Joint decision makers: men

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Age	40.01	40.26	40.40	40.41	41.15	41.22	41.55	41.94	42.22	42.27	42.64
	(10.28)	(10.16)	(9.96)	(9.84)	(9.81)	(9.64)	(9.51)	(9.62)	(9.69)	(9.54)	(9.64)
Edl1	0.230	0.222	0.122	0.120	0.095	0.086	0.088	0.068	0.058	0.049	0.040
Edl2	0.188	0.183	0.191	0.195	0.189	0.174	0.168	0.161	0.159	0.153	0.143
Edl3	0.397	0.400	0.456	0.452	0.460	0.455	0.481	0.487	0.479	0.486	0.485
Edl4	0.136	0.139	0.167	0.172	0.170	0.181	0.185	0.192	0.205	0.206	0.217
Edl5	0.049	0.052	0.060	0.058	0.061	0.066	0.073	0.075	0.082	0.088	0.093
Edl6	0.001	0.004	0.003	0.004	0.025	0.038	0.005	0.016	0.016	0.018	0.021
Wage	30.24	32.57	31.66	30.24	28.27	29.11	28.37	29.74	29.20	29.29	30.03
rate	(25.68)	(44.62)	(20.16)	(13.60)	(11.42)	(17.60)	(13.92)	(32.89)	(17.48)	(15.60)	(14.82)
N=	1654	1595	1715	1760	1740	1708	1730	1707	1733	1697	1636
h_m	37.88	37.86	37.89	37.93	38.21	38.18	38.19	37.98	37.86	37.90	38.03
	(4.26)	(4.50)	(4.32)	(4.18)	(4.59)	(4.30)	(4.18)	(4.29)	(4.37)	(4.25)	(3.89)
N	1847	1798	1909	2013	1870	1881	1877	1800	1752	1724	1702

Joint decision makers: women

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Age	37.62	37.89	37.94	38.03	38.81	38.90	39.25	39.66	39.92	39.98	40.28
	(10.25)	(10.19)	(10.00)	(9.90)	(14.39)	(9.66)	(9.58)	(9.67)	(14.19)	(9.59)	(9.70)
Edl1	0.246	0.239	0.184	0.170	0.139	0.129	0.120	0.104	0.095	0.070	0.066
Edl2	0.300	0.289	0.287	0.291	0.276	0.258	0.255	0.237	0.227	0.219	0.205
Edl3	0.335	0.346	0.387	0.390	0.400	0.408	0.446	0.452	0.465	0.478	0.478
Edl4	0.107	0.110	0.124	0.130	0.137	0.143	0.150	0.155	0.163	0.175	0.184
Edl5	0.011	0.012	0.015	0.016	0.019	0.023	0.027	0.032	0.032	0.046	0.052
Edl6	0.000	0.004	0.003	0.003	0.029	0.038	0.002	0.019	0.018	0.011	0.015
Wage	21.81	23.94	23.00	23.58	21.78	21.75	23.02	22.12	21.40	22.17	23.83
rate	(10.87)	(37.75)	(16.31)	(27.28)	(12.87)	(16.69)	(23.57)	(16.47)	(11.91)	(12.94)	(13.88)
N=	761	807	970	1056	1130	1109	1152	1171	1197	1212	1005
h_f	24.49	24.31	24.06	23.96	23.78	23.82	23.27	23.87	23.62	23.97	23.85
	(11.69)	(11.49)	(11.55)	(11.46)	(11.17)	(11.12)	(10.91)	(10.87)	(10.48)	(10.31)	(10.31)
N=	954	993	1157	1198	1246	1269	1301	1274	1251	1263	1294

Joint decision makers: men and women

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
# kids 0-3	1.511 N=454	1.446 N=363	1.521 N=470	1.508 N=459	1.527 N=404	1.508 N=413	1.541 N=386	1.545 N=387	1.529 N=395	1.546 N=377	1.557 N=359
# kids 4-12	1.599 N=753	1.629 N=700	1.650 N=754	1.654 N=772	1.661 N=760	1.680 N=726	1.682 N=723	1.674 N=666	1.641 N=640	1.620 N=631	1.596 N=631
# kids 12-17	1.293 N=427	1.319 N=408	1.333 N=423	1.338 N=423	1.293 N=440	1.315 N=448	1.337 N=451	1.384 N=437	1.344 N=436	1.365 N=405	1.370 N=376
# ch <17 N=	1.933 1203	1.904 1096	1.947 1238	1.978 1225	1.955 1193	1.917 1208	1.943 1183	1.944 1133	1.924 1104	1.919 1064	1.913 1027
Age yng child<12	4.67 N=972	4.71 N=918	4.72 N=995	4.86 N=1004	5.13 N=968	4.95 N=971	5.08 N=944	4.95 N=892	4.86 N=868	4.94 N=839	5.03 N=832
D ch 0-5	0.275	0.244	0.273	0.272	0.255	0.265	0.250	0.247	0.253	0.254	0.257
N	2110	2025	2172	2163	2140	2117	2104	2015	1940	1900	1861

All

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Unempl. rate	6.6	6.2	6.3	7.3	8.2	7.8	7.2	6.2	4.9	4.0	3.6
Economic climate	1.0	0.9	0.1	-2.1	-1.2	0.5	-0.4	0.2	1.2	0.3	0.9

Ⅳ.　研究成果の刊行に関する一覧表

IV. 研究成果の刊行に関する一覧表

書籍

著者氏名	論文タイトル名	書籍全体の編集者名	書籍名	出版社名	出版地	出版年	ページ
佐藤俊樹		佐藤俊樹	『００年代の格差ゲーム』	中央公論新社		2002年	
橘木俊詔・大田弘子・佐藤俊樹・蓼沼宏一	「日本は不平等化してよいのか・よくないのか：パネル・ディスカッション」	大塚啓二郎・中山幹夫・福田慎一・本多佑三編	『現代経済学の潮流2002』	東洋経済新報社		2002年	
田近栄治・古谷泉生	「税制改革のマイクロ・シミュレーション分析」	小野善康・中山幹夫・福田慎一・本多佑三編	『現代経済学の潮流2003』	東洋経済新報社.		2003年	
阿部　彩・大石亜希子	「母子世帯の経済状況と社会保障」	国立社会保障・人口問題研究所編	『子育て世帯の社会保障』	東京大学出版会		2005年	

雑誌

発表者名	論文タイトル名	発表誌名	巻名	ページ	出版年
Takashi Oshio	"Social Security and Intragenerational Redistribution of Lifetime Income in Japan"	一橋大学世代間利害調整プロジェクト（特定領域研究）ディスカッション・ペーパー	No.172		2003年
佐藤俊樹	「不平等社会のゆくえと共同の論理「弱者」から「敗者」へ」	『生活経営学研究』	第38巻	pp.3-7.	2003年
大石亜希子	「有配偶女性の労働供給と税制・社会保障制度」	『季刊社会保障研究』	第39巻第3号	pp.286-300.	2003年

阿部　彩	「アメリカ福祉改革の効果と批判」	『海外社会保障研究』	第147号	pp.68-76.	2004年
小塩隆士	「1990年代における所得格差の動向」	『季刊社会保障研究』	第40巻第3号	pp.277-285.	2004年
Oshio, Takashi	"Social Security and the Intragenerational Redistribution of Lifetime Income in Japan"	*The Japanese Economic Review*	Vol.56, No.1	pp.85-106.	2005年
稲垣誠一	「若年フリーター増加がもたらす将来の人口構造への影響（ミクロシミュレーションモデルによる人口の将来推計）」	『人口学研究』	（投稿中）		

V.　研究成果の刊行物・別刷

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SOCIAL SECURITY AND THE INTRAGENERATIONAL REDISTRIBUTION OF LIFETIME INCOME IN JAPAN*

By TAKASHI OSHIO
Kobe University

We investigate how social security redistributes lifetime income within the same generation in Japan, based on data from the micro data. The progressivity of Japan's state pension programme appears to be much more limited on a lifetime basis than on an annual basis. Given an ageing population, replacing the current Pay As You Go system with a simple one that consists of a flat benefit and a wage-proportional premium, and has no maximum contribution, can be desirable in terms of both efficiency and intragenerational equity. The redistributive effects of income tax and consumption tax to finance the benefit are also examined.
JEL Classification Numbers: H55, H23.

1. Introduction

The social security system redistributes income from the young to the old, because it generally has a pay-as-you-go (PAYGO) structure. This redistributive effect, especially of state pension programmes, is sometimes assessed from two viewpoints. First, with a rapidly ageing population, a PAYGO system is likely to entail substantial income transfers across generations and to reduce the net lifetime incomes of young and future generations. There have been many attempts to address empirically the issues of intergenerational redistribution and inequality by selecting a representative individual of each generation. Hatta *et al.* (1998) and Takayama *et al.* (1999) are recent examples of studies from this standpoint in Japan. However, the models of heterogeneous individuals can yield ambiguous results; for instance, the possibility cannot be ruled out that individuals with lower incomes can earn net social security transfers from the government as a result of the progressive benefit and premium/tax formula, even if the average net income of the generation to which they belong falls under a PAYGO system.

Second, social security is often expected to reduce income inequality on an annual basis, because the old who receive benefits are poorer on average than the young who pay the premiums and taxes. Indeed, the Ministry of Health, Labour and Welfare (2002) emphasized that social security as a whole succeeds in holding down the Gini index, which has been on a clear upward trend in recent years in Japan. However, this type of assessment tends to be misleading, because each individual experiences being both young and old in his or her lifetime. Indeed, comparing the data from the 1981 and 1993 Surveys on the Redistribution of Income, Ohtake and Saito (1999) found that, while the effects of redistribution

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policies were brought about mainly by a reduction of differentials within age groups in 1981, the narrowing of income gaps between age groups made a greater contribution in 1993. From these results, they pointed out the problem of simply linking a reduction of income differentials with an evaluation of redistribution policies. In addition, Teruyama and Ito (1994) decomposed the cross-sectional inequality of income and wealth into intra-age inequality ("true inequality") and inter-age inequality ("apparent inequality"), using an overlapping-generations model.

One of the key issues uncovered by these two types of discussion is intragenerational redistribution on a lifetime basis; that is, how social security as a life-cycle programme redistributes lifetime income within the same generation. While it is debatable whether or not social security *should* aim to redistribute income by itself, it is important to capture the magnitude of its *ex post* redistributive effects in order to design an overall structure of redistribution policies. On a lifetime basis, the benefit and premium/tax formula appears to redistribute income from those who earn more during their working years to those who have earned less. This progressivity of the system, however, is naturally expected to be lower than observed on an annual basis, and to be difficult to measure.

In recent years there have been a growing number of studies in the United States aiming to quantify the lifetime progressivity of the social security system using panel data, and to analyse its sensitivity to family or spousal features, mortality and other heterogeneous factors. For example, Coronado *et al.* (2000) found that social security is much less progressive on a lifetime basis than on an annual basis, and quantified several individual characteristics that are relevant to determine the progressivity of social security. Gustman and Steinmeier (2001) pointed out that social security looks less progressive if individuals are grouped into households and adjusted for variations in secondary earner's income than it does when looking at retired workers' benefits. Liebman (2002) emphasized that spouse benefits and differential mortality can offset a large part of the progressivity provided by the benefit formula. Furthermore, Coronado *et al.* (2002) conducted micro simulations to compare the effects of several PAYGO reforms on the overall progressivity of the system.

In Japan, by contrast, it is very difficult to make a lifetime-income-based analysis of intragenerational redistribution, because, unlike in the United States, adequate panel data are unavailable. On the basis of a numerical analysis of a two-period life-cycle model, Shimono and Tachibanaki (1985) determined the extent to which state pension programmes redistribute lifetime income in Japan. They showed that a flat component of the pension benefits reduces the inequity of lifetime income, and that an increase in a wage-proportional premium rate contributes to a reduction in income inequality. Takayama *et al.* (1990), who estimated the streams of lifetime income using micro data from the 1994 National Survey on Consumption, first attempted to quantify the redistribution effects of state pension programmes across and within generations in Japan. They found that in older age groups those with higher incomes are receiving greater net benefits, pointing to at least a partial regressivity of state pension programmes. However, they neglected the "incompleteness" of the system, i.e. the fact that social security benefits are covered not only by premiums but also by government subsidies (which are eventually financed by income and other taxes), as well as by burdens postponed to future generations.

This paper focuses on Japan's state pension programme, especially the Kosei Nenkin programme for employed workers in the private sector, and attempts to measure its potential redistributive effects and progressivity on a lifetime basis using data from the 1996 Survey on the Redistribution of Income. Besides measuring the progressivity of the current system, we attempt to estimate the impacts of social security and tax reforms in terms of

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both efficiency and intragenerational equity in the long run. Owing to limited information about each individual's earnings history, our analysis depends on artificially constructed streams of employees' lifetime incomes that are consistent with the actual income distribution on an annual basis shown in the Survey. Our analysis also concentrates on a steady state, in which each generation grows (shrinks) at the same fixed pace and benefit payments are completely financed by premium and/or tax revenues at each time. This type of analysis cannot grasp the dynamics of income transfer across generations or explicitly address intergenerational equity issues. We believe, however, that it can provide a basic picture of the potential progressivity and redistributive effect of social security on a lifetime basis within the same generation, something that has tended to be ignored in Japan.

The remainder of the paper is organized as follows. Section 2 first overviews the redistributive feature of a PAYGO system on a lifetime basis using a simple two-period life-cycle model. Using that model, we analyse the extent to which it can be affected by tax reforms such as the imposition of income tax on benefits, and the use of consumption tax to finance them. Section 3 illustrates empirically the extent to which the Kosei Nenkin programme is actually progressive on a lifetime basis using reorganized data from the Survey. We also conduct some policy simulations to analyse how much policy reforms could affect net lifetime income on average, and its distribution. Section 4 provides a conclusion and points out issues that remain to be addressed.

2. Theoretical analysis

2.1 A simple model

Let us consider a very simple two-period, life-cycle model, in which one works in period 1 and retires in period 2, to capture roughly the redistributive feature of social security.[1] Assume that in period 1 one gets wage income (W) and pays a social security premium, which consists of a wage-proportional component (tW) and a flat component (T). Then in period 2 the individual receives a social security benefit, which consists of a wage-proportional component (bW) with a benefit multiplier (b) and a flat component (B). Hence, the individual's net lifetime income (W^*) is generally expressed as

$$W^* = (1-t)W - T + \frac{bW + B}{1+r}, \tag{1}$$

where r is the interest rate. With no social security, or under a funded system, net lifetime income is equal to gross income (W). For simplicity, we assume that W and r are exogenously given and fixed, and we also neglect inheritances and private transfers.

It is widely recognized that a PAYGO system reduces net lifetime income if the population growth rate is lower than the interest rate, that is if $n < r$.[2] It should be noted, but is often ignored, that a PAYGO system can make net lifetime income more equally distributed than the gross lifetime income within the same generation. To show this, we rewrite W^* as

[1] In this paper, we focus on state pension programmes, ignoring other social security programmes such as medical, long-term care and employment insurance.

[2] However, Breyer (1989), Geanakoplos *et al.* (1998), Sinn (2000) and many others have pointed out that a scaling-down of a PAYGO system (or a shift to a funded system) does not allow for a Pareto improvement, taking into account the need to compensate the existing pension liabilities. The same type of problem should occur in the transition process for any kind of reform, but is neglected in this paper.

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$$W^* = \left(1 - t + \frac{b}{1+r}\right)W - T + \frac{B}{1+r}, \tag{1'}$$

which means that a PAYGO system can be interpreted as a life-cycle system of progressive income tax, as long as

$$0 < t - \frac{b}{1+r} < 1 \quad \text{and} \quad T < \frac{B}{1+r}.$$

Indeed, the coefficient of variation (CV) of net lifetime income, which is often used to gauge the relative inequality of income around its average, is calculated as

$$CV(W^*) = \left[1 - \frac{(1+n)(B-(1+r)T)}{(1+r)(1+n)\bar{W} - (r-n)(b\bar{W}+B)}\right]CV(W), \tag{2}$$

where $\bar{W}$ is average income and n is a rate of population growth, considering the government's budget constraint: $(1+n)(t\bar{W}+T) = b\bar{W}+B$. Simple calculations can show that if $T < B/(1+r)$, that is if an individual gets a positive flat benefit net over lifetime, introduction of a PAYGO system reduces the relative inequality of lifetime income.

What, then, is the optimal PAYGO system in terms of both efficiency and intragenerational equity for an ageing population, given the level of a flat benefit (B)? It is clear that a flat tax (T) should be zero, because it does not affect average net income, but increases its inequality, as seen from (2). What of the benefit multiplier (b)? Assuming that a larger value of b lowers the average net income, at the same time it reduces the CV (from (2)), because it requires a higher premium rate, which in turn adds to the progressivity of the system. Hence the government will face a trade-off between efficiency and intragenerational equity: an efficiency (intragenerational equity)-oriented government tends to choose a lower (higher) benefit multiplier. If the impact on inequality of income is relatively limited, however, the simplicity of the system—consisting of only a wage-proportional premium and a flat benefit—may look attractive.

If the government chooses this simple system, we can easily confirm that an individual with a lower income can get more net lifetime income than without a social security programme, despite a reduction in average net lifetime income. Let us assume that $b = 0$, $T = 0$ and $t = B/[(1+n)t\bar{W}]$, making net lifetime income equal to

$$W^* = \left[1 - \frac{B}{(1+n)\bar{W}}\right]W + \frac{B}{1+r} = (1-t)W + \frac{(1+n)t\bar{W}}{1+r}. \tag{3}$$

Hence, while this PAYGO system reduces average net lifetime income under an ageing population with $n < r$ because

$$\bar{W}^* = \bar{W} - \frac{(r-n)B}{(1+r)(1+n)} < \bar{W}, \tag{4}$$

it affects the net lifetime income of each individual differently in such a way that

$$W^* \geq W \text{ if } W \leq \frac{1+n}{1+r}\bar{W}; \quad W^* < W \text{ if } W > \frac{1+n}{1+r}\bar{W}.$$

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This means individuals with lower incomes become better off at the expense of those with higher incomes under a PAYGO system.[3]

To sum up, a PAYGO system has a favourable effect on income redistribution, in that it reduces the degree of inequality relative to average income, despite its adverse impact on average lifetime income under an ageing population. This is because the impact of a reduced variance of net lifetime income more than offsets the impact of its lowered average. However, two things should be noted. First, this redistributive effect decreases with lower population growth, which tends to reduce average net lifetime income and raise its relative inequality; second, the redistributive effect increases with a higher level of benefit, which requires a higher premium rate.

2.2 Annual *v.* lifetime income redistribution

The social security system, managed under a PAYGO scheme, entails income transfer from the young to the old at each time. In this sense, it makes annual income more equally distributed as long as the actual earnings of the old are lower than those of the young. Because everyone experiences being both young and old in his or her lifetime, however, income redistribution on an annual basis should be interpreted with caution.

This section illustrates the relationship between the redistributive effect of a PAYGO system on annual and lifetime income, with annual income meaning "period" income in our simple two-period life-cycle model. To address this issue clearly, I take an extreme case in which the interest rate and the population growth rate are both equal to zero. I also assume that the social security system has a simple structure consisting of only a wage-proportional premium and a flat benefit. In this extreme case, the average gross annual income for society as a whole ($\bar{W}_a$) is equal to $\bar{W}/2$, because there are the same number of the young (who earn W) and the old (who earn no income). So the variance of gross annual income is given by

$$V(W_a) = \frac{1}{2}\left(\bar{W} - \frac{\bar{W}}{2}\right)^2 + \frac{1}{2}\left(0 - \frac{\bar{W}}{2}\right)^2 + \frac{V(W)}{2} = \frac{\bar{W}^2}{4} + \frac{V(W)}{2},$$

adding the inter-age group and intra-age group variances. Hence the squared coefficient of the variance (SCV) of gross annual income is given by

$$SCV(W_a) = V(W_a)/\bar{W}_a^2 = 1 + 2SCV(W),$$

which is clearly larger than the SCV of gross lifetime income.

With the introduction of a PAYGO social security system, the net income of the young is $(1 - t)W$ and that of the old is B, given the budget constraint per capita of $t\bar{W} = B$. Then the average of net annual income ($\bar{W}_a^*$) remains the same as $\bar{W}/2$, and its variance is calculated in the same way as in the case of gross annual income:

$$V(W_a^*) = \frac{(1 - 2t)^2\bar{W}^2}{4} + \frac{(1 - t)^2V(W)}{2}.$$

[3] This discussion also suggests that there are some individuals who become worse off under a PAYGO system, even if the population growth rate exceeds the interest rate.

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Then, the SCV of net annual income is

$$SCV(W_a^*) = V(W_a^*)/\bar{W}_a^{*2} = (1-2t)^2 + 2(1-t)^2 SCV(W),$$

which is smaller than the SCV of gross annual income, because

$$SCV(W_a^*) - SCV(W_a) = -2t[2(1-t) + (2-t)SCV(W)] < 0.$$

On the other hand, the SCV of net lifetime income is

$$SCV(W^*) = (1-t)^2 SCV(W),$$

which is derived from (3) assuming that $r = n$, and becomes clearly smaller than the SCV of gross lifetime income.

Now, let us compare the redistributive effects of the social security system on annual and lifetime income in terms of a change in the SCV:

$$\left|\frac{SCV(W_a^*) - SCV(W_a)}{SCV(W_a)}\right| - \left|\frac{SCV(W^*) - SCV(W)}{SCV(W)}\right| = \frac{t(2-3t)}{1+2SCV(W)} = \frac{B(2\bar{W} - 3B)}{[1+2SCV(W)]\bar{W}^2}.$$

It can be seen that the redistributive effect of the social security system, if evaluated as a reduction in the SCV of annual income, tends to be overestimated unless the benefit is extremely high. This result appears to hold basically with more realistic assumptions for economic and demographic variables, as well as for social security schemes, as already confirmed by several empirical studies quoted in Section 1.

2.3 Taxation

The Japanese system of income taxation is often criticized for being too generous to the elderly, who can enjoy several income exemptions for taxation. In fact, most pensioners do not have to pay any income tax on benefits. With a deterioration of social security finances in prospect, some argue for the raising of income tax on benefits or an increase in the consumption tax to hold down PAYGO burdens, which are currently levied exclusively on young people. Such tax policies are likely to reduce the adverse income transfer between the generations and to raise average net lifetime income with an ageing population. Yet it is uncertain whether or not it can reduce the inequality of lifetime income within the same generation.

Let us consider the system in which the government finances a flat social security benefit by a wage-proportional tax (with a tax rate t_i), which is commonly levied on both young and old people, and compare this case with the simple PAYGO system described in Section 2.1. The budget constraint per capita of the social security system will be expressed as

$$t_i[(1+n)\bar{W} + B] = B,$$

which is given from (1) setting $T = b = 0$. Then net lifetime income (W_i^*) is expressed as

$$W_i^* = (1-t_i)\left(W + \frac{B}{1+r}\right) = \left[1 - \frac{B}{(1+n)\bar{W} + B}\right]\left(W + \frac{B}{1+r}\right). \tag{5}$$

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The effects of this taxation are mixed. On the one hand, with the same level of benefit (B), average net income is higher than in the case with no tax on benefit. To show this, we compare (5) with (4):

$$\bar{W}_i^* = \left[1 - \frac{B}{(1+n)\bar{W} + B}\right]\left(\bar{W} + \frac{B}{1+r}\right) = \bar{W}^* + \frac{(r-n)B^2}{(1+r)(1+n)[(1+n)\bar{W} + B]} > \bar{W}^*, \qquad (6)$$

assuming $n < r$ This result makes sense intuitively, because taxing the benefit spreads social security costs more widely among different generations, and mitigates intergenerational transfers with an ageing population. On the other hand, the variance of net lifetime income becomes larger, because t_i is clearly lower than t and thus reduces the progressivity of the system. Putting these factors together, we get the coefficient of variance of net lifetime income, which is equal to

$$CV(W_i^*) = \frac{(1+r)\bar{W}}{(1+r)\bar{W} + B} CV(W). \qquad (7)$$

In addition, we can show that

$$\frac{CV(W_i^*)}{CV(W^*)} = \frac{(1+r)(1+n)\bar{W}^2 - (r-n)B\bar{W}}{(1+r)(1+n)\bar{W}^2 - (r-n)B\bar{W} - B^2} > 1,$$

which indicates that taxing the benefit reduces the redistributive effect of a PAYGO system within the same generation. Hence income taxation on the benefit is desirable in terms of efficiency, but undesirable in terms of intragenerational equity.

How will these results change when applying consumption tax, which is levied on the consumption expenditures of both the young and old, instead of income tax, to finance social security benefits? Let us take a simple case in which an individual consumes all of his net lifetime income leaving no bequest, and smoothes consumption over his lifetime to maximize his utility. Denote consumption in periods 1 and 2 as C_1 and C_2, respectively, with a consumption tax rate of t_c, and assume that the lifetime utility function of an individual is expressed as

$$U(C_1, C_2) = \ln C_1 + \frac{1}{1+r} \ln C_2, \qquad (8)$$

where the discount rate of utility in period 2 is assumed to be equal to the interest rate. Then, on average for society as a whole, consumption in each period is given as

$$\bar{C}_1 = \bar{C}_2 = \frac{1+r}{(1+t_c)(2+r)}\left(\bar{W} + \frac{B}{1+r}\right),$$

Then, considering that the budget constraint of the social security system is given by

$$t_c[(1+n)\bar{C}_1 + \bar{C}_2] = B,$$

the consumption tax rate is implicitly solved as

$$\frac{t_c}{1+t_c} = \frac{B(2+r)/(2+n)}{[(1+r)\bar{W} + B]}.$$

Hence net lifetime income (W_c^*) is given by

$$W_c^* = \frac{1}{1+t_c}\left(W + \frac{B}{1+r}\right) = \left[1 - \frac{B(2+r)/(2+n)}{(1+r)\bar{W} + B}\right]\left(W + \frac{B}{1+r}\right) \qquad (9)$$

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and its average is calculated as

$$\bar{W}_c^* = \left[1 - \frac{B(2+r)/(2+n)}{(1+r)\bar{W} + B}\right]\left(\bar{W} + \frac{B}{1+r}\right) = \bar{W}^* + \frac{(r-n)B}{(1+r)(1+n)(2+n)} > \bar{W}^*. \quad (10)$$

Comparing this with (6), we get

$$\bar{W}_c^* = \bar{W}_i^* + \frac{(r-n)B(\bar{W} - B)}{(1+r)(2+n)[(1+n)\bar{W} + B]} > \bar{W}_i^*$$

assuming $n < r$ and $B < \bar{W}$.

Hence consumption tax becomes more efficient than wage-proportional income tax with an ageing population, as long as the social security benefit is lower than wage earnings. This is because in period 2 an individual consumes more than the benefit, and thus pays more (consumption) tax than in the case of income tax, which is levied not on the benefit but on consumption expenditures. Thus, consumption tax can suppress income transfer from the young to the old under an ageing population more effectively than income tax.

Meanwhile, as seen in (10), net lifetime income is proportional to the sum of wage and present discounted value of the benefit, as in the case of income taxation on the benefit (see (6)). Thus, these two types of taxation have the same CV of net lifetime income, which is expressed in (7). Under an ageing population, therefore, consumption tax is superior to income tax for financing a social security benefit, because it leads to a smaller reduction in average net lifetime income without increasing the relative inequality of lifetime income.

This assessment of consumption tax, however, would be affected by introducing "price indexation", which automatically raises the level of benefit (as well as after-tax consumer prices) by as much as the consumption tax rate. Starting with no consumption tax, the benefit is inflated to $(1 + t_{cc})B$, where t_{cc} is a modified consumption tax rate at an equilibrium. Thus, the budget constraint of the social security system is given by

$$t_{cc}[(1+n)\bar{C}_1 + \bar{C}_2] = (1 + t_{cc})B,$$

and the consumption tax rate is implicitly solved as the value that satisfies

$$\frac{t_{cc}}{1 + t_{cc}} = \frac{(1 + t_{cc})B(2+r)/(2+n)}{[(1+r)\bar{W} + (1 + t_{cc})B]}, \quad (11)$$

assuming the individual's utility function (8). This modified consumption tax rate can easily be shown to be higher than the consumption tax rate with no price indexation (t_c), because the government has to finance the benefit inflated by price indexation. Net lifetime income (W_{cc}^*) and its average are given, respectively, by

$$W_{cc}^* = \frac{1}{1+t_{cc}}\left[W + \frac{(1+t_{cc})B}{1+r}\right] = \left[1 - \frac{(1+t_{cc})B(2+r)/(2+n)}{(1+r)\bar{W} + (1+t_{cc})B}\right]\left[W + \frac{(1+t_{cc})B}{1+r}\right], \quad (12)$$

$$\bar{W}_{cc}^* = \bar{W}^* + \frac{(r-n)B[1 - (1+n)t_{cc}]}{(1+r)(2+n)},$$

the latter of which leads to $\bar{W}_{cc}^* > \bar{W}^*$, provided the consumption tax rate is lower than $1/(1+n)$, and also to $\bar{W}_{cc}^* < \bar{W}_c^*$ from (10). It is, however, indeterminate whether or

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not $\bar{W}^*_{cc} > \bar{W}^*_i$, because a higher benefit requires a higher consumption tax, which in turn raises its rate via price indexation of the benefit.[4] Meanwhile, the CV of net lifetime income is given by

$$CV(W^*_{cc}) = \frac{(1+r)\bar{W}}{(1+r)\bar{W} + (1+t_{cc})B} CV(W),$$

which is lower than that in the case of income taxation or consumption tax without price indexation (see (7)). However, we can show that consumption tax with price indexation cannot reduce the CV of net lifetime income from the level with no taxation on the benefit, as far as $n < r$. Consumption tax, if price-indexed, makes both the benefit and the tax rate higher, which adds to the progressivity of consumption tax, but this effect is more than offset by a reduction of net lifetime income with an ageing population.

In sum, the analysis in this section concludes that:

1. income tax on the benefit makes average net lifetime income higher than in the case of no taxation on the benefit, while it widens its relative inequality within the same generation;
2. consumption tax with no price indexation is preferable to income tax, in that the former makes average net lifetime income higher than the latter, while these two tax policies lead to the same relative inequality of income distribution;
3. consumption tax with price indexation makes average net lifetime income lower than consumption tax with no price indexation and possibly lower than income tax (but still higher than in the case of no taxation on the benefit), while it makes net lifetime income more equally distributed than those two types of taxation.

Discussions in this section apply to a simple social security system that has only a flat benefit and a wage-proportional premium as a baseline, but the key messages are likely to hold with a more realistic system.

3. Empirical analysis

3.1 Measurement of redistributive effects and progressivity

It is almost impossible to measure directly the impact of social security programmes on lifetime income in Japan, because no panel data are available that provide a profile of wage income, social security contributions and benefits. Our analysis thus depends heavily on cross-section data of the 1996 Survey on the Redistribution of Income, which was conducted and published by the Ministry of Health and Welfare (which is now the Ministry of Health, Labour and Welfare). The Survey reports an individual's wage, social security contributions and benefits, and income and other taxes plus her family, spouse and occupational characteristics in the survey year, but no longitudinal information is available.

4 Simple calculations show that a higher benefit makes average net lifetime income lower provided $r > n$, and that it is necessary for the tax and the benefit to satisfy the condition $B < [1-(1+n)t_{cc}]\bar{W}/(1+t_{cc})$ in order to make $\bar{W}^*_{cc} > \bar{W}^*_i$. This condition can be simplified to $B < W/3$ if $n = r = 0$, implying that a consumption tax with price indexation is more efficient than an income tax if the level of social security benefit is relatively low. This condition becomes stricter with an ageing population.

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There are several ways to evaluate the overall redistributive effects and progressivity of the system. In this paper we use three measures. First, we calculate a change in the SCV, for which a larger reduction means greater redistribution of income. The SCV is useful in that its change can be easily decomposed as:

$$\frac{SCV(W^*) - SCV(W)}{SCV(W)} = \frac{1}{V(W)}\sum_i \omega_i[(\bar{W}_i^* - \bar{W}^*)^2 - (\bar{W}_i - \bar{W})^2] + \frac{1}{V(W)}\sum_i \omega_i[V(W_i^*) - V(\bar{W}_i)] + \frac{\bar{W}^2 - \bar{W}^{*2}}{\bar{W}^{*2}}\frac{V(W^*)}{V(W)},$$

where ω_i is a share of each group of a society. The first and second terms of the right-hand side indicate changes in the intragroup and intergroup variances, respectively, of income arising from a redistribution by the social security system. The third term shows the degree of "incompleteness" of income redistribution, which Oshio (2002) discussed in more detail. The social security system is usually incomplete in terms of income redistribution, in that its benefits are covered not only by employees' own contributions, but also employers' contributions and government subsidy (which is eventually to be financed by tax), making the average net income higher than gross income, and thereby lowering the SCV.[5] We have to take into account this incompleteness in order to assess redistribution policies precisely.

Second, we compare the Gini indices before and after social security taxes and benefits. The progressivity can be gauged by the "effective progression" (EP) measure of Musgrave and Thin (1948), also used by Coronado *et al.* (2000) and others:

$$EP = \frac{1 - Gini_{AT}}{1 - Gini_{BT}},$$

where $Gini_{AT}$ and $Gini_{BT}$ are before-tax-and-benefit and after-tax-and-benefit Gini indices. A value of one indicates that $Gini_{AT}$ and $Gini_{BT}$ are the same, and that social security has no impact on income distribution. A value greater than one indicates progressivity of the system, while a value less than one indicates regressivity of the system.

Third, we compare the magnitude of the net social security tax by income class. The net social security tax rate is defined as the magnitude of the difference between the present discounted value of premiums or taxes paid and benefits received, relative to gross lifetime income. If higher income individuals face a higher net social security tax rate, we can conclude that the system is progressive. I focus on this tax rate when assessing the redistributive impact of policy reforms in Section 3.4.

First, let us provide a rough picture of income redistribution through the social security system as a whole—including all members of Kosei Nenkin, Kyosai Kumiai and Kokumin Nenkin—on an annual basis. Table 1(a) summarizes income redistribution through the social security programmes as a whole, based on all individuals classified into two age groups: the young (aged 20–59) and the old (aged 60+). The sample size is 18 253, with 12 888 young and 5365 old individuals of all kinds of occupational status, including non-working housewives. Income data are on an individual basis, with net income calculated as gross income plus social security benefits minus premiums. Gross income

[5] This incompleteness could be caused by an insufficient sample size rather than institutional factors. My sample size, however, seems to be large enough to neglect this possibility and the data are randomly selected.

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TABLE 1
Income Redistribution of the Social Security System as a Whole

	Average	St. dev.	SCV
(a) Total[a]			
Gross income (¥'000)			
Total	2385	3494	2.147
Young (age 20–59)	2914	3530	1.468
Old (age 60+)	1114	3051	7.500
Gini index (G_{BT})			0.662
Net income with social security (¥'000)			
Total	2579	3352	1.690
Young (age 20–59)	2789	3408	1.494
Old (age 60+)	2075	3157	2.315
Gini Index (G_{AT})			0.593
Reduction in SCV (%)			
Total			21.3
Inter-age group			4.6
Intra-age group			3.3
Incompleteness			13.3
Effective progression [$= (1 - G_{AT})/(1 - G_{BT})$]			1.2057
(b) Private and public employees' pension programmes[b]			
Gross income (¥'000)			
Total	3867	3511	0.825
Young (age 20–59)	5128	2998	0.342
Old (age 60+)	1012	2853	7.953
Gini index (G_{BT})			0.475
Net income with social security (¥'000)			
Total	4239	3068	0.524
Young (age 20–59)	4838	2884	0.355
Old (age 60+)	2882	3042	1.114
Gini index (G_{AT})			0.355
Reduction in SCV (%)			
Total			36.5
Inter-age group			22.6
Intra-age group			1.0
Incompleteness			12.8
Effective progression [$= (1 - G_{AT})/(1 - G_{BT})$]			1.2269

[a] Sample: 18 253 (young 12 888, old: 5365).
[b] Sample: 7030 (young: 4876; old: 2154)
Source: The micro data from the 1996 Survey on the Redistribution of Income.

in the table is the one reported by each individual in the Survey without any adjustment (see Section 3.2).

As can be seen from this table, a significant part of a 21.3% reduction in the SCV is attributable to the "incompleteness" of the programmes, which reduces the SCV by 13.3 percentage points. This is consistent with a gap between averages of net and gross income caused by two factors: (i) employers pay half of required premiums (gross income reported in the Survey excludes employers' contributions), and (ii) the government subsidizes one-third of the flat basic benefit given to the elderly. Aside from the effects of this incompleteness, the social security programmes reduce the inter-age group variance of annual income by 4.6 percentage points through income transfers from the young to the old, and they reduce the intra-age group variance by 3.3 percentage points, mainly through income redistribution among the young.

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Next, we focus on employed workers and pensioners, both of whom seem to be Kosei Nenkin or Kyosai Kumiai members. We select those (4876) who are aged 20–59 and pay Kosei/Kyosai premiums and those (2154) who are aged 60+ and receive Kosei/Kyosai benefits. The latter individuals are considered to have been employed workers, part-time or full-time, and to have paid contributions to Kosei/Kyosai programmes before age 60. Table 1(b) summarizes the results, which are different from those for all individuals. The redistributive impact of Kosei/Kyosai programmes, which lowers the SCV by 36.5%, is somewhat stronger than that observed for all individuals. This is largely due to substantial income transfers from the young to the old, in line with a remarkable reduction of the inter-age variance of net income. On the other hand, the SCV for the young remains little changed, because premiums are basically wage-proportional. A reduction of the SCV for the old is due mostly to a rise in net income, which is boosted by the benefit. The level of the incompleteness effect is almost the same as that observed for all individuals.

The numbers in the last rows in the both parts of Table 1 report the effective progression of the social security programmes: 1.206 for the total sample and 1.227 for Kosei/Kyosai members. These values indicate that the current social security system is progressive in terms of annual income, which is in line with the above-mentioned results based on a change of the SCV.

3.2 Modifying annual income and setting up lifetime income

To quantify the redistributive effects of social security more precisely, we modify and reorganize the data from the Survey. First, we modify "gross income" so that it includes employers' contributions to social security, because gross income reported in the Survey excludes them. Consequently, "gross income" hereafter means total compensation paid by an employer, which is equivalent to employment compensation on a national accounts basis. We need to make this modification to get a comprehensive picture of income redistribution. We also assume that this redefined gross income is fixed regardless of policy changes; for example, even if a new system allows employers to pay no social security contributions, they are assumed to make the same contributions as they have to pay under the current system on wages.

When calculating this redefined gross income, we take into account the relationships among redefined gross income (W_a), reported gross income (W_a^R) and "standardized" income [*hyojun hoshu*] (on which the social security premiums are levied, and which is capped by A as the maximum for calculating premiums) (W_a^S):

$$W_a^R = W_a - \frac{t_0}{2}W_a^S, \qquad W_a^S = \min[A, (1-\lambda)W_a^R],$$

where t_0 is the premium rate and λ denotes the share of bonus payments in reported gross income. Assuming for simplicity that λ is equal for all employees, and neglecting the employers' contributions to other social security programmes, we can estimate gross income from reported income by

$$W_a = \left[1 + \frac{(1-\lambda)t_0}{2}\right]W_a^R \qquad \text{if } W_a^R \le \frac{A}{1-\lambda},$$

$$W_a = W_a^R + \frac{t_0 A}{2} \qquad \text{otherwise.}$$

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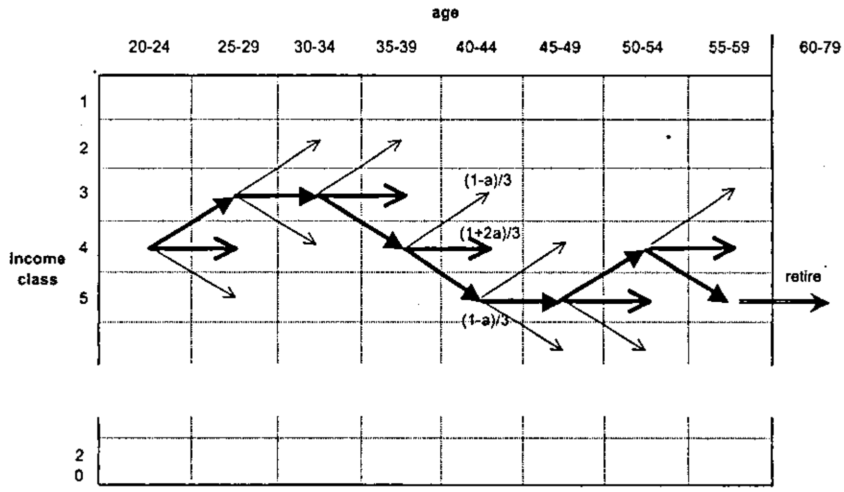

FIGURE 1. Simulated life: an example

Reflecting the current Kosei Nenkin programme, we set $t_0 = 0.165$ and $A =$ ¥7 080 000 (= ¥590 000/month × 12 months), both of which are statutory parameters in the survey year 1996; also, $\lambda = 1/4$ is close to the average among Japanese employees.

Second, and more importantly, we have to set up lifetime income. Because no panel data are available in Japan, we reorganize the micro data of the Survey to roughly estimate lifetime income, and then we evaluate the potential redistributive effects of the social security system, focusing on the Kosei Nenkin programme.

We reorganize the micro data in the following ways. First, we choose only male employees in the private sector aged 59 or under from the Survey. Second, we classify these individuals into eight age groups at intervals of five years, from 20–24 years old to 55–59. Third, we divide each age group into 20 income classes, to get 160 (= 8 × 20) "cells". Fourth, we calculate average income and Kosei Nenkin premiums for each cell through age 50–59. Then, we assume that each individual remains in one of 20 income classes for each of the life stages and earns income and pays premiums, which are estimated as the average for each cell based on the microdata.[6]

Of course, an individual may move from one income class to another at any life stage. So we tentatively define "the degree of immobility" of income classes as α ($0 \leq \alpha \leq 1$); if the individual belongs to, say, income class j at any life stage, he will remain in class j at the next life stage with a probability of $(1 + 2\alpha)/3 \times 100\%$, and will move to the neighbouring class $j - 1$ or class $j + 1$ with a probability of $(1 - \alpha)/3 \times 100\%$, respectively (as illustrated in Figure 1). For simplicity, the individual is assumed to move to no other classes, and if he belongs to either the 1st (the poorest) class or 20th (the richest) class at any life stage we assume that the probability of his remaining in that class is $(2 + \alpha)/3 \times 100\%$ at the next stage, and that the probability of moving to either the 2nd class or 19th class is $(1 - \alpha)/3 \times 100\%$. Lifetime income is calculated as the expected value of the present discounted income obtained by this simulation.

If $\alpha = 1$, that is if we assume no mobility between income classes, then each individual will continue to belong to the income class to which he belonged when he was in the

[6] In the United States there have been several research projects using arbitrary levels of income for different groups in order to analyse intragenerational redistribution of social security; see e.g. Boskin, *et al.* (1987).

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20–24 age bracket until he reaches the 55–59 age bracket. Therefore, the income distribution observed by the cross-section analysis of the age groups from the 20–24 to 55–59 age brackets will be presented in exactly the same form as it is. However, it is easy to prove that whatever value α may have—that is, whatever the lifetime income distribution may look like—the annual income distribution shown in the Survey will be reproduced as it is. Put another way, we are creating synthetic streams of individuals' lifetime income that will always reproduce the annual income distribution shown in the Survey. We have ignored here a variety of factors affecting income redistribution, such as cohort effects and technological progress. However, we believe that this is one of the most easily tractable methodologies for grasping a rough picture of lifetime income distribution, which is consistent with the cross-section actual data, especially with limited longitudinal information.

For calculations of social security benefits, we assume that Kosei Nenkin members pay premiums for 40 years, from 20 to 59 years of age, that they retire completely at age 60, and that they then depend entirely on benefits (without any other income) until they die at age 80. The benefit multiplier (b) for the wage-proportional component of the benefit is 0.3 (for those who have paid premiums for 40 years), and the amount of the flat basic benefit (B) is ¥1 560 000 (= ¥65 000/month × 12 months × 2 persons) a year, which is paid to them and their wives.[7] For simplicity, we assume no price and wage inflation, which means that the wage-proportional component of the benefit is proportional to, i.e. is 30% of, the average nominal annual wage earnings. The data for pension benefits and retirement lump-sum payments for the elderly can be obtained from the Survey, but are disregarded because it is impossible to trace their relationship to income when the pensioners were active workers. Income other than employment income, such as interest and dividend income, is ignored for the same reason.

3.3 Redistributive effect of the Kosei Nenkin programme

This section provides a simple and rough assessment of the redistributive effect of the current Kosei Nenkin programme in Japanese society, based on a sample composed of 240 individuals (12 age groups (ranging from 20–24 to 75–79 years) and 20 income classes). Table 2 presents a summary. We assume that the population shrinks by 0.5% annually, which is close to the trend in recent decades, meaning that the older age groups make up a larger proportion of the population.

First we measure progressivity on an annual basis, using the 16.5% premium rate, and we leave the "incompleteness" of the system as it is.[8] As reported in part (a) of Table 2, the SCV of gross annual income of these groups is 0.986, which is somewhat higher than the actual value of 0.825 shown in Table 1(a). This difference is due mainly to the assumption in Table 2 that individuals have no earnings except social security benefits after retirement, leading to higher differentials of annual income between young and old. The Kosei Nenkin programme reduces the SCV by 65.4%, but 11% points of this (not shown in the table) must be covered by resources other than Kosei Nenkin premiums; this is in line with the result that average net annual income is 14.8% higher than gross

[7] My samples consist of all males and we assume that they all have non-working dependent wives, who get the flat-rate basic benefits without making any contributions.

[8] However, it should be noted that employers' contributions are reflected in the calculations, unlike in Table 1.

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TABLE 2
Income Redistribution of the Current Kosei Nenkin Programme[a]

	Interest rate (%, annual)	Degree of immobility	Premium rate (%)	SCV Gross income	SCV Net income	SCV Reduction (%)	Gini indices Gross income	Gini indices Net income	Gini indices Effective progression	Change in average income (%)
(a) Incomplete system	Annual income			0.986	0.341	65.4	0.526	0.294	1.4898	14.8
	Lifetime income									
	1	0	(16.5 (given))	0.141	0.119	16.1	0.214	0.196	1.0229	5.8
		0.5		0.150	0.126	16.0	0.218	0.200	1.0235	
		1		0.166	0.140	15.7	0.224	0.205	1.0242	
	2	0		0.138	0.122	12.0	0.211	0.198	1.0168	1.5
		0.5		0.147	0.129	11.8	0.216	0.202	1.0171	
		1		0.161	0.143	11.5	0.221	0.207	1.0175	
	3	0		0.136	0.124	8.6	0.209	0.199	1.0119	−1.9
		0.5		0.144	0.132	8.4	0.213	0.204	1.0121	
		1		0.157	0.145	8.0	0.218	0.208	1.0123	
(b) Complete system	Annual income			0.986	0.314	68.1	0.526	0.275	1.5302	0
	Lifetime income									
	1	0	(37.5)	0.141	0.123	13.1	0.214	0.198	1.0198	−9.1
		0.5		0.150	0.131	12.5	0.218	0.203	1.0201	
		1		0.166	0.147	11.0	0.224	0.208	1.0204	
	2	0		0.138	0.127	8.4	0.211	0.201	1.0130	−13.5
		0.5		0.147	0.135	7.7	0.216	0.205	1.0131	
		1		0.161	0.152	6.1	0.221	0.211	1.0131	
	3	0		0.136	0.129	4.6	0.209	0.203	1.0077	−17.0
		0.5		0.144	0.138	3.9	0.213	0.207	1.0076	
		1		0.157	0.154	2.1	0.218	0.212	1.0074	

[a]A rate of population growth (n) is assumed to be equal to −0.5% (annual).

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