For public employees and other specific vocational groups, the Mutual-aid Pension Insurance is available as a part of the public pension scheme. For an overview of the Japanese pension scheme, the following site, which is managed by the National Institute of Population and Social Security Research, is very useful: www.ipss.go.jp.

the latter. They should not be confused.

The rationale for public provision of insurance, in the form of social insurance, may be a safeguard against unexpected inflation, an unexpected rise in living expenses (i.e., unexpected economic growth), social changes, or an unexpected increase in peoples' life spans. For pension²⁾, as ultra-long insurance, such uncertainties can cause serious problems. It is technically difficult for private insurance services to adequately safeguard against such uncertainties. This is a rationale for the public provision of pension insurance. On the other hand, the rationale for compulsory participation has not been discussed much, except for the aspect of the externality of free-riding on the public assistance system, i.e., non-contributors and non-participants can depend on that system in the future, even without contributing to the pension system now³⁾.

In the case of the health insurance system, the adverse selection problem is considered a rationale for compulsory participation. On the other hand, in the case of a pension system, the possibility of adverse selection on the part of pension providers would not be as serious as in health insurance. Generally, individual insurance policyholders do not know when they will die, nor can they extend their lives at will, but, as a group, insurers can estimate their average life span (average longevity risk) from a life table.

Instead, in the case of the pension system, the insurance policyholder faces two types of information problem: problems deriving from a lack of long-term information and problems at the stage of information processing, because the risks covered by such insurance continue to exist for a very long time.

As an example of the first problem, some people may make a decision on whether they join pension systems, based on their very subjective views about their own lives, which are impossible to know by nature, i.e., they believe that they will live for longer or shorter than the average lifespan, which is generally stable in developed countries. If people make such decision on their very subjective views of their individual lives, which are probably different from their actual individual lives, they over-consume or under-consume pension insurance products, which leads to an inefficient level of the purchasing of insurance products in society as a whole. This means that compulsory participation in insurance systems, based on the average lifespan, could improve the efficiency of society as a whole⁴⁾.

Problems of the latter type, i.e., those at the stage of information processing, could occur even if individuals had exact long-term information about their own lives (e.g., the time when they will die)⁵⁾. One such problem that draws attention is hyperbolic time discounting, as will be discussed later. Those who depend on time-discount rates of a hyperbolic type will always value consumption in the near future higher than consumption in the more distant future. In other words, even if people had exact long-term information and behaved on the basis of the lifecycle model, they would have only an insignificant desire for savings or participation in pension systems, because they have overvalued consumption at the present time, but undervalued it in the future. In this case, individuals would regret their choice in the future, even if they made it rationally on the basis of exact long-term information at the present time⁶⁾.

Thus, even without problems due to a lack of long-term information, such problems at the stage of information processing would still exist, which could lead to failed inter-temporal distribution of consumption. In that case, compulsory participation in pension insurance systems could improve the efficiency of society as a whole. In addition, when voters are conscious of such a rates-of-time preference, they may voluntarily support compulsory participation in pension systems to make their commitment to the pension systems at the present point, so that they will not experience regrets in the future⁷⁾.

²⁾ Cases where individuals buy pension insurance by paying a large amount of money in a lump sum are not taken into consideration here.

³⁾ The issue of free rides by non-contributors and non-participants in the pension system is that they depend upon the welfare system in the future without paying premiums now, in spite of the fact that the welfare system is financed by the taxes paid by those who join and make contributions to the pension system.

⁴⁾ Another typical problem due to the lack of long-term information is that pension insurance products are complicated and ordinary buyers lack sufficient knowledge of these to reflect the long membership terms involved in such products.

⁵⁾ This has drawn attention to a more generalized aspect, i.e., the question whether a person's processing capacity may be lower for longer term matters. Refer to Dennett (2003), for example.

⁶⁾ Take a student's homework for a one-month summer vacation as an example. The optimal inter-temporal distribution of homework is to do it piece by piece for one month, starting now. For a student, however, with hyperbolic time discounting, it is always a rational choice at the present time to do it piece by piece, starting the next day: in other words, such a student makes such a rational choice every day and finally comes to the end of the summer vacation without finishing the homework.

⁷⁾ It is the same mechanism whereby alcoholics choose to join, of their own free will, an abstaining program where they come under the total control of a hospital, etc.

What are the differences in policy implications, in reality, between compulsory participation to deal with the problems due to a lack of long-term information, and compulsory participation to deal with problems at the stage of information processing, i.e., failed inter-temporal distribution of consumption?

Take such implications in withdrawal and lump-sum benefits in a defined-contribution pension plan as an example. There is strong demand for deregulation of lump-sum benefits at retirement, from both pension funds and participants. On the assumption that the lack of long-term information on longevity risks is a rationale for compulsory participation in a public pension system, a system where participants might take a lump-sum benefit, would be somewhat rational because it would allow each participant to redistribute the lump-sum benefit among consumption, savings and insurance when he or she has a final longevity risk for himself or herself at the age of 60, i.e., retirement age⁸⁾.

However, on the assumption that problems at the stage of information processing, such as hyperbolic discounting, are a rationale for compulsory participation in a public pension system, the regulations on the choice of lump-sum benefits should not be relaxed, because people would be highly likely not to redistribute the lump-sum benefit among consumption, savings and insurance in an inter-temporally consistent way, and would make such decisions about lump-sum money that they would eventually regret.

As seen in the above-mentioned examples, a fundamental question is: What is the rationale behind compulsory participation in pension systems? This is related to the basis for the existence of pension systems, or desirable pension policies. This paper elucidates the rationale for compulsory participation in pension systems, by conducting an empirical analysis of the non-contribution to, and non-participation in, the National Pension system on the basis of originally-collected microdata.

2. Background and prior studies⁹⁾

(1) Theoretical analysis of non-contribution to and non-participation in the pension system – hyperbolic discounting

In the 1970s, with reference to income redistribution, possible market failure and paternalism as three reasons for the existence of an income security system by means of a public pension system, Diamond (1977) already pointed out the limits of a person's capacity to choose in the face of uncertainties, or in an inter-temporal aspect, as a

⁸⁾ Nevertheless, even in that case, no long-term information on the longevity risk since the age of 61 can be obtained, so there is still room for arguments against such extreme deregulation that one can receive all one's pension benefits in the form of a lump-sum payment.

⁹⁾ The greatest issue that the National Pension system faces is increased non-contributors. Avoidance of contributions to the National Pension system may lead to: a) financial instability of Basic Pensions; and b) the non-contributors' dependence upon public assistance as their sole income source when they become unable to work because of disease, disability, or old age, unless they have built up enough assets.

The direct cause of the rises in the number of non-contributors in the National Pension system was increased diversification of employment contracts in the labor market during the 1990s. Typical workers (so-called regular employees) who are required to join Employees' Pension Insurance where their contributions are deducted from their wages before they receive them have decreased, whereas atypical workers who are required to join the National Pension system have increased. As a consequence, the gaps between the employment rates according to age group and the rates of participants in Employees' Pension Insurance have been much larger since the mid-1990s.

There are some discussions in which the issue of such non-contribution in the National Pension system is considered as a matter of non-participation in the system (i.e., not register as an insured person with the National Pension system). As discussed later, it is actually difficult to distinguish non-contribution from non-participation on data on individuals/households. However, according to the Ministry of Internal Affairs and Communications (MIC) (2004), non-contribution and non-participation in the system are different concepts. Actually, the rate of non-contribution has risen, while the rate of non-participation has declined. The number of non-participants in the public pension systems is now about 635,000.

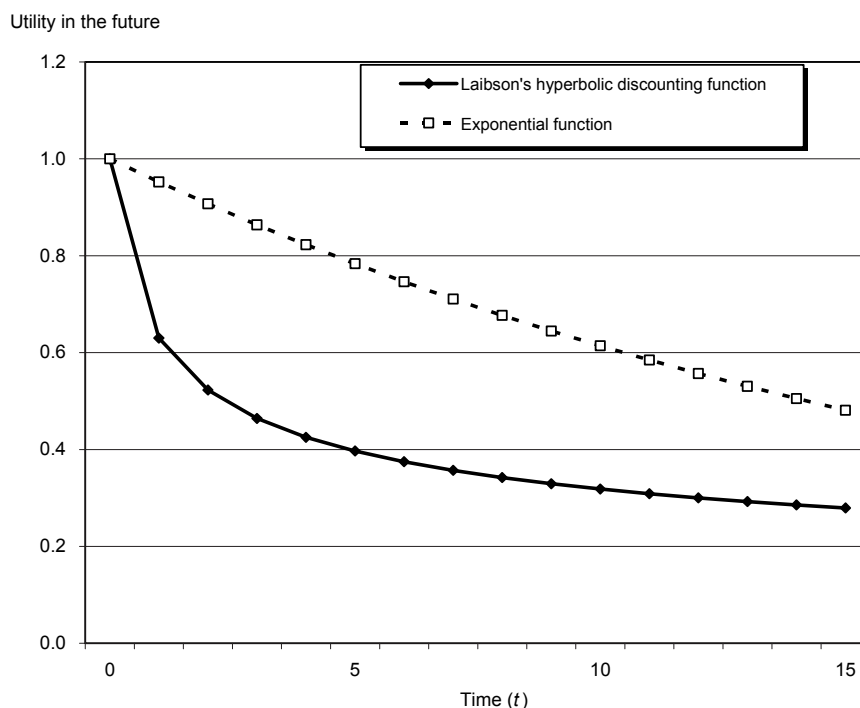
The background to such discussions where non-contribution and non-participation are confused, is not only the issue of data on individuals/households on which it is difficult to distinguish non-contribution from non-participation in the system, as discussed later, but also a strong influence of the economic idea of questioning whether participation in the National Pension system as an insurance system is decided by the individuals' rational choice. In other words, the issue of non-contribution that has occurred due to Employees' Pension Insurance that cannot accommodate changes in the labor market, i.e., an institutional factor, is substituted with the issue of non-participation in the system that is a matter of economically rational selection. Accordingly, if the study subject refers to non-contribution, the discussion would involve a strong consciousness of policy implications. On the other hand, if it refers to non-participation in the system, it would be focused on checking whether individuals make rational choices on participation in insurance, rather than policy implications. Implications that may result from the two different approaches need to be distinguished. For example, the recent rapid deterioration in the National Pension system itself cannot be explained in an analytical framework of rational choice in the latter, to pursue rationales for compulsory participation in the system. Rather, it can be explained as a rise in the rate of non-contribution due to an increase in non-regular employees, i.e., a diversified mode of employment, in the former perspective.

rationale for paternalism. The limit of a person’s capacity to select in an inter-temporal aspect that has recently drawn attention in the field of behavioral economics or neuro-economics, is a hyperbolic time preference.

How much consumption a person would refrain from at present, for future consumption, is closely related to how he or she values future consumption at the present time. Consumption held back at present for future consumption, is referred to as the inter-temporal substitutability of consumption, which can be measured in terms of a time discount rate. The disutility of refraining from consumption at present, in an inter-temporal distribution of consumption, varies according to the individual. The higher such disutility is for an individual, the higher his or her time preference for consumption at present is: in other words, the higher interest rate that he or she desires in consideration of refraining from consumption now, which means a higher time discount rate. Such an individual values consumption at the present point highly.

A lifetime consumption plan selected by a rational person would be dynamically consistent. In other words, it is assumed that a consumption plan selected at a point in time would also be the best choice at any point in time in the future. A required condition for dynamic consistency is that the time discounting function be an exponential function with a constant discount rate. An exponential function of time (t), $D(t) = e^{-t \ln(1+\alpha)}$, is often used as an example. In this function, even if the discount rate is high, it means that consumption at present is simply given more importance on a planned basis, and a reduced consumption that may have to be made in the future will not cause any regret at that future point in time.

There is, however, doubt if individuals actually behave rationally in such a dynamically consistent way. For example, in the choice between 10,000 yen one year later and 10,500 yen one year and one day later, individuals would take the latter. However, in the choice between 10,000 yen today and 10,500 yen tomorrow, would they not take 10,000 yen today? In case of an exponential type of discount rate, there is no reverse preference according to the time distance from the present: on the other hand, with a hyperbolic time discounting function, there may be such a reverse preference. An example of such a hyperbolic time discounting function is $D(t) = (1 + \alpha t)^{-\beta/\alpha}$ (Figure 1).



Note: This graph is created from Tada (2003).

Figure 1 An exponential function and a hyperbolic discounting function

Studies on whether individuals actually act in a manner that such a hyperbolic time discounting would apply have recently drawn attention as behavioral economics, or neuro-economics. Such studies are now being applied in the areas of savings, debt, health, and wages, etc. Applied studies recently done in the area of social security include a theoretical analysis of the effect of social welfare benefits provided during a limited period, by Fang and Silverman (2004), and an analysis of the effect of such benefits on joining a pension system, by Amador, et al. (2003). Fang and Silverman (2004) suggest that limiting the period of the provision of social welfare benefits for beneficiaries may enhance their welfare under certain particular conditions. Amador, et al. (2003) find a rationale for governmental paternalistic intervention required to optimize a combination of commitment and flexibility, by which the welfare of economic agents is improved by analyzing the problem of undersavings, etc., on a model of inter-temporal selection by an economic agent with hyperbolic discounting.

(2) Empirical analysis of non-payment to, and non-participation in, the public pension system

There are eleven empirical analysis reports on non-contribution (evasion) to the National Pension system that have been published so far. The purposes of analysis, data, samples analyzed, models, variables used, major results, and policy implications are summarized in Table1.¹⁰⁾

Data aggregated at a national level were used in an early analysis report by Ogura and Chiba (1991), while data aggregated at the prefectural or municipal level were used in the subsequent reports by Komamura (2001), and Maruyama and Komamura (2005). Individual-level microdata sets were used in analysis by Ogura and Kadoda (2000), Suzuki and Zhou (2001, 2005), Abe (2001, 2003), Nakajima, et al. (2005), Nakajima and Usuki (2005), and Tsukahara (2005). Thus, detailed data are more frequently used and furthermore, data collected particularly for the purpose of analysis of non-payment of pension contributions are now being used.

As to the causes of evading contributions to the National Pension system, recent study reports have focused on not only: (i) liquidity constraints (i.e., a hypothesis that people with insurance premiums relatively high to their income, or assets, are likely to be non-contributors or non-participants), but also: (ii) the factor of diversified modes of employment (i.e., a hypothesis that atypical workers are likely to be non-contributors or non-participants); (iii) the factor of unfairness among generations (i.e., a hypothesis that the younger cohort generation groups are, the more likely they are to be non-contributors or non-participants because they have a stronger feeling of unfairness); (iv) the factor of the requirement of 25-year participation (i.e., a hypothesis that persons become non-contributors or non-participants when they know that it is impossible for them to satisfy the requirement period for qualification for pension benefits), as research results have accumulated, and also: (v) the factor of the propensity for risk aversion (i.e., a hypothesis that persons more risk tolerant are likely to be non-contributors or non-participants); (vi) the adverse selection factor (i.e., a hypothesis that persons with shorter life expectations are likely to be non-contributors or non-participants); (vii) the hyperbolic time discounting factor (i.e., a hypothesis that persons with time discount rates inconsistent with inter-temporal utility maximization are likely to be non-contributors or non-participants). These analysis results of prior studies can be described as follows:

¹⁰⁾ This sub-section focuses on parts of those reports concerning the non-contribution to the National Pension system, and does not address any knowledge on other matters, even if a finding may be important in another context.

Table 1 Empirical analysis of non-payment of National Pension contributions, etc.

	(a) Ogura and Chiba (1991)	(b) Ogura and Kadoda (2000)	(c) Suzuki and Zhou (2001)	(d) Abe (2001)	(e) Komamura (2001)	(f) Abe (2003)
Purpose	To investigate the payment of health insurance premiums and pension insurance premiums, and problems involved in them, from a wide range of aspects; and to analyze the causes of non-contribution to the National Pension and National Health Insurance	To analyze the behavior of payment of social insurance premiums of those households whose premiums are not withheld from income at source, and its changes, as related to their attributes; and to compare the results with the burden of the households whose premiums are withheld from income at source (i.e., employees' households)	To analyze the causes of non-participation in the National Pension. Specifically, to analyze on a quantitative basis the effects on such non-participation of (1) liquidity constraint (i.e., financial assets excluding personal pensions, unemployment/non-employment, and household income excluding the individual's own income), (2) the expected ages of death (health conditions), and (3) unfair disparities among generations (for young ages), (2) and (3) are referred to as "adverse selection factors".	To analyze whether (1) liquidity constraint (premium rate = assumed premium/equivalent household income), (2) institutional factors (requirement for 25-year membership = dummy for ages 35-39), (3) community factors (dummy for the size of municipalities), and (4) adverse selection factors (dummy for life insurance, dummy for individual pension) affect the participation in, and contribution to, the National Pension	To study whether the causes of non-contribution to the National Pension are different from those of non-payment of National Health Insurance premiums, paying attention to institutional differences between them, i.e., the unit of participation, calculation formulas for contribution and premium, and the effects on municipal finance	To analyze the time of non-participation; and to confirm whether the time of non-participation involves the cohort effect. The modes: (1) a person ceases participating upon reaching the age of participation, and (2) a person stops participating after participating in the system. There are far more cases of (1) than (2), so this analysis covers (1).
Data	Data aggregated at the national level, including (1) National Income Statistics, Labor Force Survey, Annual Operational Reports by the Social Insurance Agency, for analysis of the rate of non-contribution to the National Pension, and (2) Annual Reports on Social Security Statistics, Report of Survey on the Insured in Health Insurance, Labor Force Survey, for analysis of the rate of non-participation in the system	Individual-level micro data from Comprehensive Survey on Living Conditions (1986, 1989, 1992 and 1995) by the Ministry of Health, Labor and Welfare	Individual-level micro data from Survey on Choice of Financial Assets in Households (1996) by the Postal Services Research Institute. The survey covered 6,000 households with the heads aged 20 or more.	Individual-level micro data from Survey on Income, Redistribution (2006) by the Ministry of Health, Labor and Welfare	Data aggregated at the prefecture and municipal levels, including (1) Annual Operational Reports, Household Income and Expenditure, Employment Security Statistics, Basic School Survey, Resident Registry Database, National Census, for analysis of the rate of non-contribution to the National Pension, and (2) Annual Reports on National Health Insurance Services, Household Income and Expenditure, Employment Security Statistics, National Census, for analysis of the rate of non-participation in the system	Individual-level micro data from the Survey on Women's Lifestyles and Pension (2001). The data was reconstructed into pseudo-panel data according to retrospective question items, with 1,063 female samples (160 events) and 796 male samples (111 events).
Samples analyzed	(1) Rates of non-payments to the National Pension: 1972-1988 (2) Rates of non-participation in the National Pension: 1973-1988 (* Aggregated at the national level)	The heads of households aged 20-59 among those covered by the income survey, in addition, among their households, (1) those that belong to the National Health Insurance (12,897 sample households whose premiums are not withheld from income at source, with the heads who are participants in the National Health Insurance and no one in their households is a participant in employees' health insurance systems) and (2) those of participants in employees' health insurance systems (38,216 sample households whose premiums are withheld from income at source)	(1) The heads of households and (2) aged 20 (inclusive) - 60 (exclusive) (among 611 such samples, 60 samples, or about 10%, are non-participants). Those other than the heads of households, which are thought to include many more non-participants, are not covered.	2,814 samples (among them, 494 non-participant samples) extracted, on the conditions of: (1) the age of 20 (inclusive) - 60 (exclusive); (2) excluding members of households receiving public assistance; (3) excluding full-time housewives who are spouses of self-employed persons; (4) excluding students; and (5) excluding those who have received pension benefits from (6) the supposed Category I insured (= Category I insured by the National Pension + persons/their spouses who are not a participant in any of the National Pension, Employees' Pension Insurance, and the mutual aid associations' pension systems (i.e., non-participants))	(1) Rates of non-payment of National Pension contributions: 1991-1998, and (2) rates of non-payment of National Health Insurance premiums: 1991-1997 (* Aggregated at the prefecture level)	Those covered by this study are only females and their spouses. The male samples are those who are married with wives aged 30-55. Many of the samples are employees (second category persons insured) and their full-time wives.
Empirical methods	(1) Rate of non-payment of pension contributions: OLS estimate by means of OLS estimate method and Cochran-Orcutt method, and (2) rate of non-participation: OLS estimate	(1) Rate of contribution: GLS estimate, and (2) prescribed insurance premium: Heckman model combining Probit (on whether even one yen is paid) with Tobit (on what percent of the premium is paid) (right-censored at 100% contribution)	Estimate on a bivariate Probit model to allow for participation in both personal pension systems and the National Pension	Estimate on a Probit-with-selection model to allow for participation in, and contribution to, the National Pension. Those with the largest earnings in the households are divided from other members in the measurement.	Pooled OLS estimate (year dummy used)	Estimate of the time of non-participation in the National Pension with the age of 20 as Time = 0 on a hazard model (with participating in the National Pension as an event). Estimated according to male and female, and according to cohorts (on a stratified model for the latter).
Explained variable	Rate of non-payment of contributions = rate of exemption from obligation of contribution + (1 - rate of such exemption) x (1 - rate of non-confirmed contributions), and rate of non-participants (estimate equations different from year to year)	A) Households whose contributions are not withheld from income at source: (1) rate of contribution (amount of insurance premiums paid / social insurance premium estimated on the assumption that everyone insured by the National Pension system is requested to make contributions to the system, (full-contribution insurance premium), and (2) prescribed insurance premium rate (rate of payment based on whether even one yen is paid for social insurance and with the upper limit of 1); and B) households whose contributions are withheld from income at source: (3) rate of collection (shares of social insurance premiums paid / estimated social insurance premiums)	(1) Participating in personal pension system, and (2) participating in the National Pension	Participation in the National Pension, and whether or not contributions to the pension system are made (not the amount of contributions made). The definition of non-contributors is "one who is taxed on his or her income, but does not pay any, or even one yen of, insurance premiums (* including ones with special exemption)".	(1) Rate of non-payment of National Pension contributions (= 100 - rate of confirmed contributions), and (2) Rate of non-payment of National Health Insurance premiums (= 100 - rate of confirmed payment)	Time from the age of 20 to participation in the National Pension system. Those under study are: (1) first category persons insured (occurrence of event), (2) second category persons insured (truncation), (3) third category persons insured (truncation), and (4) non-participation continued (non-occurrence of event).

Table 1 Empirical analysis of non-payment of National Pension contributions, etc. (continued)

	(a) Ogura and Chiba (1991)	(b) Ogura and Kadoda (2000)	(c) Suzuki and Zhou (2001)	(d) Abe (2001)	(e) Komamura (2001)	(f) Abe (2003)
Explanatory variables	(1) Rate of non-payment: National Pension insurance premium rate relative to average income of the self-employed, and (2) rate of non-participation: relative premium rate of National Pension insurance, rate of compulsory participation in Employees' Pension insurance, ratio of job seekers to job openings, ratio of average benefit of the Employees' Pension insurance to that of the National Pension, and year dummy for 1985 (year of pension reforms)	(1) Rate of contribution: social insurance premium / social insurance premium estimated on the assumption that everyone insured by the National Pension system is requested to make contributions to the system (full-contribution insurance premium), 1 / full-contribution insurance premium, savings (estimated) / full-contribution insurance premium, the number of household members, dummy for single-person household, dummy for the job type of a spouse, sex, age, place of residence, dummy for the birth year of the head of household, dummy for the head of household's consciousness of health, and (2) prescribed insurance premium: (Probit estimate) income, income of the previous year (?), dummy for the job type of the head of household, and <i>ditto</i> . (Tobit estimate) same as the equation for estimating the rate of contribution	Age, unemployment/non-employment, household income excluding the individual's own income, financial assets excluding personal pensions, real assets, suffering from / prone to disease, educational background, sex, size of city/town/village (only in case of the National Pension participant model)	(1) Participation: insurance premium rate, sex, age group, position in corporation/organization, participation in private pension systems, population size of place of residence, and (2) contribution: insurance premium rate, sex, age (not age group), participation in private pension systems, population size of place of residence	(1) Rate of non-payment of National Pension contributions: consumption, effective ratio of job seekers to job openings, proportion of students who go on to universities/colleges, ratio of the population aged 20-24 to the total population, population concentration, and (2) rate of non-payment of National Health Insurance premiums: the explained variable in (1) excluding the proportion of students who go on to universities/colleges, and the proportion of the population aged 20-24 to the total population	Dummy for student, dummy for student since 1988 (compulsory participation for students since this year), dummy for Category I insured by the National Pension with or without a spouse, dummy for Category II insured by the National Pension with or without a spouse (without-a-spouse, or with-a-spouse who is not Category I or II insured, is set as a basis), non-regular employment, dummy for temporary workers, workers sent from labor agencies, contract workers, and entrusted workers
Results	Rate of non-payment: a 1% rise in the relative rate of National Pension insurance premiums leads to a 4% rise in the rate of non-payment; and rate of non-participation: a 1% rise in the relative rate of National Pension insurance premiums leads to a 3% rise in the rate of non-participation in the National Pension, a 1% rise in the rate of compulsory participation in Employees' Public Pension systems leads to a 0.6% fall in the rate of non-participation in the National Pension, a rise of the ratio of jobs to applicants by τ (the figure indicates effective opening posts) per person) leads to a 3.5% fall in the rate of non-participation in the National Pension, and a rise by 50% of the ratio of average benefit of the Employees' Pension insurance to that of the National Pension leads to a 7% fall in the rate of non-participation in the National Pension	A) Household whose contributions are not withheld from income at source: (1) rate of contribution: household income (-); financial assets of household (+); ordinary full-time employee, contract worker/peacemaker at home/other, unemployed (-; compared with self-employed); dummy for birth year insignificant (partially significant, p. 103); deteriorated health condition (-), and (2) prescribed insurance premium rate, (Probit part) logarithm of income (+), logarithm of income of the previous year (?), unemployed (-); newer cohorts more inclined to pay no social insurance contribution at all; (Tobit part) the highest household income (+), savings balance (-), unemployed, businesses with 30 or less members, contract worker/peacemaker at home/other, jobs (-); no decrease in the rate of contribution of young cohorts if they make a contribution of even one yen; single-person household (+) B) Household whose contributions are withheld from income at source: (3) rate of collection: the reasons why household income is extremely low and significantly negative is at	Both factors were confirmed to be significant, but the adverse selection factor had a higher explaining power. (This is a simple likelihood ratio, so it should be carefully interpreted if variables in an estimate equation are not orthogonal.) It was confirmed that there is a turning point due to 25-year participation (i.e., a sharp decline in the rate of non-participation in the age group of 35-39, seen in a bar graph).	(1) Liquidity constraint (this affects contribution only), (2) institutional factors (N shape for participation by age), (3) community factors (systematic effect on non-participation, and U shape for non-payment), and (4) adverse selection factor (life insurance has a positive effect on both participation and contribution, but personal pensions are insignificant (i.e., alternative hypothesis rejected)	Consumption as a proxy indicator for the capacity to bear the economic burden has no significant effect. This is because National Health Insurance premiums involve a factor corresponding to the capacity of bearing burdens, and because it is short-term insurance premium rate system in the low income groups.	No cohort effect is recognized. The dummy for regular employment decreases hazards to participation, because it belongs to the second category. The dummy for non-regular employment increases hazards to participation (because it belongs to the first category). For second category persons insured with a spouse in the second category, only males show a positive significant effect (i.e., hazards to participation increased), which is the converse of the assumption (in other words, it does not restrain participation).
Policy implications	The main cause is increases in the insurance premium rate. Thus, if a substantially voluntary participation system is maintained, the rate of non-payment will increase each time the National Pension insurance rate is increased.	Rapid increases in the social insurance burden have decreased the rate of contribution in households whose contributions are not withheld from income at source by more than 20%. Particularly, they have caused many younger people to drop out of social insurance systems.	Abolition of the requirement of 25-year participation: expansion of reduction/exemption of insurance premiums; and extension of voluntary participation period	Non-participation and non-payment are structurally different from each other. Liquidity constraint effects contribution only, so the introduction of a half-exemption system may improve an inverse-progressiveness of the insurance premium rate system in the low income groups.	Effects of non-employment or regular/non-regular employment are greater than that of district in the system (no cohort effect recognized for those aged 30 and higher). It is important to lead young people into the condition where they can join pension systems.	Effects of non-employment or regular/non-regular employment are greater than that of district in the system (no cohort effect recognized for those aged 30 and higher). It is important to lead young people into the condition where they can join pension systems.

Note: This table only focuses on the parts of each report that are related to an empirical analysis of non-payment of National Pension contributions; any findings that are not related to it are not discussed, however important they are in other contexts. Note that some of the reports set contribution (participation) = 1 as an explanatory variable, so the sign of the explanatory variable means the reverse.

Table 1 Empirical analysis of non-payment of National Pension contributions, etc. (continued)

	(g) Maruyama and Komamura (2005)	(h) Suzuki and Zhou (2005)	(i) Nakashima, Usuki and Kitamura (2005)	(j) Nakashima and Usuki (2005)	(k) Tsukahara (2005)
	To analyze whether atypical workers (represented by proportion of college graduates who work as a temporary worker as a proxy) and the unemployed (represented by "non-employed high-school graduates" and "non-employed college graduates" as a proxy) are prone to be non-contributors, with diversified modes of work. In addition, to study whether a higher income leads to a lower rate of non-payment, and whether a higher rate of young people (represented by the rate of people in their 30s) leads to a higher rate of non-payment.	Different from Abe (2004) (Abe used data mainly on households in their 30s, with students and other household members than the heads), this is to analyze whether cohort effects may be ascertained on general data. In addition, to study whether there is a sharp rise in the rate of participation around the age of 35, which is the oldest age at which the requirement of 25-year participation can be met.	To study eight causes of non-payment of National Pension contributions: (1) liquidity constraint (low income), (2) liquidity constraint (other uses), (3) adverse selection (shorter life), (4) high risk tolerance (tolerance for changes in consumption), (5) subjectively high discount rate, (6) highly hyperbolic discounting (subjectively higher discount rate for near future than far future), (7) abundant funds in preparation for old age, and (8) uncertainty and distrust in the system.	In view of the fact that the non-payment of National Pension contributions is not sufficiently explained with the economic capacity to pay (i.e., liquidity constraint), this is to study four causes of non-contribution: (1) higher discount rate for near future than far future, (2) higher discount rate for near future than far future, (3) a feeling of obligation in the future is perceived, (4) a feeling of obligation when one feels it is a loss rather than an obligation), and (4) subjective life span (adverse selection factor).	To analyze whether there exists adverse selection by comparing the actual states of participation in public pensions and personal pensions or people's intention of participation in public pension systems if it is discretionary with the risks.
Purpose					
Data	(1) Data aggregated at the prefecture level, such as Basic School Surveys and Annual Reports of Prefectural Accounts, made into panels, and (2) Data aggregated at the municipal level, such as Pension Numbers, National Census, Survey on Taxation by Cities, Towns and Villages, and Population Estimates	Survey on Household Economy and Savings (1998, 2000, 2002 and 2004) by the Postal Services Research Institute, i.e., data on individuals collected by sampling households with the heads aged 20 or higher, with an effective response rate of around 62% for all years)	Subjects of experiments of behavioral economy: (1) 55 samples of students of Y state-university, (2) 66 samples gathered through a working student's job site called "Web-an" provided by Gakusei Engokai Co., Ltd., and (3) samples (55 non-participant samples with no contribution + 53 self-employed samples) gathered through the Survey Research Center. A questionnaire survey was conducted on those subjects gathered through those three routes after the experiments in January and February 2005 ended.	(* Same as the left)	3,500 male and female samples of self-employed people (where freelancers and managers belong to the same category) aged 20 or higher extracted from the master samples of Central Research Services, Inc., with a recovery rate of 51% (i.e., 1,799 samples), implemented in February and March 1997
Samples analyzed	(1) Data aggregated at the prefecture level: 1994-2002, and (2) data aggregated at the level of cities, towns and villages: 1994-2001	(1) Heads of households (which include no student samples that account for most of the non-participants), (2) heads of households aged 20-59, and (3) participants only in the National Pension, or non-participants (2,543 samples of participants only in the National Pension + non-participants (413 samples of the latter))	All the samples in the above field (Samples A) and a portion of them with an annual personal income before taxes of at least 1.3 million yen, with 99 samples (including 31 samples without making contributions at all), i.e., 13 samples fewer than analyzed. Because of the above-mentioned definition, Samples B included fewer students but more self-employed, more males and more people aged 35 or more than Samples A.	Focused on those with an annual personal income before taxes of at least 1.3 million yen, with 99 samples (including 31 samples without making contributions at all), i.e., 13 samples fewer than analyzed by the report of Nakajima, Usuki and Kitamura (2005).	Managers and self-employed people, excluding employees of private corporations who have changed jobs, and also limited to the age of 65 or more (of 816 samples, 62 samples are non-participants)
Empirical methods	(1) Data according to the prefecture: pool and panel estimate, and (2) data according to cities/towns/villages: cross-sectional estimate	Probit estimate with a restrictive condition that the sum of the effects of three parameters: age group, cohort and year, should be 1. Also, an estimate based on the Probit model with sample selection in two tiers by whether a sample should be a participant in the National Pension, and then, the person becomes a non-participant in the National Pension.	(1) Multiple linear regression analysis (with stepwise selection of variables), and (2) same as the above	Only analysis by means of a cross-aggregation table	Estimate based on Logit model
Explained variable	(1) Rate of non-payment of National Pension contributions (analysis based on data aggregated at the prefecture level), and (2) rate of confirmed contributions (analysis based on data aggregated at the level of cities, towns and villages)	Whether one is aware of his or her non-participation. This is different from the definition of the Social Insurance Agency ("if one has made even one contribution in the past, he or she is considered as a non-contributor but not a non-participant according to the definition of the Agency.")	(1) Payment history of National Pension insurance premiums in the past 24 months including the months for which exemption or special exemption for students is formally approved (1: full payment of premiums for 24 months to 5; no payment of them at all), and (2) intention of payment on the assumption of voluntary participation (1: certainly will pay, 5: certainly will not pay)	(1) Payment history for the past two years, and (2) intention of payment on the assumption of voluntary participation ("Same as the left)	(1) Participation in public pensions (participation = 1), (2) participation on the assumption of voluntary participation (participation = 1), and (3) participation in personal pensions

Table 1 Empirical analysis of non-payment of National Pension contributions, etc. (continued)

	(g) Maruyama and Komamura (2005)	(h) Suzuki and Zhou (2005)	(i) Nakashima, Usuki and Kitamura (2005)	(j) Nakashima and Usuki (2005)	(k) Tsukahara (2005)
Explanatory variables	(1) Estimate by prefecture: non-employed high-school graduates, proportion of college graduates with temporary work, non-employed college graduates, income level of the prefecture, proportion of people in their 30s, year dummy, and (2) Estimate by municipality: unemployment rate, income level, rate of single-person households, ratio of tertiary industry, proportion of people in their 30s	Dummy for unemployment/non-employment (which is excluded in case of sample selection, where 100% identified), amount of financial assets, household income, size of city, town or village, owning a house, number of household members, financial assets and household income were converted to real values based on the consumer price index of 2000.	(1) Contribution payment history, variables to correspond to hypotheses 1-3, sex, age of 35 or more, or not, dummy for non-regular employment (part-timer workers, temporary workers (excluding working students), contract employees, employees sent by labor agencies), dummy for the married, dummy for household member, and (2) voluntary participation: same as the above	(Cross-aggregated table) income, age, subjective discount rate	Sex, age, number of children, educational background, expected life span, participation/non-participation in personal pensions, household income, owning a house
Results	(1) By prefecture: effect of expansion of atypical work or unemployment to reduce the rate of contributions (particularly, magnitude of the coefficient of "proportion of college graduates with temporary work"). However, in the panel estimate, the effect of the income level of the prefecture is not stable. (2) By municipality: unemployment rate had a higher effect in 2001. The sign of the proportion of people in their 30s changed (i.e., turned negative for 2001). Increases in the proportion of single-person households and those in the proportion of atypical workers (represented by the "ratio of tertiary industry" in National Census as a proxy here) both reduced the rate of contribution payment.	The dummy for unemployment/non-employment is significantly + financial assets - owning house + and size of city, town or village +. The coefficient of those aged 35 or less is different from those aged over 35, so it is ascertained that there is a notch (a sharp decline indicating a letter V) there. A Wald test on such coefficients supported that the rate of non-participants sharply falls aged 35. A cohort effect was not recognized in either of the models.	(1) Contribution payment history: Samples A: owning a house without loans (-, non-contribution paid ↓), subjective life span (-), average of living expense in one's old age by National Pension benefit (+, non-payment ↓) Samples B: high personal income before taxes (-, non-payment ↓), subjective life span (-), average of relative orders of time preference rates (2) Voluntary participation: Samples A: owning a house without loans (-, no contribution paid ↓), the more tax payment is important, the more one is likely to pay voluntarily, risk aversion (-), agree with the view that National Pension premium revenue is used in wasteful ways (+), in favor of a large reduction in benefits and a large increase in insurance premiums to maintain the National Pension System (-), time preference rate for 800,000 yen at the point of one year later (+, no contribution paid ↓) Samples B: personal income before taxes (-, no contribution paid ↓), the more tax payment is important, the more one is likely to pay voluntarily, risk aversion (-), time preference rate for 800,000 yen at the point of one year later (+, no contribution paid ↓), if	(1) There does not appear to be a particular relationship between the household income and non-payment, as in Government surveys; younger generations tend to avoid making pension contributions more; no clear relation with hasbiness was observed. (2) High hasbiness leads to refraining from voluntary participation. There does not appear to be a clear relationship of hyperbolic discounting (subjective discount rate at the point of 10 years later - such rate at the point of one year later) with actual contribution payment or voluntary participation. There does not appear to be a clear relationship of one's lowest probability of rainfall in a weather forecast with which one would carry an umbrella with actual pension contribution payment or voluntary participation. The shorter the expected life span is, the higher the actual rate of non-contribution is.	(1) Actual participation in public pension systems: owning a house (+; probability of participation ↑) is the only significant variable. (2) voluntary participation in public pension systems: sex (+), age (+), expected life span (+), and (3) personal pension; household income (+), owning a house (+)
Policy implications	The system can no longer accommodate changes in the economic environment (unemployment).	Separating the effect of age from the cohort effect still does not make it possible to confirm the latter. It was confirmed again that there is a notch at the age of around 35.	The causes can be explained in the framework of traditional economics, so they are not anomalies. However, if there is a possibility of non-participants misunderstanding facts, it should be corrected by means such as providing information.	If one has a wrong subjective view, the behavior as mentioned above cannot be said to be rational. Correct information should be provided.	The cause of non-participation in public pensions is related to economic capacity (no adverse selection). The age variable, significant in voluntary participation, reflects the near-sightedness and unfairness among generations as causes of non-participation. If participation in public pensions is made on a voluntary basis, adverse selection may occur. For personal pensions, the expected life span is not effective, so there does not occur a cause of adverse selection (i.e., no possibility of sufficient life pension).

Note: This table only focuses on the parts of each report that are related to an empirical analysis of non-payment of National Pension contributions; any findings that are not related to it are not discussed, however important they are in other contexts. Note that some of the reports set contribution (participation) = 1 as an explanatory variable, so the sign of the explanatory variable means the reverse.

(i) Liquidity constraints

The proxy indicator for this factor is different from paper to paper, such as the ratio of insurance premiums to the amount of consumption or income, personal income, or household income, however, almost all relevant studies recognize that liquidity constraints are a cause of non-payment to the National Pension. On the basis of such results, it is suggested that a more detailed premium schedule corresponding to income levels should be set.

(ii) Diversified modes of employment

The proxy indicator for this factor is different from paper to paper, such as contract employees, non-regular employees, or tertiary industry workers. However, Ogura and Kadoda (2000), Abe (2003), and Maruyama and Komamura (2005) recognize that diversified modes of employment would significantly increase the probability of non-payment to the National Pension.

(iii) Unfairness among generations

The cohort effect by which younger cohorts (groups according to their birth date) who have strong feeling of unfairness against the pension system are therefore more likely not to join the system, was analyzed and clearly shown by Ogura and Chiba (1991), and Suzuki and Zhou (2001). However, when Abe (2003), or Suzuki and Zhou (2005), performed a more precise analysis controlling the cohort effects, this did not render a significant result. Accordingly, there is room for argument about this effect.

(iv) The requirement of 25-year participation

Suzuki and Zhou (2001, 2005), and Abe (2001), considered the age of 35 as the limit for qualifying for pension benefits, and examined whether people's behavior regarding non-participation in the pension systems was different before and after that age. Both studies recognize that there is a turning point around the age of 35, and thus, the requirement of 25-year participation has an effect. On the basis of such results, it is suggested that this requirement should be abandoned.

(v) The propensity for risk aversion

Nakajima, et al. (2005), used people's lowest probability of rainfall in a weather forecast for which he or she would carry an umbrella (an assumed weather forecast), or a preferred saying as a proxy variable for this factor. The results show that the former is not significant, but that higher risk-aversion represented by a preferred saying would decrease the rate of non-payment to the pension system significantly.

(vi) Adverse selection

Nakajima, et al. (2005), Nakajima and Usuki (2005), and Tsukahara (2005) used subjective expected lifespan as a proxy indicator for adverse selection, and all show that it is significant as a factor for non-participation, or for voluntary non-participation under an assumed situation, so they assert that adverse selection was ascertained.

(vii) Hyperbolic time discounting (an issue at the stage of information processing)

Nakajima, et al. (2005) explicitly addressed this factor for the first time. As discussed above, if this factor is confirmed, it can theoretically be a rationale for mandatory pension systems. However, according to Nakajima, et al. (2005), this factor did not show such a significant effect as to support the hypothesis. However, Nakajima, et al. (2005) recognized that the higher the subjective time discount, the higher the probability of non-payment.

With respect to the issue of the adverse selection problem, there is, however, room for argument whether a subjective expected lifespan can be considered as a proxy indicator in an exact sense. That is because, as pointed out by Nakajima and Usuki (2005), a person's subjective expected lifespan is not necessarily equal to his or her actual lifespan. Unless it is proved that people's subjective expected lifespan coincide with, or are correlated to, their actual life spans, the difference between the subjective expected lifespan and the average expected lifespan may not be an appropriate proxy indicator for adverse selection, but should be considered as a lack of an individual's long-term information. Even so, if either the effect of adverse selection or a lack of long-term information is ascertained, it can be a rationale for compulsory participation in the pension system.

3. Data and Analytical Framework

(1) Data

We performed an empirical analysis of non-payment to the National Pension system on the basis of an individual level microdata set, especially related to the issue of hyperbolic time discounting. We used a data set from an original survey, *Survey on Attitudes about Pensions (SAP)*, conducted in the Research Project on the Pension System to Accommodate to Diversified Modes of Employment, in which the authors took part.

This survey was designed to analyze non-payment (i.e. evasion) to the National Pension. It covered 2,600 males and 2,059 females across the country. Questionnaires were sent and received by post between September 30 and October 19, 2005. The effective response rate was 40% with about 1,000 samples obtained.

Of these, this paper uses 824 samples, excluding those with missing values, students and those who have already received public pension benefits. The 824 samples were divided into two groups: (I) A National Pension group (256 samples) and (II) Others (568 samples), for analysis.

(I) The National Pension group specifically consists of (Ia) National Pension participants, (Ib) non-participants in public pensions, and (Ic) National Pension non-contributors. (Ia) National Pension participants are defined as those who have joined the National Pension system, and pay, or are exempted from paying, monthly contributions. National Pension non-contributors are defined as an aggregation of (Ib) and (Ic), for the purpose of this paper.

(II) Others consist of category II insured persons (mainly regular employees of corporations or public organizations) who have joined Employees' Pension Insurance or mutual aid associations' pension systems, and category III insured persons who are dependents of category II insured person, as spouses. Hereinafter they are called an Employee group.

(2) Analytical Framework and Hypotheses

The following empirical analysis consists of a Probit analysis on (I) National Pension group with actual contributions to the National Pension as dependent variable (non-payment = 1), and a Probit analysis on both (I) the National Pension group and (II) the Employee group who offered voluntary participation in response to the question "Would you participate in a public pension system if participation is on a voluntary basis (i.e., you can decide whether you join or not)" as an explained variable (voluntary non-participation = 1). In the present National Pension system, generally non-participation actually occurs only if a person fails to follow the procedure to join the system when he or she changes jobs. However, non-participation is the same as non-payment of contributions in that insurance premiums are not paid. It is difficult to distinguish non-payment from non-participation in the data. In this paper, therefore, non-payment of pension premiums is considered equivalent to non-contribution.

Following the prior studies, we selected independent variables to correspond to five hypotheses, excluding diverse modes of employment and unfairness among generations. Specifically the variables used were:¹¹⁾

(i) Liquidity constraints

A person's income from his or her job (unit: 10,000 yen), in comparison with the average household income. It was expected that the lower a person's income, the higher the probability of non-payment (or voluntary non-participation) (+).

(ii) The requirement of 25-year participation

Whether it is possible for a person to satisfy the requirement of 25-year participation by the age of 60. If a person knows that he or she will not be able to satisfy such requirement for qualification for National Pension benefits, it is assumed that the probability of his or her non-payment (or voluntary non-participation) will rise (+).

¹¹⁾ For the factor of diversified modes of employment, it was impossible for the authors to obtain enough samples for analysis on the basis of positions in work from the data. Therefore, no variables for the hypothesis on that factor are included.

(iii) The propensity for risk aversion

A person's lowest probability of rainfall in a weather forecast for which he or she would carry an umbrella, and whether a person invests in stocks. It is assumed that a person with a high propensity for risk aversion would carry an umbrella even when the probability of rainfall is low. Such a person would also refrain from investing in stocks. For such persons, the probability of non-payment (or voluntary non-participation) would be lower because they would like to avoid the risk of living without pension benefits in the future (-).

(iv) Adverse selection / lack of long-term information

The gap between the subjective expected lifespan and the average expected lifespan. If the subjective expected lifespan is longer than the average expected lifespan, the probability of non-payment (or voluntary non-participation) would decline (-).

(v) Hyperbolic time discounting / issue in the stage of information processing

The relationship among time discount rates for one week later, one year later and ten years later¹²⁾ is divided into six categories: (a) larger than 20% for three points in time, (b) one week (more than 20%) > one year > 10 years, (c) one week (20% or less) > one year > ten years, (d) one week < one year < ten years, (e) no particular tendency, and (f) the same for three points in time. Among these, (a), (b) and (c) involve hyperbolic time discounting, so it is assumed that the probability of non-payment (or voluntary non-participation) would rise with (a), (b) or (c) (+). Those who fall into categories (d) or (e), could inter-temporarily maximize their utility inconsistently. For those who fall under (d), which induces inconsistent inter-temporal utility maximization, the probability of non-payment (or voluntary non-participant) could rather decline (-).

We pay special attention to the coefficients of the variables related to the hypotheses of (iv) and (v) as rationales for compulsory participation in pension systems. If those coefficients take predicted signs (plus or negative), the hypotheses could be rationales for compulsory participation in pension systems.

Moreover, the state of assets (including participation in personal pensions), personal attributes (age, and married or single), local attributes, etc., were added as control variables.

Basic statistics for the variables for each group are shown in Table 2.

4. Empirical Results

(1) Preliminary analysis of non-payment of National Pension contributions

In this paper, we intended to elucidate whether rationales exist for compulsory participation in pension insurance systems. As mentioned above, such rationales could be related to a lack of long-term information and defective information processing, and adopted two variables: subjective lifespan and hyperbolic time discounting as proxy indicators for these.

Before discussing the results of parametric analysis, we show the distributions of those two important variables concerning non-payment to the National Pension. Figure 2 shows the distribution of subjective expected life spans by age group and according to non-contributors and non-participants in the National Pension.

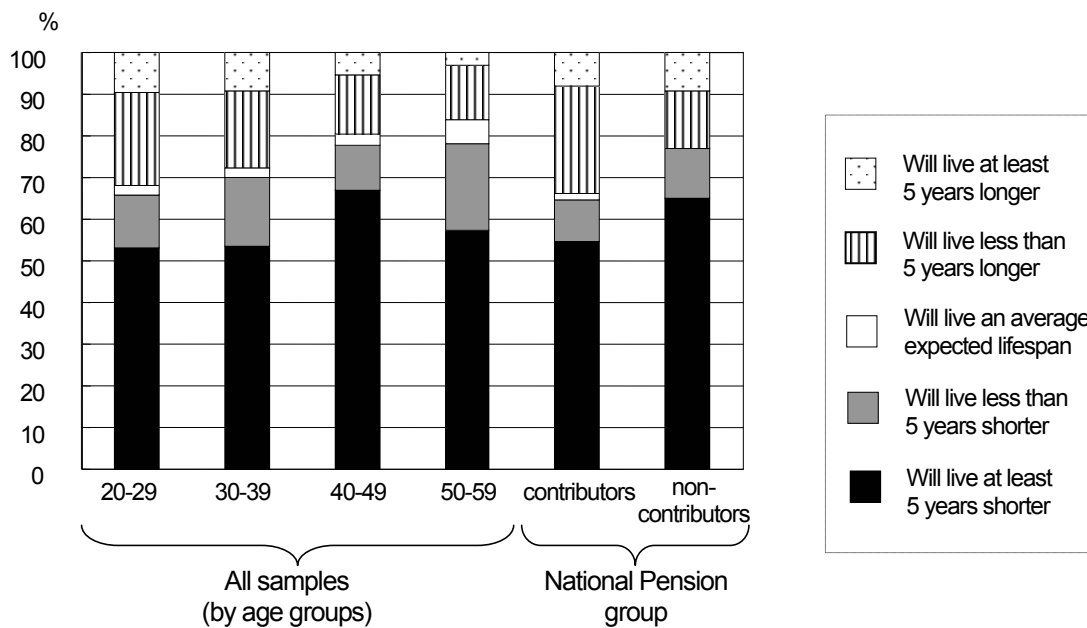
The first thing to be noted is that the percent of those who subjectively think that they will live longer than the average expected lifespan is smaller than those who subjectively think that they would live for shorter, for each age group. In other words, those in each of the age groups tend to subjectively think that they will live for shorter than the average expected lifespan.

¹²⁾ Specifically, in the question: "Which would you think is better to receive (A) 10,000 yen today or (B) another amount after a certain period?", three periods are set: one week, one year and ten years, and the choices of interest rates for (B) are 0%, 2%, 6%, 10% and 20% on 10,000 yen. Thus, in this paper, the interest rate chosen by the subject is considered as a time discount rate.

Table 2 Basic statistics

	(I) National Pension group		(II) Employee group	
	Mean	[Std.Dev.]	Mean	[Std.Dev.]
Non-payment of National Pension contributions(=1)	0.168	[0.374]
Voluntary non-participation in public pensions(=1)	0.734	[0.442]	0.593	[0.491]
Age	37.145	[11.25]	36.467	[10.22]
Woman	0.371	[0.484]	0.511	[0.500]
Junior-high school graduate	0.117	[0.322]	0.000	[0.000]
Senior-high school graduate	0.523	[0.500]	0.428	[0.495]
Junior-college or college-of-technology graduate	0.176	[0.381]	0.241	[0.428]
University/College, or graduate-school graduates	0.184	[0.388]	0.296	[0.457]
With spouse	0.426	[0.495]	0.613	[0.488]
One's own income from a job (unit: 10,000 yen)	174.836	[202.3]	295.667	[255.6]
Much lower than the average household income	0.305	[0.461]	0.106	[0.308]
Impossible to satisfy the requirement of 25-year participation by the age of 60	0.035	[0.185]	0.026	[0.160]
Category III insured	0.225	[0.418]
Employed	0.254	[0.435]	0.121	[0.327]
Gap from the average expected life span (years)	-6.848	[11.43]	-5.894	[8.452]
(100-a person's lowest probability of rainfall in a weather forecast for which he or she would carry an umbrella) / 100	0.471	[0.194]	0.505	[0.189]
No stock investment	0.457	[0.499]	0.463	[0.499]
Time discount rates: larger than 20% for three times	0.152	[0.360]	0.070	[0.256]
Time discount rates: one week (larger than 20%) > one year > ten years	0.348	[0.477]	0.398	[0.490]
Time discount rates: one week (20% or less) > one year > ten years	0.063	[0.243]	0.077	[0.268]
Time discount rates: one week < one year < ten years	0.113	[0.318]	0.144	[0.352]
Time discount rates: no particular tendency	0.168	[0.375]	0.185	[0.389]
Time discount rates: 0% for three times	0.023	[0.152]	0.016	[0.125]
Time discount rates: the same for three times (except for the above)	0.133	[0.340]	0.109	[0.312]
Household debts (unit: 10,000 yen)	462.109	[798.1]	611.224	[917.9]
Financial assets of household (unit: 10,000 yen)	541.504	[792.4]	602.333	[782.9]
Home ownership	0.340	[0.475]	0.398	[0.490]
Place of residence: country, town, village	0.188	[0.391]	0.113	[0.316]
Place of residence: city designated by ordinance	0.254	[0.436]	0.252	[0.434]
	<i>N</i>	256	568	

Source: Estimation from *Survey on Attitudes about Pensions* (2005) by the authors



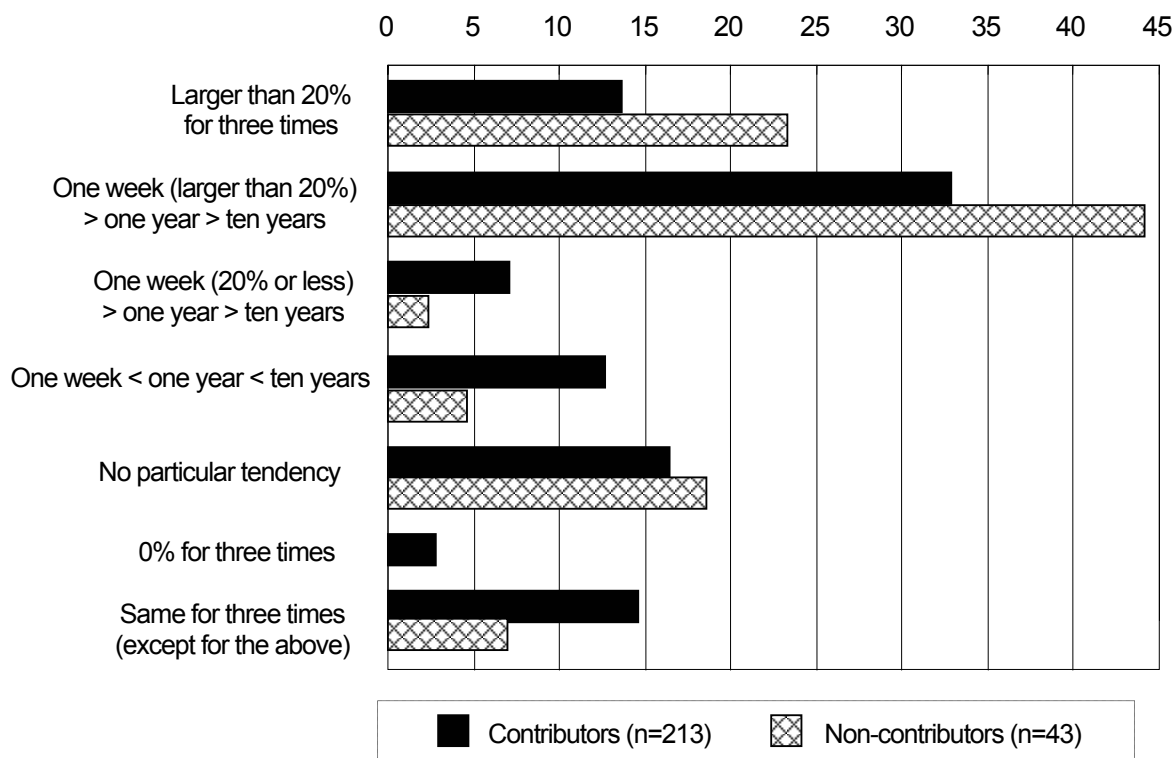
Source: Estimation from the *Survey on Attitudes about Pensions* (2005) by the authors

Figure 2 Subjective expected lifespans and non-payment of National Pension contributions (=1)

In addition, in the comparison between those who have paid insurance premiums and those not in the National Pension group, it is apparent that the percent of those who expect their lifespans to be at least five years shorter than the average expected lifespan is larger by 10 points in the group of those who did not contribute to the National Pension plan than those who paid such contributions. If their subjective expected longevity coincided with their actual longevity, there would be no problems. However, in case of National Pension non-contributors who subjectively expect to coincide with their longevity, with a downward bias from the actual longevity, they would have to live without pensions or with low pension benefits for a long time in their old age.

For hyperbolic time discounting as a proxy indicator of defective information processing, this has been categorized into seven types in Figure 3, where the difference between those who have made contributions to the National Pension (Contributors) and those who have not (Non-contributors), is observed. In the comparison between the Contributors and the Non-contributors, it is recognized that: 1) those with time discount rates of at least 20% for all the times of one week, one year and ten years; and 2) those with higher time preference rates for the near future rather than the distant future, i.e., a hyperbolic preference, account for higher proportions of the Non-contributor group than in the Contributor group.

To sum up, there are differences between Contributors and Non-contributors in terms of their subjective lifespans and their hyperbolic time discount rates, as seen from cross-tabulations. In other words, it appears that participation in insurance systems involves both the issue of a lack of long-term information and defective information processing.



Source: Estimation from *Survey on Attitudes about Pensions* (2005) by the authors

Figure 3 Time discount rates and non-payment of National Pension contributions

(2) Probit analysis of non-contribution to the National Pension System and voluntary non-participation in public pension systems

The results of a Probit analysis, with personal attributes controlled, on what effects those variables have on non-contribution to the National Pension or voluntary non-participation in public pensions in an assumed situation, are shown in Table 3.

The attributes used as bases for analysis are male, employed, junior-high-school graduate, and the same time discount rate for three points in time (except for at least 20% for three points in time).

Let us consider the actual payment behavior of the National Pension group. The first column in Table 3 shows the results. Table 3 does not show coefficients, but rather marginal effects. For example, the group junior-college or college-of-technology graduate shows a value of -0.122 with a significance of 5%. This means that, if all other conditions are the same, junior-college or college-of-technology graduates show a 12% lower probability of non-payment of National Pension insurance premiums than junior-high school graduates do.

Table 3 Probit analysis of non-contribution to/voluntary non-participation in pension systems

	Analysis of non-contribution to National Pension		Analysis of voluntary non-participation in National Pension		Analysis of voluntary non-participation in public pension	
	(I)National Pension group		(I)National Pension group		(II)Employees group	
	dF/dx	[Std. Dev.]	dF/dx	[Std. Dev.]	dF/dx	[Std. Dev.]
Age	-0.006	[0.003] **	-0.001	[0.003]	-0.009	[0.003] ***
Woman	-0.018	[0.049]	0.068	[0.060]	-0.052	[0.056]
Senior-high school graduate	-0.122	[0.060] **	-0.287	[0.106] **	0.032	[0.115]
Junior-college or college-of-technology graduate	-0.121	[0.040] **	-0.325	[0.171] **	0.011	[0.121]
University/college or graduate-school graduates	-0.079	[0.046]	-0.362	[0.161] **	-0.112	[0.122]
With spouse	0.007	[0.049]	0.065	[0.062]	0.101	[0.058] *
One's own income from a job (unit: 10,000 yen)	0.000	[0.000]	0.000	[0.000] ***	0.000	[0.000]
Much lower than the average household income	0.006	[0.048]	0.059	[0.058]	0.087	[0.070]
Impossible to satisfy the requirement of 25-year participation by the age of 60	0.425	[0.194] ***	0.108	[0.106]	-0.100	[0.141]
Category III insured					0.001	[0.081]
Unemployed	0.048	[0.063]	0.081	[0.067]	0.016	[0.082]
Gap from the average expected life span (years)	0.000	[0.002]	-0.007	[0.003] **	-0.004	[0.003]
(100 - a person's lowest probability of rainfall in a weather forecast for which he or she would carry an umbrella)/100	0.026	[0.104]	0.144	[0.152]	0.003	[0.115]
No stock investment	0.011	[0.043]	-0.002	[0.058]	-0.027	[0.046]
Time discount rates: larger than 20% for three times	0.194	[0.116] **	0.195	[0.061] **	0.010	[0.101]
One week (larger the 20%) > one year > ten years	0.157	[0.084] **	0.149	[0.076] *	0.067	[0.069]
One week (20% or less) > one year > ten years	-0.011	[0.120]	0.066	[0.098]	-0.113	[0.100]
One week < one year < ten years	-0.034	[0.087]	0.125	[0.076]	0.013	[0.080]
Time discount rates: no particular tendency	0.141	[0.112]	0.147	[0.067] *	0.141	[0.073] *
Debts of household (unit: 10,000 yen)	0.000	[0.000]	0.000	[0.000] **	0.000	[0.000] **
Financial assets of household (unit: 10,000 yen)	0.000	[0.000]	0.000	[0.000]	0.000	[0.000]
Owning a house	-0.042	[0.052]	-0.228	[0.078] ***	-0.060	[0.060]
Place of residence: country, town, village	-0.038	[0.047]	0.004	[0.074]	-0.108	[0.072]
Place of residence: city designated by ordinance	0.123	[0.064] **	0.004	[0.067]	0.013	[0.051]
Log Likelihood	-96.235		-125.300		-347.350	
Pseudo R²	0.170		0.155		0.064	
N	256		256		568	
(Ratio of explained variable = 1(%))	17%		73%		59%	

Note: ***, ** and * indicate significances of 1%, 5% and 10% respectively. The reference groups are "male", "having a job", "having a spouse", and "owning no house". Dummy variables for education levels are based on "junior-high school graduate"; and those for time discount rates on "the same time discount rate for three points in time" except for at least 20% for all three points in time. Students are excluded from the analysis because they can apply for a special exemption rule.

Source: Estimation from the *Survey on Attitudes about Pensions (2005)* by the authors

In the estimate's results, significant variables are summarized as follows:

- (i) As age increases, the probability of non-payment of National Pension contributions becomes lower. This was confirmed on the basis of the aggregated data published by the Social Insurance Agency (Maruyama and Komamura (2005)). On the other hand, in the National Pension group, age does not affect behavior if participation is on a voluntary basis. The reason why the actual payment of contributions is different from the results on the assumption of voluntary participation may be an effect of the requirement of 25-year participation. The estimate's results show that the awareness of the impossibility of satisfying the requirement of 25-year participation by the age of 60 increases the probability of non-payment in the National Pension group by 43%. On the other hand, the requirement of 25-year participation may promote the payment of insurance premiums for those under 35 years of age. This can also be deduced from the fact that aging has a negative effect on payment behavior. There is, therefore, some doubt as to whether it is preferable that the requirement of 25-year participation be abolished, as asserted by Suzuki and Zhou (2001, 2005), and Abe (2001). However, to ascertain that the requirement of 25-year participation has an absolute effect of inducing the generation under the age of 35 years to make contributions to the National Pension, it is necessary to analyze past contribution records directly (i.e., panel data), not just the state of contributions at one time point (i.e., cross-section data). This is a subject for future studies.
- (ii) Those with higher time discount rates, of at least 20%, show a higher probability of non-payment and they would be more likely to be non-participants in the National Pension group if participation is on a voluntary basis. This is because they value consumption at present much higher than that in the future. It might be rational in that sense.
- (iii) A preference on hyperbolic time discounting by which people value consumption at nearer points in time higher would increase the probability of non-contribution to the National Pension by 19%. A preference with high hyperbolic discounting would increase the rate of voluntary non-participation in the National Pension group.
- (iv) A one-year extension in the subjective expected lifespan would result in a 1% drop in the probability of voluntary non-participation in the National Pension group. This suggests that, if the subjective expected lifespan corresponded to the objective expected lifespan, there would be an adverse selection problem.
- (v) In the Employee group, the above-mentioned variables have little significant effects on the probability of voluntary non-participation in public pension systems, except for age. That may be because: 1) insurance premiums and benefits in employees' pension systems are proportional to their wages, different from the National Pension with flat-rate insurance premiums and flat-rate benefits, and therefore, respondents might provide their responses on the basis of premiums and benefits proportional to their wages on the assumption of voluntary participation, and/or 2) those in the Employee group might be psychologically more dependent upon a public pension if it effectively permits consumption smoothing relative to the National Pension. Thus, it may be affected by unobserved factors.

5. Conclusion

This paper analyzed the effects of time discount rates on contribution payments and participation in pension systems. As a consequence, it is recognized that people with excessively high time discount rates or hyperbolic time discount rates have less incentive to pay contributions and join pension systems. As in other studies on hyperbolic discounting, this study also suggests that persons are generally vulnerable to short-term temptation, and are not good at making rational plans on a long-term basis, and that they might regret not having paid pension contributions or not having joined pension systems, as in the case of health, debts, or multiple debts.

Economics has so far explained that the reason for the existence of public pension systems is adverse selection, i.e., market failure. However, there may be cases of non-payment and non-participation because of hyperbolic time discounting, and then, it may be possible to justify the government's forcible participation in pension systems on a paternalistic basis. This enforcement would supplement the limitation of an individual's capacity for planning long-term savings/consumption. This implies no permission for easy withdrawal from defined contribution pension plans of lump-sum money if such pension plans are used as a substitute for public pensions, with matching

contributions or preferential tax treatment expanded, when the level of benefits of the public pensions diminishes in the future. In other words, it would be necessary to restrict the right to withdraw from, or terminate a contract with, defined contribution pension plans. In view of the foregoing, it is justifiable to expand compulsory participation for atypical workers to be covered by Employees' Pension Insurance in which compulsory participation can be more effectively implemented, in order to prevent non-payment of pension contributions by atypical workers. Even in the current system, some atypical workers can be covered by Employees' Pension Insurance, but do not join in many instances. The first priority is to ensure that Employees' Pension Insurance covers all those deemed to be under its coverage and it is necessary to ensure the strict implementation of such systems and collection of contributions in the reforms of the Social Insurance Agency, currently underway. The responsibility for monitoring this should be shared by the Board of Audit of Japan.

In addition, if voters are aware of the above-mentioned time preference, they may spontaneously support such policies with a view to committing themselves to pension systems so that they will not experience regrets in the future.

Besides the rationales for compulsory participation, another implication is whether to change the current 25-year participation and contribution requirement for qualification for benefits. This requirement has the effect of encouraging and discouraging the payment of pension contributions. Although the basis for the number of years itself is not very legitimate, the rule of the qualification period, i.e., by which a person receives no pension benefits at all unless he or she pays pension insurance premiums for a total of 25 years, including periods of being exempted from such premiums, may induce people to commit themselves more to pension systems as they grow older: 1) because they will receive no pension benefits at all if they do not pay premiums fully in the period after their mid-thirties at the latest; and 2) because, even if they pay some premiums, they cannot receive any pension benefits without a total of 25 years of contributions, including periods of exemption, nor can they receive a refund of paid insurance premiums. The rule, however, has the effect of discouraging people completely against paying premiums when they are aware that they no longer have a chance of satisfying the requirement of the period for qualification. There should be a more detailed consideration of the most appropriate qualification period, based on the optimized combination of people's commitment and the flexibility of the system.

The issue of statutory limitation on payments should also be reconsidered. A person with a hyperbolic time preference is disposed to feeling regret for what he or she did, so such a person may wish to pay contributions after two years of the statutory limitation has expired¹³⁾. Would it be better to extend the statutory limitation period? This would give rise to another problem. In some extreme cases, the most rational behavior is for a person to pay premiums after he or she has made sure that an insured accident has occurred. The insurance system would then collapse¹⁴⁾. If the statutory limitation period is extended, it may be suggested that an additional cumulative insurance premium should be charged punitively.

This analysis of hyperbolic time discounting does not measure direct discounting, but simply adopts an explanatory variable of whether preference changes according to temporal distances. In behavioral economics, studies on hyperbolic discount rates by more precise methods have been developed, and thus, analyzing the non-payment of pension contributions by such study methods will be a future issue.

¹³⁾ For the case of exemption or some specific payment, the statutory limitation is ten years, but interest is added to insurance premiums. The government has set a time-limited system for voluntary participation for people at the age of 60 or older, so that they can satisfy the required participation period for qualification for benefits. Actually, the time limit for that system was extended each time during pension system reforms. At this point, generations of 40 years of age or older (for women) are now allowed to join the pension system voluntarily until they reach 70 years old.

¹⁴⁾ For example, in an extreme case, one would pay an amount of insurance premiums for 40 years in a lump sum when the person actually reaches age of 65.

References

- Abe, Aya (2001), 'Revision of Insurance Premium Exemption System of National Pension: Rates of Non-participation and Non-payment of Premiums, and Effect on Inverse-progressiveness,' *Nihon Keizai Kenkyu* 43, pp. 134-154.
- (2003), 'An Analysis of Non-participation in Public Pensions,' *The Quarterly of Social Security Research*, Vol. 39:3, pp. 268-285.
- Ainslie, George (2006), *Breakdown of Will*, Cambridge University Press.
- Amador, Manuel, Ivan Werning and George-Marios Angeletos (2003), 'Commitment vs. Flexibility,' *MIT Working Paper*; pp. 03-40.
- Diamond, Peter (1977), 'A Framework for Social Security Analysis,' *Journal of Public Economics*, Vol. 8:3 (Dec.), pp. 275-298.
- Dennett, Daniel Clement (2003), *Freedom Evolves*, Penguin (translated by Yamagata, Hiroo (2005), *Freedom Evolves*, NTT Publishing Co., Ltd.).
- Fang, Hanming and Dan Silverman (2004), 'On the Compassion of Time-limited Welfare Programs,' *Journal of Public Economics*, Vol. 88, pp. 1445-70.
- Hirota, Sumire, Shinya Masuta, and Takayuki Sakagami (ed.) (2002), *A Picture of World of Risk by Psychology*, Keio University Press.
- Komamura, Kohei (2001), 'A Positive Analysis of Non-payment of Social Insurance Premiums,' Maruo, Naomi, Masumura, Machiko, Yoshida, Masahiko, and Iijima, Hirokuni, *General Policies of Post-welfare State*, Minerva Publishing Co., Ltd.
- (2006), *Research on Pension System to Accommodate to Diversified Modes of Employment*, in the framework of Research on Policy Planning and Evaluation by support of Health and Labor Sciences Research Grants.
- Maruyama, Katsura and Kohei Komamura (2005), 'The Issue of Decay in National Pension, and the Way the Pension System Should Be,' in *New Institutional Design of Social Security System*, compiled by Kido, Yoshiko and Kohei Komamura, Keio University Press, pp. 223-250.
- Ministry of Internal Affairs and Communication (2004), *Administrative Evaluation and Monitoring on Pension – Focused on National Pension Operations – Secondary Advice on the Basis of Evaluation and Monitoring Results*, (http://www.soumu.go.jp/hyouka/pdf/nenkin_result_02_1.pdf).
- Nakashima, Kunio, Seiji Usuki and Tomoki Kitamura (2005), 'Behaviors of Participation and Contribution Payment of First Category Persons Insured in National Pension, and Effective Way of Provision of Information,' in *Research on System to Provide Each Individual with Information on Benefits and Cost of Public Pensions for Him or Her*, by NLI Research Institute, in the framework of Research on Policy Planning and Evaluation by support of Health and Labor Sciences Research Grants of Fiscal 2004 (2004 General Research Report), pp. 55-75.
- Nakashima, Kunio and Masaharu Usuki (2005), 'Causes of Non-contributions to National Pension,' *Nissei Kisoken Report*, June, pp. 1-6.
- Ogura, Seiritsu and Tomotaro Chiba (1991), 'The Burden of Social Insurance Premiums in Japan in an Aspect of Fairness,' *Financial Review*, Vol. 19, pp. 27-53.
- Ogura, Seiritsu and Tamotsu Kadoda (2000), 'An Analysis of Payment and Collection of Social Insurance Premiums on Household Data,' *Keizaiken*, Vol. 51:2, pp. 97-110.
- Suzuki, Wataru and Yanfei Zhou (2001), 'An Economic Analysis of Non-Contributors to National Pension Contribution,' *Nihon Keizai Kenkyu*, 42, pp. 44-60.
- (2005), 'An Economic Analysis of Non-participants in National Pension: Focused on Cohort Effects of Participants,' in the framework of positive analysis of Research on Specified Area, *Positive Analysis and Design of Economic Systems*, by support of Grants-in-Aid for Scientific Research by Ministry of Education, Culture, Sports, Science and Technology, *Discussion Paper Series*, No. 75.
- Tada, Yosuke (2003), *An Introduction to Behavioral Economics*, Nikkei Inc.
- Tanahashi, Shunsuke (2006), 'Attached Material: An Explanation of Attitude Survey on Pension, etc.,' in *Research on Pension System to Accommodate to Diversified Modes of Employment*, in the framework of Research on Policy

Planning and Evaluation by support of Health and Labor Sciences Research Grants of Fiscal 2005 (2005 General Research Report), pp. 169-86.

Tomono, Norio (2006), *Behavioral Economics*, Kobun Shinsho.

Toshino, Masashi (2004), *Security Market and Behavioral Finance*, Toyo Keizai, Inc.

Tsukahara, Yasuhiro (2005), 'Adverse Selection in Pension,' in *Aging Society, and Health and Welfare Policies*, Tokyo University Press, pp. 3-16.