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Untapped work capacity among old persons and their potential contributions to the "silver dividend" in Japan

Rikiya Matsukura [a,*], Satoshi Shimizutani [b], Nahoko Mitsuyama [c], Sang-Hyop Lee [d], Naohiro Ogawa [c,e]

[a] Nihon University, Japan
[b] Ricoh Institute of Sustainability and Business, Japan
[c] University of Tokyo, Japan
[d] University of Hawaii, United States
[e] University of Malaya, Malaysia

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ABSTRACT

In contemporary Japan, the utilization of healthy elderly persons in economic production is one of the most urgent policy matters. In this paper, we have measured the untapped work capacity of old persons, using the microdata gathered in the Japanese Study of Aging and Retirement (JSTAR), a longitudinal survey carried out on subjects aged 50–75. Our computed results show that the volume of untapped work capacity of the Japanese elderly aged 60–79 is vast, amounting to more than 11 million workers at present. We have also applied the computed results to the National Transfer Accounts (NTA) framework, and quantified the magnitude of the use of the untapped work capacity upon potential economic growth. The accumulated effect of the economic support ratio upon potential economic growth is substantial in the long term, generating a sizable amount of the so called "silver dividend". We have also examined the issue of whether or not the use of untapped work capacity provided by old persons could affect the well-being of workers in other age groups. The regression results support the view that the substitutability between the selected age groups of the elderly and the young is negligible, so that the utilization of potential work capacity of elderly persons is unlikely to pose any serious threat to the employment opportunities of their young counterparts in Japan.

Introduction

Over the past several decades, Asia's demographic landscape has witnessed a series of dramatic changes. Until the beginning of the 1980s, an overwhelming majority of developing countries in Asia perceived population aging as an issue prevailing only among developed countries. However, as a consequence of rapid declines in fertility toward the end of the 20th century, coupled with remarkable improvements in longevity, many countries in Asia, both developed and developing, have been experiencing unprecedented changes in their age structures. In some of them, the child dependency ratio has been declining swiftly, generating an important demographic dividend - Cambodia, Vietnam and the Philippines are salient examples. In others such as South Korea and Thailand, the rise in old age dependency has been creating formidable new policy challenges. It should be stressed that the policy response to these changes will obviously influence economic growth and poverty, intergenerational equity, and social welfare for many years ahead.

In Asia, Japan's fertility decline was the earliest to occur. In addition, it was also the greatest in magnitude among all the industrialized nations. Following a short-lived baby boom period (1947–1949), Japan's fertility dropped at a phenomenal speed (Hodge and Ogawa, 1991; Ogawa and Retherford, 1993; Retherford and Ogawa, 2006). Between 1947 and 1957, the total fertility rate (TFR) in Japan declined by more than 50 percent, from 4.54 to 2.04 children per woman. This 50-percent reduction of fertility over a 10-year period was the first such experience in the history of mankind. Subsequent to this rapid fertility reduction in the 1950s, there had been only minor fluctuations around the replacement level until the first oil crisis in 1973. Thereafter, the TFR started to fall again and sunk to 1.26 in 2005, which was an all-time low in Japan's modern history. It should be noted, however, that after 2005, the Japanese TFR slowly recovered to 1.46 in 2015. If fertility were to remain constant at the current level, each successive generation would decline approximately at a rate of 30 percent per generation.

* Corresponding author.
E-mail address: matsukura.rikiya@nihon-u.ac.jp (R. Matsukura).

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Although Japan's recent very low fertility has been attracting a great deal of attention, both domestically and internationally (Ogawa et al., 2015), only a limited amount of attention has been paid to the unprecedented rapidity with which its mortality transition has been under way. Age-specific mortality rates have declined remarkably since the close of World War II. During 1947–1965, Japan's life expectancy at birth rose from 50.1 to 67.7 years for men and from 54.0 to 72.9 years for women. When Japan joined the OECD at the end of 1964, its life expectancies for both men and women were the lowest among all the OECD member countries (Mason and Ogawa, 2001). By the mid-1970s, however, Japanese life expectancy had become one of the highest among the OECD members. In 2015, male life expectancy at birth reached 80.8 years to become the fourth highest in the world, following Hong Kong, Iceland and Switzerland, and female life expectancy became 87.1 years, the second highest in the world after Hong Kong. Moreover, between 1964 and 2015, life expectancy at age 65 grew substantially, from 12.2 to 19.5 years for men and from 14.8 to 24.3 years for women, implying a marked increase in the retirement period and in the joint survival of husbands and wives to older ages. Primarily because of such long-term improvements in mortality, the number of centenarians has been increasing at an annual rate of 13 percent over the past five decades (National Institute of Population and Social Security Research, 2016). In addition, according to one of the recent papers published in the British medical journal *Lancet* (Global Burden of Disease Study 2013 Collaborators, 2015), Japan has been ranked first in healthy life expectancy in the world.

Due to these rapid demographic transformations, the age distribution of the Japanese population has been changing rapidly over the past several decades. Ever since 2005 when it surpassed Italy, Japan has been the most aged society in the entire world. In addition, the absolute size of Japan's total population has been continuously diminishing since 2010.

In view of these fast demographic shifts, the Japanese government is becoming increasingly alarmed over the country's aging and declining population and has looked into possible measures to cope with, or even, reverse such trends. Major government concerns include a possible loss of economic dynamism and future difficulties in maintaining the solvency of the country's social security system, which has provided universal pension and medical care coverage since 1961 (Ogawa and Retherford, 1997). In addition, businesses are concerned about the shrinking numbers of consumers on the demand side and workers on the supply side (Matsukura et al., 2007). Furthermore, with one or two or even no children, adults worry about who will take care of them in their old age (Ogawa and Ermisch, 1996).

Undoubtedly, the policy responses to these demographic changes will influence economic growth and poverty, intergenerational equity, and social welfare in Japanese society for many decades ahead. Obviously, some of these policy responses can be generated from the labor market. Although Japan's total labor force has been declining since 1998, the labor force participation rate for men 65 and older has remained around 30 percent in recent years, which is substantially higher than the corresponding values for Europe (which remain below 10 percent). Older women in Japan are also more likely to continue working than their counterparts in industrialized countries in the West. Over a long term, however, Japan's labor force participation rate for men and women combined had declined almost continuously from 32 percent in 1970 to 20 percent in 2005, after which it marginally oscillated up to 2010. Between 2010 and 2015, it went on a slow, but steadily upward trend (except in the year of the *tsunami* disaster – 2011), recording 22 percent in 2015 (Statistics Bureau, 2016). It is interesting to note that the recent rise in the labor force participation rates among the elderly has been widely observed not only in Japan, but also in other developed countries, partly due to the reduction of pension benefits in developed nations in general (Oshio et al., 2016).

As regards the Japanese labor market, its mandatory retirement policies still remain an extreme among the practices of industrialized nations. In 2015, more than 97 percent of large firms with more than 1000 employees had mandatory retirement policies that required workers to leave the company at a relatively young age - typically at age 60. It should be stressed, however, that despite the fact that the mandatory retirement age has been set relatively low, in the past several decades a sizable proportion of Japanese elderly workers has consistently shown stronger work preferences than the elderly in Europe or North America (Clark et al., 2008, 2015). It is important to bear in mind that due to such strong work preferences, many older Japanese move from career jobs to bridge jobs and self-employment. Thus, it may be said that strong work preferences among older Japanese men and women lead to higher work rates to a considerable degree. The validity of this view seems to be partially supported by the data derived from the *Employment Status Survey* from 1987 to 2012, in which older persons were asked about their reasons for leaving their last job. As presented in Table 1, among people (both men and women combined) at 65 and older in 1987, 55 percent indicated that they had left their jobs because of illness or old age. The proportion of respondents indicating that health issues were the primary cause of their retirement has considerably declined over time, recording 41 percent in 2012. It should be noted that such declining trends have been pronounced especially among older men. In contrast, there has been a significant increase in the proportion of older Japanese who state that they left the labor force because they had reached the mandatory retirement age. The proportion increased from 30 percent in 1987 to 40 percent in 2012. It is highly conceivable that as more people reach the mandatory retirement age in good health, they are more likely to be motivated to remain on the job.

With life expectancy and health improving rapidly and institutional factors related to the labor market adjusting only slowly, the constraint of mandatory retirement on the employment of older Japanese has become more severe with the passage of time. In order to alleviate the constraint imposed by the long-lasting inflexible mandatory retirement age, the Japanese government enacted the Law Concerning Stabilization of Employment of Older Persons in 2004. The passage of this law required firms to make one of the following three employment schemes available to their old employees: (i) abolishing the mandatory retirement age altogether, (ii) raising the mandatory retirement age to 65, and (iii) introducing a continued employment system. In the case of the scheme (ii), the salary does not fall at age 60 and beyond. In contrast, in the case of the continued employment system, firms are required to rehire their old workers at age 60, and keep them on the payroll up to age 65 should they desire to continue working, but are given the right to drastically reduce their working hours and salaries, starting from age 60; when the old workers are rehired at age 60, they are offered only 50–70 percent of their previous salaries. Under this law, companies were required to complete the transition in the age limit from 60 to 65 over the period of 2006–2013 according to the following time schedule: raising retirement age (i) to 62 years old during the fiscal year from April 2006 to March 2007, (ii) to 63 years old between April 2007 and March 2010, (iii) to 64 years between April 2010 and March 2013, and (iv) to 65 years old beginning from April 2013.

Due to the implementation of this law, the labor force participation rate among elderly workers in their early 60 s has been increasing to a considerable extent in the recent past. For instance, the labor force participation rate for men aged 60–64 increased from 71 percent in 2006 to 78 percent in 2014. Similarly, the labor force participation rate of women in the same age group rose from

Table 1
Reasons for leaving a job among those aged 65 and more, 1987–2012.

Males Reason for leaving job	1987	1992	1997	2002	2007	2012
Personnel curtailment, liquidation or bankruptcy of the company	6.9	4.1	4.8	10.4	9.1	10.5
The job was a temporary or precarious one	0.0	1.2	0.8	1.8	1.3	1.9
Low income	0.6	0.6	0.8	0.5	0.7	0.7
Unsatisfactory working conditions	0.6	1.7	0.9	3.0	0.7	0.7
I did not like the job	0.6	0.6	5.2	0.3	0.4	0.4
A family member's finding or changing a job, transfer or relocation of the establishment etc	0.0	0.6	0.4	0.1	0.2	0.1
Retirement age etc	30.2	26.2	43.7	38.9	40.7	41.7
Illness or old age	52.8	54.1	38.1	33.1	35.6	31.5
An aged or sick family member's care	–	1.7	1.1	1.3	1.6	1.4
Other reasons	8.2	9.3	8.5	10.1	9.8	11.1
Females Reason for leaving job	1987	1992	1997	2002	2007	2012
Personnel curtailment, liquidation or bankruptcy of the company	2.1	3.8	5.8	11.9	11.7	12.0
The job was a temporary or precarious one	1.0	1.0	0.8	1.5	1.3	1.5
Low income	2.1	1.0	1.2	0.7	1.0	0.6
Unsatisfactory working conditions	1.0	1.0	0.9	2.6	0.7	0.7
I did not like the job	0.0	0.0	2.9	0.2	0.4	0.3
A family member's finding or changing a job, transfer or relocation of the establishment etc	1.0	1.0	0.8	0.4	0.5	0.5
Retirement age etc.	14.6	12.5	22.0	19.1	20.6	23.3
Illness or old age	61.5	61.5	51.8	43.8	45.7	41.2
An aged or sick family member's care	–	5.8	4.9	5.5	5.8	5.4
Other reasons	12.5	10.6	11.1	13.4	12.4	14.3
Both sexes combined Reason for leaving job	1987	1992	1997	2002	2007	2012
Personnel curtailment, liquidation or bankruptcy of the company	3.7	2.8	6.6	12.8	9.9	13.0
The job was a temporary or precarious one	0.5	0.4	1.2	1.6	1.3	2.1
Low income	0.5	0.6	0.7	0.5	0.8	0.8
Unsatisfactory working conditions	0.3	0.4	1.2	0.6	0.6	0.8
I did not like the job	0.3	0.3	0.2	0.2	0.3	0.4
A family member's finding or changing a job, transfer or relocation of the establishment etc	1.0	0.8	0.5	0.2	0.3	0.3
Retirement age etc	30.2	35.4	29.7	29.7	31.4	40.1
Illness or old age	54.5	47.6	48.2	41.2	40.6	41.4
An aged or sick family member's care	0.0	2.8	2.6	3.1	3.3	3.5
Other reasons	8.9	8.9	9.1	10.1	10.7	14.5

Source: Japan Statistics Bureau, *Employment Status Survey*, various years.

40 to 49 percent over the same time period. It should be emphasized, however, that persons in this age group who do not wish to work at all do not have to submit themselves to this policy change. In fact, during 2005–2009, the proportion of men 60–64 who did not wish to be employed declined marginally, from 15.1% to 13.4%. More importantly, since the implementation of this law, more than 70 percent of the firms have chosen the continued employment system for their workers beyond age 60. This implies that a considerable amount of the work capacity of old workers at ages 60–64 is neither fully utilized in terms of hours worked, nor financially compensated. It is also worth noting that for the age groups that are outside the scope of the policy change (i.e., 65+), there has been only a slight increase in labor force participation rates for both men and women.

In recent years, enhancing the labor participation of elderly people is being increasingly recognized by the Japanese government and business circles as an agenda of prime importance. In view of that, this study attempts to measure the potential work capacity of old workers in search of effective labor-related policy options to alleviate the adverse effects of aging and population decline on Japan's economic growth in the next few decades. To conduct this study, we will heavily draw upon the following two methodological and analytical approaches. First, in the recent past, Usui, Shimizutani and Oshio (forthcoming 2017) have examined the work capacity of older Japanese, i.e., the extent to which they can potentially extend their work lives, by applying microdata gathered in the three rounds (2007, 2009 and 2011) of the Japanese Study on Aging and Retirement (JSTAR). The authors have employed the Cutler et al. method (Cutler et al., 2012) as an analytical framework within which they have measured how many more people with a given level of health could work if they were to work as much as their younger counterparts with a comparable health status. In their study, Usui, Shimizutani and Oshio utilized the JSTAR data to estimate the relationship between health and employment for men and women aged 50 to 54, respectively, and used the estimated result, along with the actual characteristics of older people aged 55 to 75, to simulate the latter's capacity to work based on health.[1]

Second, in the past 10 years or so, a macroeconomic model called the system of "National Transfer Accounts (NTA)" has been drawing a great deal of attention from policymakers and researchers interested in tackling a wide range of policy problems related to population aging. In the present study, we will attempt to introduce estimated statistical results derived from JSTAR into the system of NTA, constructed on the basis of Japanese data gathered in 2009. This study, combining JSTAR and the NTA in the same analytical domain, is the first of its kind not only in Japan, but also elsewhere. We will first estimate employment probabilities by regression for those aged 50–59, using the data from JSTAR. We will then quantify the potential work capacity of those aged

[1] Usui et al. (forthcoming 2017) have introduced an alternative way to estimate work capacity by asking respondents about the intensity of their work. They have found that Japanese men who are employees at age 54 tend to be under-employed if they continue working, while those who are self-employed at 54 tend to be over-employed.

60–79, assuming that they continue to work as much as those aged 50–59. In addition, by using the framework of the National Transfer Accounts, we quantify the extent to which the economic support ratio would be enhanced through the utilization of the untapped work capacity among old workers aged 60–79. In the present paper, we propose that this increased economic support ratio induced by the additional work force derived from the elderly aged 60–79 be called the "silver dividend." Furthermore, we briefly discuss the effect of an increase in the labor supply of older persons on the labor supply of younger segments of the population and their wages, relative to their older counterparts.

To achieve these objectives, this paper is structured as follows. In the next section, the NTA and the method of computing the first demographic dividend are briefly described to facilitate the discussion that follows. In the ensuing section, some basic features of JSTAR are discussed, and subsequently the regression-based computational results regarding untapped work capacity among the elderly population are presented. Moreover, the impact of the use of untapped work capacity upon total labor income and labor supply is discussed. In the following section, by drawing upon the statistical results obtained in the previous section, the impact of the use of the untapped work capacity among elderly workers on the "silver dividend" is discussed. In the subsequent section, the effect of the change in the labor supply among the elderly upon that of the young is examined. In the final section, the main findings are summarized together with some policy implications and limitations of the present study.

The NTA system and the first demographic dividend in Japan

A brief introduction to the NTA

With a view to analyzing a wide range of socioeconomic and demographic problems caused by age structural transformation, an international collaborative research project was launched around the turn of the century under the leadership of the University of Hawaii (Andrew Mason) and the Center for the Economics and Demography of Aging at the University of California, Berkeley (Ronald Lee). At the time of writing this paper, a total of 52 countries have participated in this global project.

One of its principal objectives is to develop the National Transfer Accounts (NTA), which is a system for measuring economic flows across age groups. These flows arise because in any viable society, dependent members of the population – those who consume more than they produce – are supported by members of the population who produce more than they consume.

The NTA provide a comprehensive framework for estimating consumption, production, and resource reallocations by age. The accounts are constructed so as to be consistent with and complementary to the National Income and Product Accounts (NIPA). The NTA are being constructed with sufficient historical depth to allow for analysis of key features of the transfer system, and can also be projected to analyze the economic and policy implications of future demographic changes. Furthermore, sectoral disaggregation allows the analysis of public and private education and healthcare spending. It should be noted, however, that no gender differentiation is incorporated in the NTA system, except in an experimental way. In the case of Japan, the Japanese NTA team is still in the process of differentiating the population by gender.

A fuller explanation of the NTA's basic concepts, the crucial computational assumptions utilized, and definitions of key variables are available on the NTA global project website (http://www.ntaccounts.org). Moreover, a volume containing many NTA country reports, together with several chapters on the foundations of NTA and inter-country comparative analysis on selected topics, has been published (Lee and Mason, 2011).

The first demographic dividend in Japan

The NTA system provides important new information relevant to the following issues: (i) intergenerational equity and poverty, (ii) aging policy, (iii) the first demographic dividend, and (iv) the second demographic dividend. In the present paper we focus our attention solely on the first demographic dividend. It should be noted that in the ensuing sections, we call the first demographic dividend that is generated specifically due to an increased supply of elderly workers the "silver dividend".

The first demographic dividend arises because changes in population age structure have led to an increase in the working ages relative to the non-working ages. To be more precise, the first demographic dividend arises because of an increase in the share of the population at ages during which production exceeds consumption.

Fig. 1 depicts the age-specific profiles of consumption and production in contemporary Japan, based on the National Survey of Family Income and Expenditure (NSFIE) carried out in 2009. By utilizing the computed results displayed in this graphical exposition as statistical weights to adjust for the population, we have calculated the number of effective workers and the number of effective consumers over the period 1950–2050, using the United Nations population projection prepared in 2015. The ratio of effective workers to effective consumers is called the "economic support ratio (ESR)." When the ESR value rises, the economy is in the period of the first demographic dividend. The computed results pertaining to Japan's first demographic dividend from 1950 to 2050 are shown in Fig. 2.

A brief glance at the results reported in Fig. 2 reveals that Japan's first demographic dividend was positive for 46 years from 1950 to 1996. The magnitude of the positive first demographic dividend was especially large during the rapid economic growth of the 1960s (Ogawa et al., 2012). This result provides an additional piece of empirical evidence pointing to the high likelihood that the unprecedented fertility reduction subsequent to the baby boom (1947–1949) played an important role in boosting the growth of per capita income to phenomenal levels during this high economic growth period. It is also conceivable that in the case of Japan, the first demographic dividend was utilized primarily for augmenting physical capital, rather than for boosting consumption. It seems reasonable to infer that what the Japanese people had experienced in the 1950s and 1960s was also observed in East Asia's high-performing economies during their economically successful years in the 1990s.

Measuring the untapped work capacity among Japanese old workers

A brief description of JSTAR

We use the data from the first three waves of the Japanese Study on Aging and Retirement (JSTAR) to compute the untapped work capacity. JSTAR is a longitudinal, inter-disciplinary and internationally-comparable data collection of the middle-aged and older generations. JSTAR is a family survey compatible with the Health and Retirement Study (HRS) in the United States, the English Longitudinal Survey on Ageing (ELSA) in the United Kingdom, the Survey on Health, Aging, and Retirement in Europe (SHARE) in continental Europe, as well as the Chinese Health and Retirement Longitudinal Study (CHARLS) and the Korean Longitudinal Study of Aging (KLoSA) in Asia. JSTAR's design and sample methodology are described elsewhere (Ichimura et al., 2009).

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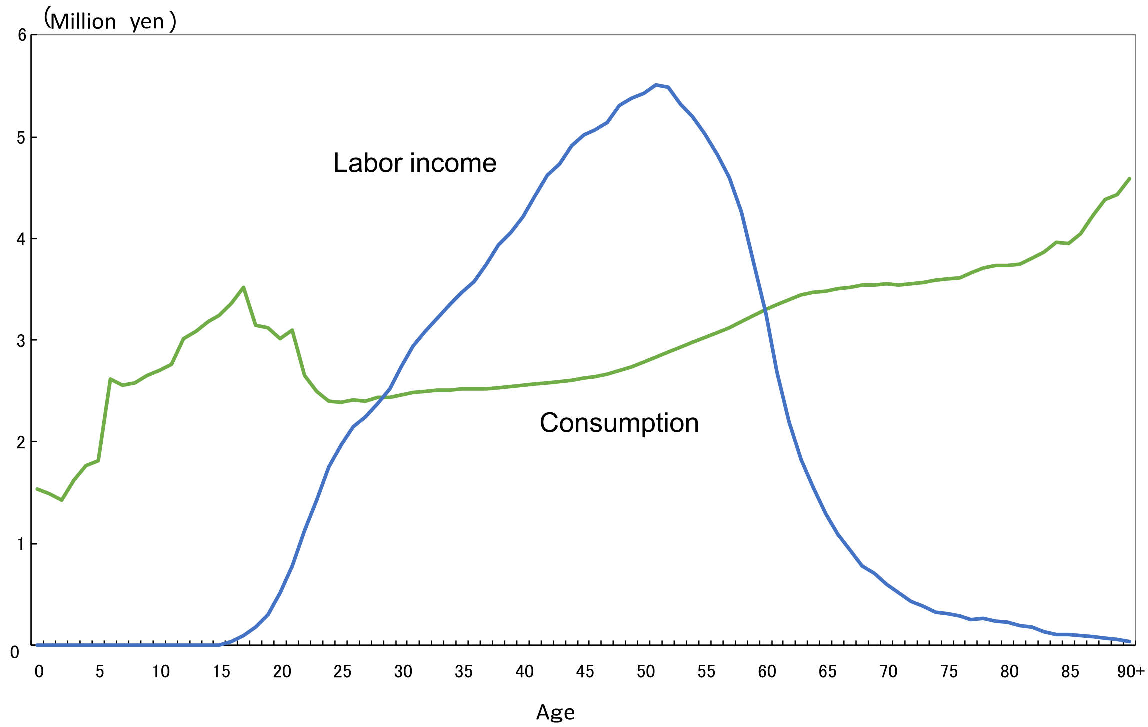
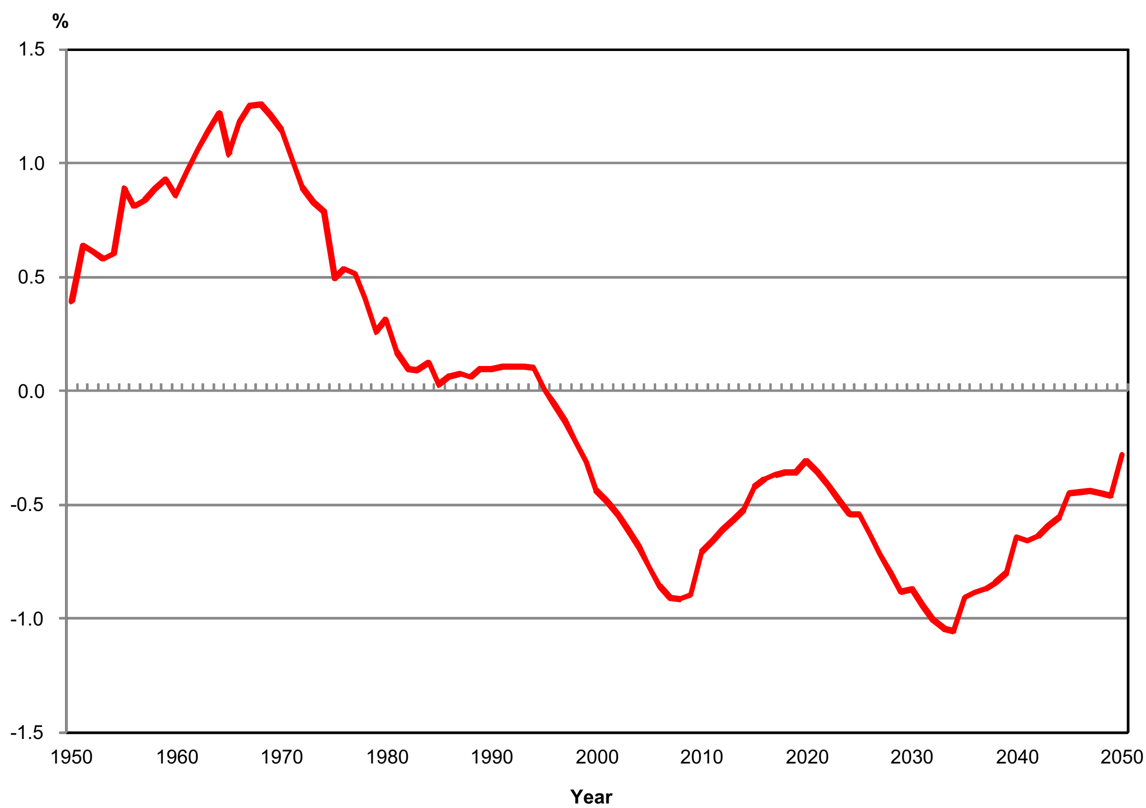


Fig. 1. Age-specific profiles of per capita consumption and labor income in Japan, 2009.



Source: United Nations (2015), *World Population Prospects: The 2015 Revision.*

Fig. 2. Japan's first demographic dividend, 1950–2050.

The baseline sample consists of males and females aged 50 to 75 from 10 municipalities, and the respondents were randomly chosen from household registries in each municipality. The sample size and the average response rate at the baseline are approximately 8000 and 60 percent, respectively. JSTAR collects a wide range of variables including the economic, social, family and health conditions of middle-aged and older adults.

In this section, we attempt to quantify the untapped work capacity in Japan in terms of health status. Thus, in our analysis, we do not include a number of factors affecting the decision of labor supply (e.g., wages) but focus on the health disability to examine to what extent the labor supply of the elderly is limited. We employ a linear probability model to regress a binary variable of employment, which is equal to 1 if the individual is in the labor force (both employed and unemployed) and 0 if the individual is out of the labor force, on the following explanatory variables: (1) dummy variables for self-reported health status (five-point scale), (2) the prevalence of limitations on instrumental activities of daily living (IADLs), (3) the CESD depression scale, (4) the Nagi physical ability index, (5) limitations in eyesight, hearing and chewing,[2] and (6) individual attributes, such as sex, educational attainment and marital status. In addition, dummy variables for each municipality and survey years are included.[3]

In the estimation, we pool all the observations from the first to third waves of JSTAR collected in 2007, 2009 and 2011. We use the sample of individuals aged 50 to 59 and combine both sexes for the baseline regression. In this analysis, we implicitly assume that adults aged 50 to 59 are likely to be in the labor force unless their health is impaired. We have a sample of 3371 person-year observations. We do not use the longitudinal feature of the JSTAR sample since we are interested in the prevalence of work capacity (factors that determine the level of work capacity at a point in time) by age, rather than the incidence (i.e., factors that change work capacity over time) along with age.

The summary statistics of the variables used in the estimation are presented in Table 2. First, looking at non-health variables, the proportion of those in the labor force (the dependent variable), which includes both those employed and unemployed, is 84%. The male and female shares are both close to a half. As for the educational attainment, the largest proportion belongs to high school graduates who account for more than 40%, followed by university undergraduates or more (including graduate schools) and by junior college graduates. The reference group consists of junior high school graduates and high school dropouts. Moreover, more than 80% are currently married.

Second, it is worth noting that there is a considerable amount of variability with respect to the health variables that are of primary interest in the present study. The self-rated health status, which is a five-point scale ranging from "excellent" to "poor" (the North American version) indicates the proportion of "good" (the middle rating) is the largest (36%), followed by "very good" (27%) and "excellent" (26%). The CESD (the Center for Epidemiologic Studies Depression Scale) sets a score of 16 points as a threshold for being depressed, and 20% of the respondents fall in this category. The proportion of those who have one or more limitations among the 15 IADLs (Instrumental Activity of Daily Living) items is 37%.

Table 2
Summary statistics.

Variables	Mean	SD
Employed	0.844	0.363
Male	0.497	0.500
Education		
Junior high school graduates	0.130	0.336
Senior high school graduates	0.428	0.495
Junior college graduates	0.216	0.412
University graduates	0.226	0.419
Currently married	0.811	0.392
Self-rated health status		
Excellent	0.256	0.436
Very good	0.265	0.441
Good	0.362	0.481
Fair	0.099	0.299
Poor	0.017	0.131
CESD $\geqslant$ 16	0.204	0.403
IADLs $\geqslant$ 1	0.374	0.484
Nagi index		
Walking 100 meters	0.015	0.121
Sitting continuously for two hours	0.025	0.158
Standing up from a chair after sitting for a long time	0.035	0.183
Climbing several steps without using the handrail	0.033	0.179
Climbing one step without using the handrail	0.020	0.141
Squatting or kneeling	0.037	0.188
Raising hands above the shoulders	0.015	0.121
Pushing and pulling a large object such as a living-room chair or sofa	0.024	0.152
Lifting and carrying an object weighing more than 5 kg	0.024	0.153
Picking up a small object such as an one-yen coin with fingers	0.009	0.096
Sensory organs		
Eyesight	1.976	0.162
Hearing	1.987	0.117
Chewing ability	1.982	0.139
Municipalities		
Sendai	0.146	0.353
Kanazawa	0.180	0.384
Takikawa	0.059	0.236
Shirakawa	0.136	0.342
Adachi	0.119	0.324
Naha	0.120	0.325
Tosu	0.070	0.256
Hiroshima	0.089	0.285
Chofu	0.040	0.196
Tondabayashi	0.040	0.196
Survey year		
2007	0.391	0.488
2009	0.292	0.455
2011	0.318	0.466

Fig. 3 shows the age gradient of the prevalence of the Nagi physical ability index.[4] The Nagi index in JSTAR consists of 10 items and is designed to capture difficulties in physical activities that are relevant to work capacity: (1) walking 100 meters, (2) sitting continuously for two hours, (3) standing up from a chair after sitting for a long time, (4) climbing several steps without using the handrail, (5) climbing one step without using the handrail, (6) squatting or kneeling, (7) raising hands above the shoulders, (8) pushing and pulling a large object such as a living-room chair or sofa, (9) lifting and carrying an object weighing more than 5 kg, and (10) picking up a small object such as a one-yen coin with fingers.

For males in their 50s the proportion of those who reported having some difficulty in performing physical activities is only

[2] For each of the three physical functions (eyesight, hearing and chewing) , we have assigned the following three numerical values: 2 denotes conditions ranging from "very good" to "below average", whereas 1 stands for "poor", and 0 for "fully impaired".

[3] In addition, Usui et al. (forthcoming 2017) use the following explanatory variables: limitations on physical activity, limitations on activities of daily living (ADLs), past medical history, present diagnosed diseases (from a list of about 20 diseases), being over or underweight (the BMI measure) and being a current or a former smoker, all of which are common in papers produced by other countries' researchers in the NBER (National Bureau of Economic Research)'s International Social Security (ISS) Project. However, these health variables have not been included in the present study. This is because the prevalence of physical or ADL limitations, as well as diseases diagnosed by medical doctors, is quite low among those in their 50s. Also, the BMI measure and smoking status seem to be less relevant for assessing the work capacity of the elderly in Japan.

[4] By heavily drawing upon micro-level data gathered from the Nihon University Japan Longitudinal Study of Aging (NUJLSA), Ogawa et al. (2005) and Clark et al. (2008) have used the Nagi index to analyze a number of health factors affecting work (See Nagi (1965, 1979) for the original work on the index). While the items regarding daily activities differ slightly between JSTAR and the NUJLSA, the expression that follows the two strains of work is identical or similar. The numerical values reported in the graph are not simple averages across the sample in JSTAR, but are adjusted for age and sex, using national population data compiled by the Statistics Bureau.

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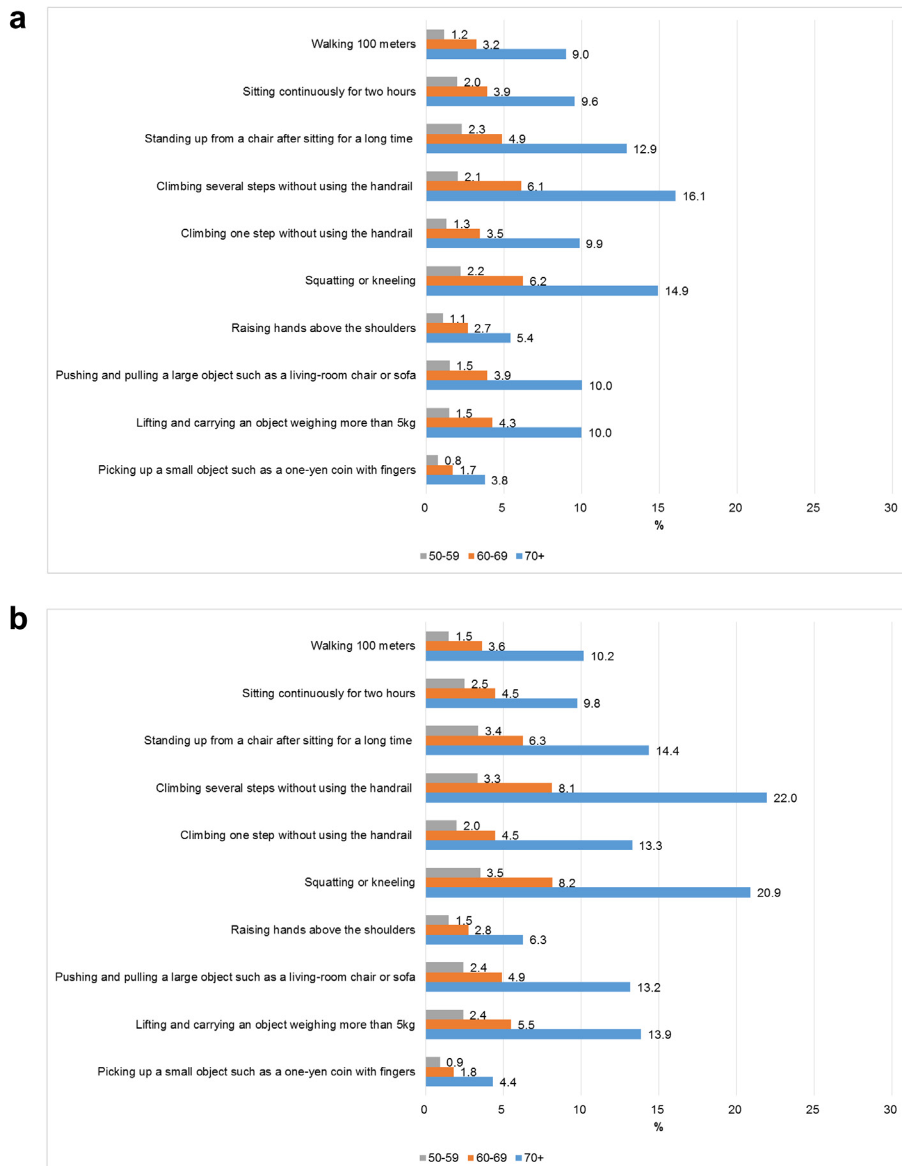

Fig. 3. Age gradient of the Nagi index by sex: (a) males, (b) females.

one or two percent, but the percentage increases for all items as they reach their 60s and becomes more diverse across items - the largest is found in the category of "squatting or kneeling" (6.2%) and "climbing several steps without using the handrail" (6.1%), while the smallest is the case of "picking up a small object such as a one-yen coin with fingers" (1.7%). Moreover, the proportion of those who report having some difficulty further increases considerably in all activities and shows a greater variation for men in their 70s – the largest is found in category of "climbing several steps without using the handrail" (16.1%), followed by "squatting or kneeling" (14.9%). For females, the pattern of the age gradient is similar to that for males, but the difficulties in these activities are more pronounced and the gradient is steeper. The proportion of women who in their 50s report having difficulties in each item varies from one percent ("picking up a small object such as a one-yen coin with fingers") to five percent ("climbing several steps without using the handrail"). More than a quarter of females in their 70s reports difficulties in the category of "climbing several steps without using the handrail" (27.4%) or "squatting or kneeling" (26.4%).

Fig. 4 illustrates limitations in eyesight, hearing and chewing. For males, the proportion of those who report limitations in eyesight ("below average" or "poor") is 13% in their 50s, and slightly declines to 10.5% in their 60s, but increases again to 13.6% in their 70s. The age gradient is more pronounced with regard to limitations in hearing and chewing: it is 6.4% for men in their 50s, and 18.2% for men in their 70s in the case of hearing, and 2.8% and 8.6%, respectively, in the case of chewing. The pattern for females is similar to that for males. The proportion of females in their 50s who report limitations in eyesight is larger than that of their male counterparts, and although the proportion declines in their 60s, it increases to 15.4% in their 70s. The female respondents show the same pattern of limitations in hearing and chewing as the male respondents. However, their level of limitation is generally lower than that of their male counterparts.

Estimated results

Table 3 shows the estimated results. Model 1 reports the estimated coefficients using the most concise version of the specifica-

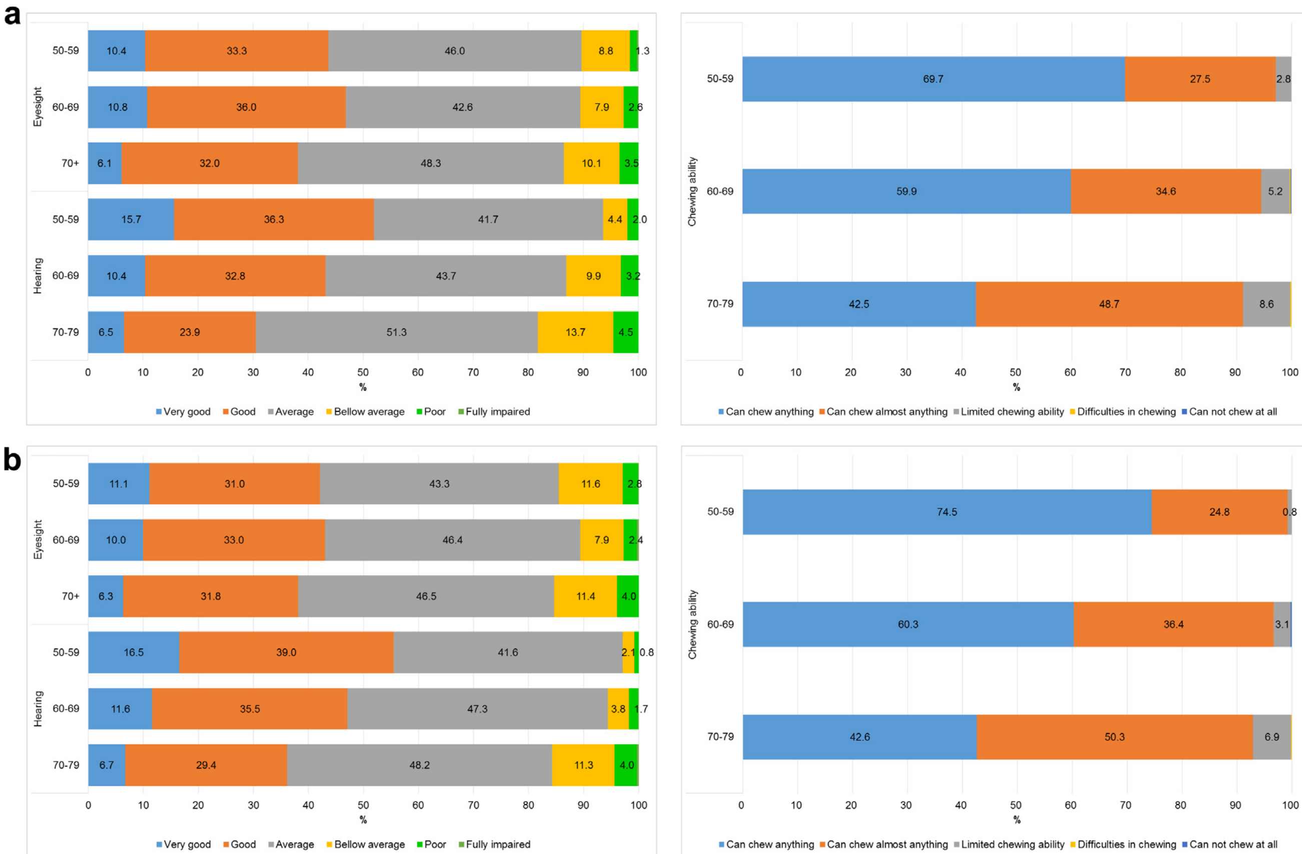

Fig. 4. Age gradient of limitations in eyesight, hearing and chewing: (a) males, (b) females.

tion. First, the coefficient for males is positive and significant, indicating that males are more likely to be in the labor force than females by 23%. Moreover, the education gradient is also observed. Compared with the reference group (junior high school graduates), high school graduates and university graduates are more likely to be in the labor force by 3% and 6%, respectively. The coefficient for being currently married is statistically significant and shows a negative sign. This seems to be attributable to the fact that married women tend to rely on their husbands for economic security, thus being less likely to participate in the labor force than their unmarried counterparts.

Second, turning to the health variables, the estimated coefficients for the self-rated health status show that the respondents who rate their own health level higher than the reference group ("very good") are, as expected, more likely to be in the labor force. For instance, those who report that their health is "excellent" are more likely to be employed than those included in the reference group by 4%, and those who report that their health is "poor" are less likely to be employed than to be employed the reference group by 29%. The coefficient for the variable representing the CESD measure is unexpectedly positive but not statically significant. Similarly, the prevalence of IADLs has a positive coefficient but is not statically significant. On the other hand, the estimated coefficient for the Nagi index, in which "1" denotes respondents who report any difficulties in performing at least one of the activities and "0" otherwise, is negative and statistically significant. The coefficients for eyesight, hearing and chewing are mixed. The coefficient for eyesight limitations and hearing limitations are negative and statically insignificant, but the estimated coefficient for chewing is positive and statically significant. In addition, most of the estimated coefficients related to the municipality and survey year are not significant.

Model 2 shows the estimated coefficients for the same repressors in Model 1 except that variable representing the Nagi index has been broken down by its ten components. As shown above, the coefficient on the Nagi index is indeed negative and significant in Model 1, indicating that some difficulties in performing physical activities included in the Nagi index adversely affect the participation of those aged 50–59 in the labor force. In Model 2, we observe that the negative and significant coefficients are found in the categories of "walking 100 meters" and "lifting and carrying a heavy object". The other coefficients are negative, but statistically insignificant. The estimated results for the variable other than the Nagi index are virtually the same as those in Model 1.

In addition, Model 3 reports the estimated results for the regression incorporating interaction terms between males and a few other selected explanatory variables. As displayed in Table 3, there are a number of large gaps between males and females; we can observe them in the following variables: the Nagi index, other health variables, and non-health variables (educational attainment and marital status). First, it should be noted that although the estimated coefficients for males are statistically significant in both Model 1 and Model 2, that is no longer the case in Model 3. A similar observation is applicable to the case of education-related variables. Attention should be drawn to the variable representing the current marital status. This variable is statistically significant but the interaction term with the male dummy turns out to be positive with respect to the labor force participation. This result seems to suggest a contrasting effect of the marital status on employment between males and females – married males are more likely to be in the labor force than their female counterparts.

Second, as regards the health variables, in Model 3, the estimated results for "excellent" and "poor" remain the same as in Model 1 and Model 2. The coefficient for the interaction term is

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Table 3
Estimated results.

Variables	Model 1		Model 2		Model 3	
	Coefficient	S.E	Coefficient	S.E	Coefficient	S.E.
Sex						
Male	0.228	0.012***	0.229	0.012***	−0.159	0.295
Female (reference)						
Education						
Junior high school graduates (reference)	–	–	–	–	–	–
Senior high school graduates	0.032	0.018*	0.033	0.018*	0.051	0.034
College graduates	0.027	0.021	0.029	0.021	0.040	0.036
University graduates	0.057	0.018***	0.057	0.018***	0.081	0.042*
High school graduates × male	–	–	–	–	−0.040	0.037
College graduates × male	–	–	–	–	−0.016	0.039
University graduates × male	–	–	–	–	−0.056	0.043
Currently married	−0.082	0.014***	−0.082	0.014***	−0.189	0.020***
Currently married × male	–	–	–	–	0.254	0.026***
Self-rate health status						
Excellent	0.036	0.014**	0.036	0.014***	0.054	0.027**
Very good (reference)	–	–	–	–	–	–
Good	−0.010	0.014	−0.009	0.014	−0.015	0.025
Fair	−0.063	0.024***	−0.059	0.024**	−0.066	0.040
Poor	−0.290	0.061***	−0.291	0.062***	−0.401	0.089***
Excellent × male	–	–	–	–	−0.037	0.028
Good × male	–	–	–	–	0.013	0.027
Fair × male	–	–	–	–	0.033	0.046
Poor × male	–	–	–	–	0.226	0.119*
CESD ⩾ 16	0.007	0.015	0.009	0.015	0.034	0.024
CESD ⩾ 16 × male	–	–	–	–	−0.053	0.027**
IADL ⩾ 1	−0.008	0.011	−0.007	0.011	0.006	0.022
IADL ⩾ 1 × male	–	–	–	–	−0.020	0.024
Nagi index						
Difficulty in any activities ⩾ 1	−0.051	0.008	–	–	–	–
Walking 100 meters	–	–	−0.167	0.095*	−0.176	0.115
Sitting continuously for two hours	–	–	−0.075	0.058	−0.174	0.092*
Standing up from a chair after sitting for a long time	–	–	−0.015	0.054	0.062	0.070
Climbing several steps without using the handrail	–	–	−0.023	0.070	0.000	0.078
Climbing one step without using the handrail	–	–	−0.037	0.088	0.023	0.103
Squatting or kneeling	–	–	−0.053	0.049	−0.125	0.065*
Raising hands above the shoulders	–	–	0.004	0.081	0.075	0.098
Pushing and pulling a large object such as a living-room chair or sofa	–	–	−0.040	0.079	−0.114	0.088
Lifting and carrying an object weighing more than 5 kg	–	–	−0.149	0.079*	−0.116	0.086
Picking up a small object such as an one-yen coin with fingers	–	–	0.093	0.105	0.024	0.132
Walking 100 meters × male	–	–	–	–	0.131	0.203
Siting for 2 h × male	–	–	–	–	0.285	0.107***
Standing up from a chair × male	–	–	–	–	−0.229	0.100**
Climbing several steps × male	–	–	–	–	−0.063	0.181
Climbing one step × male	–	–	–	–	−0.285	0.197
Stooping or bend the knees × male	–	–	–	–	0.240	0.087***
Raising hands above the head × male	–	–	–	–	−0.241	0.171
Pushing and pull an large object × male	–	–	–	–	0.236	0.167
Lifting and carry a heavy object × male	–	–	–	–	−0.142	0.178
Grasping a small object with fingers × male	–	–	–	–	0.191	0.199
Variables	Model 1		Model 2		Model 3	
	Coefficient	S.E	Coefficient	S.E	Coefficient	S.E
Sensory organs						
Eyesight	−0.041	0.030	−0.046	0.029	−0.049	0.046
Hearing	−0.020	0.046	−0.024	0.046	−0.025	0.073
Chewing ability	0.098	0.048**	0.098	0.048**	0.047	0.100
Eyesight × male	–	–	–	–	0.012	0.051
Hearing × male	–	–	–	–	0.040	0.090
Chewing ability × male	–	–	–	–	0.063	0.112
Municipalities						
Sendai	−0.081	0.035**	−0.082	0.035**	−0.082	0.035**
Kanazawa	−0.019	0.034	−0.019	0.034	−0.015	0.034
Takikawa	−0.028	0.039	−0.029	0.039	−0.029	0.038
Shirakawa	0.014	0.034	0.012	0.034	0.007	0.033
Adachi	0.004	0.035	0.001	0.035	0.008	0.035
Naha	−0.022	0.035	−0.022	0.035	−0.022	0.035
Tosu	−0.034	0.037	−0.034	0.037	−0.037	0.036
Hiroshima	−0.035	0.034	−0.034	0.034	−0.037	0.034
Chofu (reference)	–	–	–	–	–	–
Tondabayashi	−0.0071612	0.0386122	−0.006	0.039	−0.008	0.038

(*continued on next page*)

Table 3 (*continued*)

Variables	Model 1		Model 2		Model 3	
	Coefficient	S.E	Coefficient	S.E	Coefficient	S.E
Survey year						
2007 (reference)	–	–	–	–	–	–
2009	−0.018	0.015	−0.019	0.015	−0.020	0.015
2011	−0.020	0.018	−0.021	0.018	−0.016	0.018
Constant	0.744	0.150***	0.762	0.151***	0.929	0.255***
Number of observations	3731		3731		3731	
Adjusted R squared	0.170		0.170		0.192	

Note:
*** Statistical significance at the one-percent level.
** Statistical significance at the five-percent level.
* Statistical significance at the ten-percent level.

positive and significant for males who report their health status as "poor", which suggests that males are more likely to be in the labor force even if they rate their own health as "poor". It is interesting to note that although the coefficient on the CESD measure is not statistically significant, when interacted with the male dummy, it not only becomes statistically significant but also changes its sign from positive to negative, implying that males are less likely to be in the labor force if depressed.[5] The coefficient for the prevalence of IADLs is not statistically significant. In the case of the disaggregated Nagi items, the estimated coefficient for the category of "sitting continuously for two hours" without the interaction term is negative and statistically significant, but turns positive and significant when interacting with the male dummy variables, which implies that having difficulties in sitting for a long time reduces female labor force participation. In contrast, the coefficient for the category of "standing up from a chair after sitting for a long time" is positive and not statistically significant. However, it becomes negative and statistically significant when interacting with the male dummy, thus indicating that the difficulty in standing up after sitting for a long time reduces male employment. The coefficient for the category of "squatting or kneeling" is negative and significant. It should be noted, however, that the coefficient turns positive and statistically significant when interacting with the male dummy, and the size of the coefficient increases. These results indicate that "squatting or kneeling" matters only for females. Lastly, none of the estimated coefficients for eyesight, hearing and chewing are statistically significant. The results reported in Model 3 show that the effect of most of the explanatory variables on the employment status differs between males and females.

As indicated at the bottom of Table 3, we have reported the adjusted R^2 for each model. In view of the goodness of fit, Model 3 has produced the best result among the three alternative regressions. For this reason, we will use the estimated coefficients obtained in that model to simulate the untapped work capacity in the ensuing sections.

The impact of the use of untapped work capacity upon total labor income and labor supply

In order to simulate the untapped work capacity for those aged 60–79, we use the estimated coefficients to compute a predicted value for each individual and the average predicted values for all individuals at each age. The "untapped work capacity" is defined as a slack between the actual and the predicted employment probability. Table 4 shows that the estimated untapped capacity increases with age: from 7.6% for age 60 to 31.6% for age 65, reaching 43.8% for age 70 and exceeding 40% for ages higher than 70. If we use the size of population at each age in 2009, the amount of the untapped capacity is estimated to be 11.1 million persons for ages 60–79.

The impact of the potential work capacity among elderly workers upon the economic support ratio and the silver dividend

In this section, by utilizing the computed results of the employment regression for those at ages 50–59, we have first computed the age-specific number of potential workers at each age from 60 to 79 in 2010. Then, by applying the age-specific computational results for the number of those at age 60 and over to Japan's future population projection data derived from the 2015 United Nations projection, we have calculated the potential number of old workers aged 60 to 79 for the period from 2011 to 2050. On the basis of these projected results pertaining to the total number of potential elderly workers older than 60, by assuming that their age-specific labor income and consumption profiles remain unchanged, we have calculated the economic support ratio (ESR), which we call the "Standard Case", as shown in Fig. 5.

Besides the Standard Case, we have calculated the following three hypothetical cases. CASE I assumes that if the potential elderly workers are employed, they earn their labor income on the basis of the age-specific labor income profile observed in 2009, as depicted in Fig. 1; CASE II assumes that potential elderly workers at each age can earn the same amount of labor income earned by their counterparts who were employed in 2012[6]; and CASE III assumes that if the potential elderly workers are employed, they earn only the minimum wage set by the Japanese law.[7] Then, we have calculated, by using the above-mentioned UN population projection, the ESR for each of these three hypothetical cases, as shown in Fig. 5.

In the Standard Case, the ESR continuously declined from 0.821 in 1996 to 0.758 in 2010, and is expected to be on a downward trend during the rest of the simulation period. In all hypothetical cases, however, the ESR increases significantly in 2010, as presented in Fig. 5. For instance, the ESR for 2010 grows to 0.818 in CASE I, 0.829 in CASE II, and 0.801 in CASE III. It is worth observing that the value for CASE II in 2010 is higher than that recorded in postwar Japan. Moreover, although the amount of the first demographic dividend to be generated is −0.9% in the Standard Case

[5] Care should be exercised, however, in interpreting this result. It is plausible that because male workers are frequently depressed at work, they tend to drop out of the labor force. On the other hand, male workers who are not employed are prone to be depressed. To address this causality problem, we have considered the possibility of conducting the endogeneity test. However, due to the lack of appropriate instrumental variables in the dataset at hand, we could not pursue this possibility.

[6] The data required for computation are derived from the 2012 Employment Status Survey.

[7] We take working hours broken by age from the 2012 Employment Status Survey, calculate the weighted average minimum wage by area, and use the minimum hourly wage of 730 yen (in 2010) as the national minimum wage value to calculate the average age-specific labor income.

Table 4
Estimated untapped work capacity.

Age	Predicted labor force participation	Actual labor force participation	Slack of labor force participation	Estimated untapped work capacity (ten thousand persons)
60	0.828	0.752	−0.076	17.3
61	0.832	0.707	−0.125	28.0
62	0.835	0.678	−0.157	33.4
63	0.819	0.604	−0.215	28.8
64	0.813	0.548	−0.265	38.0
65	0.809	0.493	−0.316	55.3
66	0.801	0.476	−0.326	55.2
67	0.817	0.450	−0.367	63.7
68	0.796	0.408	−0.388	65.3
69	0.808	0.376	−0.432	65.9
70	0.786	0.348	−0.438	57.8
71	0.777	0.287	−0.490	68.7
72	0.775	0.275	−0.500	71.5
73	0.768	0.248	−0.520	73.7
74	0.747	0.214	−0.534	71.6
75	0.758	0.205	−0.553	69.2
76	0.732	0.147	−0.585	72.2
77	0.731	0.204	−0.527	62.2
78	0.713	0.227	−0.486	54.2
79	0.715	0.129	−0.586	60.5

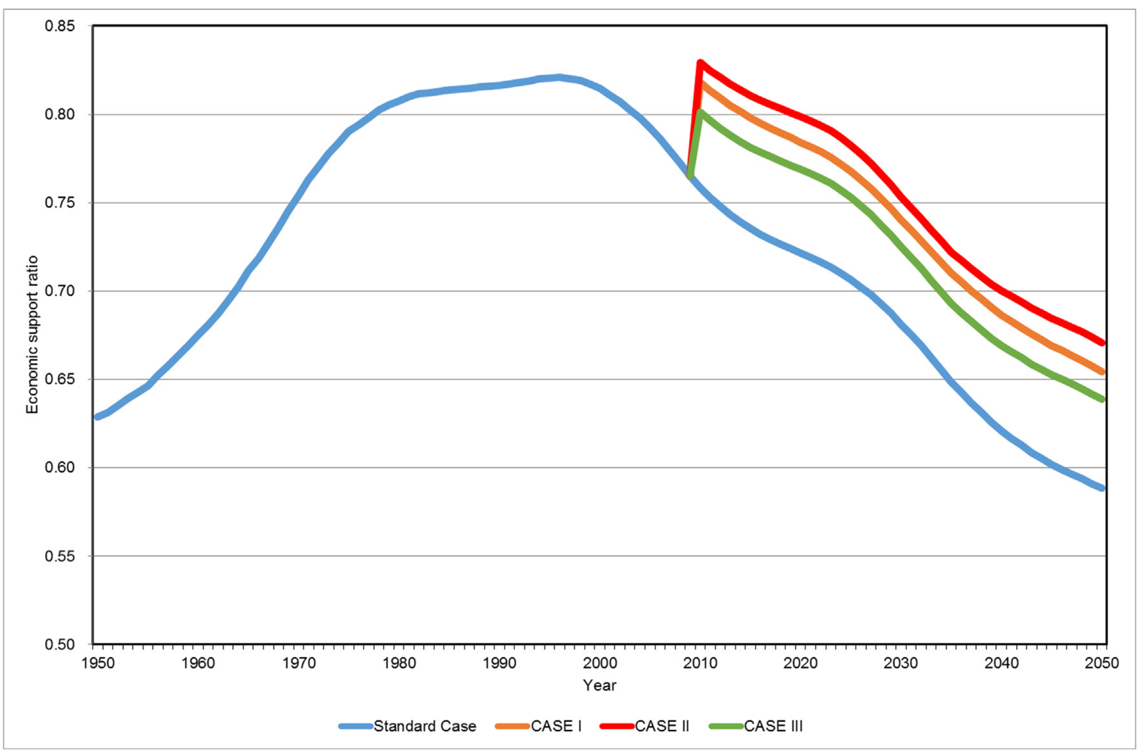

Fig. 5. Trends in economic support ratios.

in 2010, the corresponding values in our simulations are 6.9% for CASE I, 8.4% for CASE II, and 4.7% for CASE III. It is important to note that these results suggest that the real GDP would be substantially larger in all the hypothetical cases than in the Standard Case.[8] Thus, generating the "silver dividend" through the use of the untapped work capacity of healthy elderly workers would constitute a considerable potential for boosting Japan's future economic growth.

Caution should be exercised with regard to the fact that the age-specific consumption profile is assumed to remain unchanged in the above simulation exercise. We should keep in mind that if the old workers earn higher labor income, it is conceivable that they may increase their consumption. Thus, in response to increased labor income, we would have to shift the age-specific consumption profile upward among those older than 60 years of age. It should be emphasized, however, that the interaction between the age-specific labor income and consumption profiles is extremely complex, thus falling outside the scope of this study.

[8] The real GDP for CASE II in 2010 is 4.5 % larger than that for the Standard Case, and this difference in real GDP remains virtually unchanged during the rest of the simulation period. Similar observations are applicable to CASE I and CASE III.

Table 5
Results of regression analysis for aged 60–64 versus other age groups, 1980–2009.

WR(Age group)		Explanatory variables		Adj. R^2
	Intercept	LABOR	CYCLE	
WR(60–64/25–29)	1.136***	−0.229**	0.600*	0.319
	(0.067)	(0.116)	(0.170)	
WR(60–64/30–34)	0.897**	−0.112***	0.436***	0.205
	(0.055)	(0.093)	(0.169)	
WR(60–64/35–39)	0.769***	−0.057***	0.251***	0.089
	(0.046)	(0.081)	(0.159)	
WR(60–64/40–44)	0.749***	−0.107***	0.061***	
	(0.047)	(0.083)	(0.162)	0.066
WR(60–64/45–49)	0.794***	−0.227***	−0.192***	0.220
	(0.048)	(0.089)	(0.151)	

Values in parentheses below each coefficient are standard errors.
Note:
*** Statistical significance at the one-percent level.
** Statistical significance at the five-percent level.
* Statistical significance at the ten-percent level.

The effect of increased labor supply among old workers upon other age groups

An increase in the supply of workers at a certain age affects their own wages due to the increased competition within the same age group. Moreover, it often influences the number of workers employed in other age groups.[9] If workers of different ages are not perfect substitutes for each other in production, that is, if older workers work in a different way from younger workers, then it is reasonable to expect that a change in the relative supply of the two age groups of workers should have an effect on the relative wages of the groups.

The results of an analysis of cohort size effects on age-earnings profiles in the United States reported by Welch (1979), Freeman (1979), and Berger (1983) confirmed this hypothesis. For the case of Japan, Martin and Ogawa (1988) substantiated the validity of this hypothesis, while Mason et al. (1994) incorporated into their econometric model specifically developed for Japan the effect of the change in the age structure on the pattern of wages by age of worker.

To shed light on the effect of increased labor supply among old workers upon other, younger age groups, we examine the relationship between the ratio of the earnings of elderly workers to the earnings of young workers (WR) and the ratio of the labor force size of a selected elderly age group to that of a young age group (LABOR). We have used a regression with the same specification as that employed in the Martin-Ogawa study. As Freeman (1979) has shown, the coefficient on LABOR can be interpreted in terms of the elasticity of substitution between the two age groups of workers.

To estimate the coefficients in the regression, we have utilized the data gleaned from the Basic Survey of Wage Structure (BSWS) over the period 1980–2009. The BSWS is conducted on an annual basis by the Japanese Ministry of Health, Labour and Welfare. We collected the data for WR for the same period from the Labour Force Survey, which was conducted by the Statistics Bureau. It should be noted that the data in the BSWS only covers the earnings of full-time paid employees, which is substantially different from the labor income data used for estimating the age-specific labor income profile in the NTA. Thus, the computed results reported in this section need to be carefully interpreted.

In addition to these two variables (one dependent and one explanatory) related to labor supply, we have introduced into the regression analyses another explanatory variable (CYCLE), which is expected to capture the effect of business fluctuations on the age-earnings profile. CYCYE corresponds to the deviation of the logarithm of the real gross domestic product (GDP) from its trend.

We have run a number of regressions for various age groups covering different time periods. Among the different results, here we focus on the regression results for the age group 60–64, as opposed to other age groups over the period 1980–2009, as displayed in Table 5. The changes in LABOR and WR for the workers in two age groups, 60–64 and 25–29, over the period 1980–2009 are plotted in Fig. 6 for illustrative purposes.

In all the five regression cases, the estimated coefficients for LABOR are consistently negative but statistically insignificant. This implies that the substitution of labor between the two age groups is not significant and that an increase in the number of old workers relative to the number of young workers does not influence the ratio of earnings between the two age groups. That is, an increase in the number of workers in the age group 60–64 is unlikely to affect the wages and the number of workers of other, younger age groups.[10]

Moreover, a quick glance at Table 5 reveals that the estimated coefficients of CYCLE are statistically insignificant in the four cases, and a negative sign in the case of the age groups (60–64/25–29) is statistically significant at the 5-percent level. This seems to suggest that the business cycle affects various age groups differently, depending on the employment policies adopted by the government and the response of businesses to changes in internal and external economic factors.

The computational results presented in Table 5 are based on the actual wage and labor force data observed in Japan. It should be noted that the applicability of these empirical results to the hypothetical simulation results presented in the previous section is one of the issues that remain to be addressed in our future work.

[9] Using the time-series data for Japan, Oshio et al. (2010) have demonstrated that the relationship between the labor force participation of the old and the unemployment of the young age groups is virtually non-existent. In addition, the same conclusion has been reached by Börsch-Supan (2013) in his cross-national comparative analysis based upon the data for a number of OECD countries.

[10] It should be noted that we have also run regressions for the other old age group, namely 65 and over. The computed results are highly comparable to those for the age group 60–64.

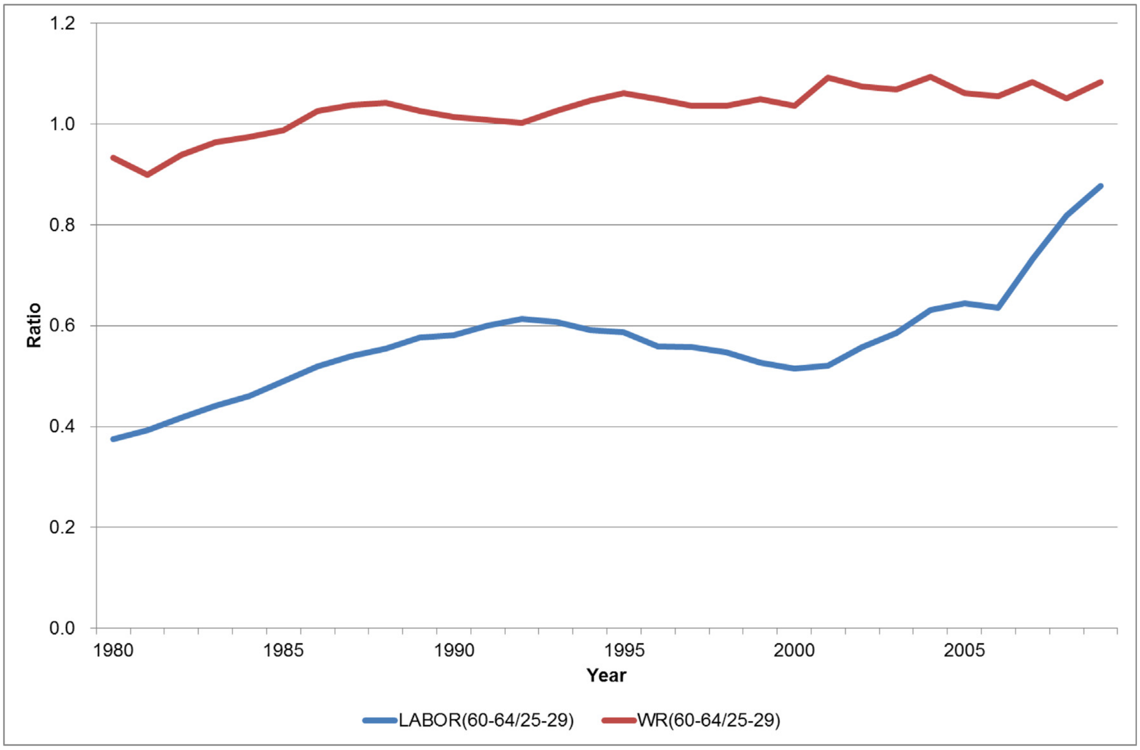

Fig. 6. Trends in LABOR and WR from 1980 to 2009.

Concluding remarks

At present, Japan is the most aged society in the entire world, and it is expected that population aging in Japan will further accelerate in the next few decades. Although Japanese elderly persons enjoy not only the highest level of life expectancy at birth but also the highest health expectancy in the world and many of them want to continue to work, they drop out of the labor force due to the existence of the mandatory retirement age. In contemporary Japanese society, the utilization of healthy elderly persons in economic production is one of the most urgent policy matters.

In this paper, we have measured the untapped work capacity of old Japanese persons, using the microdata gathered in the JSTAR survey, and our computed results show that the volume of untapped work capacity of the Japanese elderly among those aged 60–79 is vast, amounting to more than 11 million workers at present. We have also applied the computed results to the NTA framework, and quantified the magnitude of the use of untapped work capacity upon potential economic growth. Although there are some limitations in the computational process we employed, the accumulated effect of the economic support ratio upon potential economic growth seems substantial over the long term, and seems to produce a sizable amount of the silver dividend. We have also examined the issue of whether or not the use of untapped work capacity of old persons could affect the well-being of workers in other age groups. The regression results support the view that the substitutability between the elderly group and the group of younger persons is negligible, so that the utilization of potential work capacity of elderly persons is unlikely to pose any serious threat to the employment opportunities of their young counterparts in Japan.

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