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INCOME REDISTRIBUTION THROUGH THE TAX SYSTEM: A SIMULATION ANALYSIS OF TAX REFORM

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In this paper, we consider reforming the tax system to a comprehensive income tax model in order to amend the differential treatment of income sources. Our simulation analysis shows that the tax reform improves the effectiveness of the tax system on the redistribution of all sources of income including earned income, financial wealth income, and imputed rent. The analysis of incidence of the tax reform suggests that the tax burden for young renters decreases the most and that for young loan-free land owners increases the most through this tax reform.

1. INTRODUCTION

Japan experienced a drastic increase in land prices in the late 1980s. During this period, the general sense of inequality increased, especially due to the increased inequalities of financial assets and land. The land owners enjoyed inflated asset value, while the renters suffered because of the hike in rental prices. Tachibanaki and Yagi (1994) estimated the contribution of various income sources, including imputed rent, to inequality in total income by using decomposition analysis. They also investigated the effect of the Japanese tax system, namely the separated tax system on income redistribution. The results obtained in their decomposition analysis indicated a relatively weak effect from the separated tax system on the redistribution of income from imputed rent.

In this paper, we consider a tax reform from the current separated tax system to a comprehensive tax system in order to amend this differential treatment of income sources. Under the current separated tax system, each income source is taxed at a different rate. The purpose of this tax reform is to equalize the taxation for various income sources. It would therefore bring about an increase in tax on imputed rent. Taxation of imputed rent has been strongly advocated by many researchers such as Rosen (1985) because it improves efficiency in tenure choice and in the housing market. A change from the separated tax system to the comprehensive income tax system has been proposed by researchers such as King (1983), Hills and Sutherland (1991), and Callan (1992). In Japan, most studies focus on the income tax system, land related tax, consumption tax, capital income tax, and

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the bequest tax separately, but few examine a tax reform from the existing separated tax system to a comprehensive tax system. However, some studies such as Ishi (1980) and Hashimoto *et al.* (1990) are revealing in their consideration of the redistributive role of the Japanese tax system. Ishi (1980) revealed the redistributive effect of the Japanese tax system in detail, and Hashimoto *et al.* (1990) examined the changes in redistributive effect of income tax system from an income tax reform. In contrast to their studies, we examine imputed rent income, and simulate changes in the income redistribution effect of the tax systems and investigate incidence of a tax reform.

Our simulations confirm that the tax reform substantially improves the effect of the tax system on total income redistribution including earned income, financial wealth income, and imputed rent. The analysis of the incidence of the tax reform suggests that the tax burden decreases most for young renters, and increases most for young loan-free land holders. The analysis seeks to reveal who benefits from the current unfair tax system.

The organization of this paper is as follows. Section 2 provides an overview of the land market in Japan. Section 3 summarizes the results obtained by Tachibanaki and Yagi (1994) in order to establish the importance of the issues considered in this paper. Section 4 simulates conversion to the comprehensive income tax system, and investigates the welfare effects of the tax reform.

2. Overview of the Japanese Land Market

2.1. *Land Price Movement in These Two Decades*

Most Japanese are not satisfied with the price and quality of housing. Noguchi (1994), for example, shows that the price of a typical new home is about two to three times higher than annual income in the U.S. and about five to eight times higher than annual income in Japan. Ito (1994) provides evidence for the relatively small size of Japanese houses. The average area of new housing in Japan is 84.4 square meters, compared to 134.8 square metres in the U.S.

Figure 1 shows the movement of land price in the Tokyo metropolitan area for these two decades. From 1986, the land price soared rapidly, and attained its peak in 1991. After it attained its peak, the land price decreased considerably and the price level at 1995 was around the same level as that of 1987. The surge in land price from 1986 to 1991 is called *the Bubble*, and this period is called *years of bubbles*. Since the consumer price index increased 7.5 percent during 1985–90, the increase in land prices during the years of bubbles is quite unusual. It is worth noting that the timing of the decrease in land prices corresponded to the timing of the introduction of public policy measures such as a limit on land-related lendings from banks and a land-holding tax.

Some economists, however, are not satisfied with recognizing this surge in land price as just bubbles. There are several explanations for the surge in land prices. One explanation is to recognize the surge in land prices as a "rational bubble" [see, for example, Asako, Kano and Sano (1990)]. A rational bubble is generated when people consider that the asset price includes the bubble which follows an arbitrary stochastic process. The theory of rational bubbles cannot

explain what economic conditions in 1986 made bubbles, and it does not inform us how to cope with the bubbles.

Another group tries to explain the surge in land prices from the household's rational behavior along the lines as of Ueda (1990) and Yoshida (1993). Ueda claims theoretically that the smaller risk premium in the 1980s caused the surge in land prices. Yoshida clarifies the reason for the surge in land prices following Ueda's explanation. From the no-arbitrage conditions between a safe asset and a risky asset, we can show that the smaller risk premium makes the price higher. To explain the surge in land prices, the reason why the risk premium became smaller should be explained. In his paper, he proxies the risk premium by the time preference rate, and estimates the demand function of land by specifying the time-varying time preference rate. According to his paper, the surge in land prices during the years of bubble can be attributed not to bubbles but to changes in investors' time preferences.

There are several other explanations for the surge in land prices. One argues that the surge in land prices was fuelled by demographic factors. The period of years of bubbles was the period of the years when baby boomers reached the ages for starting to buy houses. This increased the demand for land sharply. Another line of discussion focuses on the structural factors of the Japanese economy to explain the surge in land prices. They argue that the deregulation and liberalization of the Japanese economy in the 1980s revitalized her economy and increased the demand for land. The surge in land prices was the important signal for low efficiency in utilizing land and increasing demand for land.

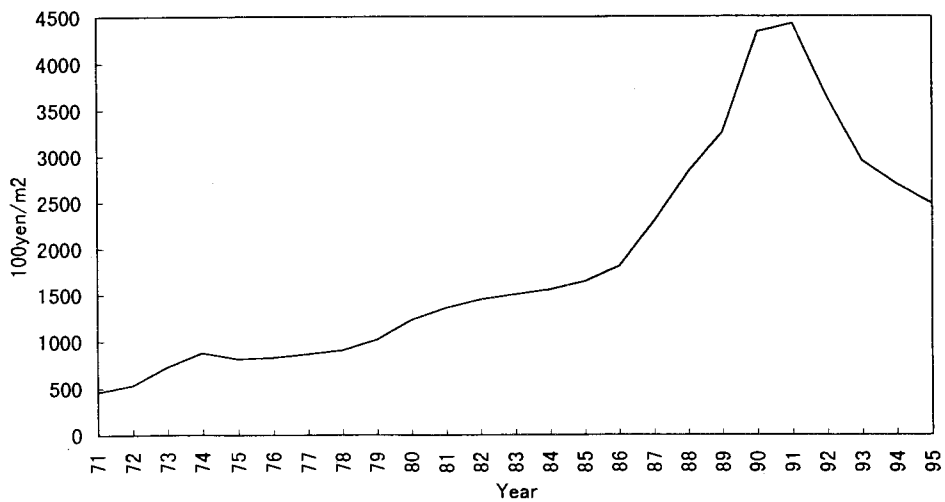

Figure 1. Time Trend of Land Price in Tokyo Area

Source: The Japan Real Estate Institute, "Land Price Index in City Area."

2.2. *Japanese Tax System for Land-holding*

This subsection summarizes a number of aspects of the Japanese land related tax system that are necessary for our discussion [see Ito (1994) for more detailed

explanations]. First, we explain the different prices for the same piece of land: (1) the market price; (2) the monitoring price by the Land Agency (koji kakaku); (3) the assessment for inheritance tax purpose by the National Tax Agency (rosen ka); (4) the assessment for the property tax, administered by the municipal government; (5) the monitoring for representative places by the prefectural government.

In Japan, the property tax (prefectural tax) rate is 1.4 percent (50 percent of the property tax is deductable for residential use). However, the assessment of real estate varies with prefectures. Homma and Atoda (1990) show that in 1988 the gap between the *koji kakaku* and the *rosen ka* ranges from 33.5 percent to 94.1 percent with the average of 56.5 percent of the *koji kakaku*. Wealthy prefectures tend to assess less. An around 50 percent assessment of land value implies that the property tax is subsidized, and encourages hoarding when prices are expected to rise.

The property tax and city planning tax (0.3 percent) are levied on landholding, but no tax is levied on imputed income from land-holding (special landholding taxes may be assessed by a municipality at the rate of 1.4 percent). Four types of taxes for land acquisition exist. (1) The property, including land and structures, is assessed by a real estate tax assessment and taxed by a prefecture. The rax rate is 4 percent. (2) The special land acquisition tax is imposed by a municipality. The land assessment is the actual purchase price and the tax rate is 3 percent. (3) Registration tax is collected at the rate of 0.5 percent by the national government. (4) Inheritance tax is imposed on acquisition by bequest. There are three types of capital gains tax, but an application of this tax is very limited.

There are some important housing-related taxes. Owner-occupied housing, however, enjoys some tax benefits. For example, there exists a tax credit for owner-occupied housing loans. The amount of tax credit is 1 percent of the loan balance at the end of the year. This tax credit is limited to loans for structures and six-year period.

In this paper, we do not consider some potentially important aspects of land and capital income taxation such as the favourable tax treatment of capital gains on land and equities, the undervaluation of land for inheritance tax purposes, etc. We, however, briefly comment on the taxation of interest and dividend income. In Japan, both the system of withholding taxation (at a separate rate, 20 percent) within a certain limit and the system of comprehensive income taxation (at a progressive tax rate) for interest and dividends are prepared, at the taxpayer's option. As of 1980, only 30 million yen of interest income is taxed at a progressive tax rate, while 4.525 million yen of interest income is taxed separately at a 20 percent tax rate [see Kikutani and Tachibanaki (1990), p. 279]. Based on this fact, we assume that all the taxpayers pay taxes on interest income at a flat rate of 20 percent in the following analysis.

3. The Effect of the Japanese Tax System on the Income Redistribution of Imputed Rent

In this section, we briefly summarize the results obtained in Tachibanaki and Yagi (1994) to show how our analysis in this paper is relevant to the current Japanese situation.

3.1. *Method of Estimating Imputed Rent*

First, we shall explain Tachibanaki and Yagi's method of estimating imputed rent [see Tachibanaki and Yagi (1994) for details]. In estimating the imputed rent, the following arbitrage condition between the price of land and rent is applied

$$Q_t = \sum_{j=t}^{\infty} p_j (1+r)^{t-j-1}, \tag{1}$$

where Q_t is the land value evaluated at time t, p_j is the rent at time j (referred to as imputed rent here), and r is the interest rate [see King (1980) and Skinner (1989)]. The imputed rent p_j can be estimated under the given values of both Q_t and r.

To define changes in imputed rents, the following identity for all j is assumed

$$p_{j+1} = (1+g_p)p_j, \tag{2}$$

where g_p is the rate of increase in imputed rents. This assumption implies that imputed rent grows constantly over time. Empirical values of 5 percent for g_p, and 6.74 percent for r are used. The growth rate of rental price g_p is calculated for the Kanto (Tokyo Metropolitan) area from price index data. The long-run interest rate r is the weighted average of loan interest rates by city banks, public financial institutes for housing loans, and private financial institutes for housing loans. The weight is calculated by loan amounts of each institution.

3.2. *Data*

The data used in Tachibanaki and Yagi is the 1990 *Nikkei-Rader Survey of Financial Assets*, which surveyed five thousand households between the ages of 25 and 69 in the Tokyo metropolitan area. This data was selected by applying a two-stage random selection process. In the first stage, sample areas (300 points) were randomly selected. In the second stage, sample households (16 households per point) were randomly selected. Although this data source gives information on land values assessed by respondents, it does not provide information on housing values. Thus, only imputed rent that arises from land is estimated. It should be reminded that the exclusion of the imputed income from housing creates a downward bias. It is difficult to estimate the value of structure because the value depends on a number of facts such as the year of construction, type of building and size. One simple criterion for guessing the magnitude of the bias is the ratio of new housing value to land value in the Tokyo metropolitan area as of 1990. The construction cost of structure per square metre is around 200,000 yen and the land price per square metre is around 400,000 yen. That is, the ratio is less than half, and the magnitude of the bias would be less than that ratio.

To examine the reliability of the Nikkei Rader survey data, we compare them with the 1990 Census (see Table 1). Descriptive statistics are listed in Table 2. It is important to note the difference in the proportion of home owners. In analyzing the data, we eliminated "no-answer" samples, and 2,629 samples are actually used in the analysis. It is likely that the "no-answer samples" are more frequently obtained for home owners than renters, because the questionnaire on land value

TABLE 1

RELIABILITY OF THE NIKKEI RADER SURVEY

Age Class	1990 Nikkei Rader	1990 Census
25–34	0.268	0.241
36–44	0.294	0.275
45–59	0.332	0.349
60–69	0.105	0.134
Number of family members (proportion)	1990 Nikkei Rader	1990 Census
2	0.206	0.265
3	0.229	0.249
4	0.355	0.321
5	0.141	0.110
More than 6	0.069	0.056
Income, tenure and Gini coeff.	1990 Nikkei Rader	1989 NSFIE
Annual income (yen)	7,078,000	7,445,000
Savings (yen)	11,277,000	9,931,000
Ratio of home owners	0.475	0.656
Ratio of loan holders	0.279	0.392
Gini coefficient	0.304	0.288

Sources: Prime Minister's Office, Statistics Bureau, 1989 National Survey on Family Income and Expenditure. Nihon Keizai Shinbunsha, 1990 Nikkei Rader. Prime Minister Office, Statistics Bureau, 1990 Census.

Note 1: Since the coverage area of the Nikkei Rader is restricted to Tokyo, Saitama, Chiba, Kanagawa, the value of the Census is recalculated for these areas.

Note 2: The value of NSFIE (National Survey on Family Income and Expenditure) is recalculated for Keihin metropolitan area.

Note 3: In using 1990 Nikkei Rader, samples which contain no-answered items are eliminated from the analysis. The rate of home holders (including mansion) before eliminating no-answered samples is 71.4 percent.

Note 4: Gini coefficient by NSFIE is calculated for the whole nation.

is more easily answered by renters. The proportion of home holders before eliminating no-answered samples is 71.4 percent for the Nikkei Rader, and this value is not far from that of the 1990 Census. Gini coefficients are not directly comparable because the coverage of area is not the same. Gini coefficient by NSFIE is calculated for the whole nation. Nevertheless, we do not observe a serious difference between the NSFIE and the Nikkei Rader.

TABLE 2

MEANS AND STANDARD DEVIATION OF LAND VALUE, LOAN, MONETARY WEALTH INCOME

		Age Class		
		20–39	40–59	60–
Land value	Frequency	992	1,319	318
	Mean	1,078.33	2,877.67	3,956.60
	STD	3,465.75	5,436.68	6,108.11
Annual loan	Mean	23.83	46.32	14.40
	STD	55.03	89.40	52.53
Financial wealth income	Mean	28.74	96.09	161.84
	STD	70.56	193.36	256.73

Source: 1990 Nikkei-Rader.

Note: Unit is 10 thousand yen.

Some readers may be skeptical about using the data confined to the Tokyo Metropolitan area. This limitation has to do with the data availability. The authors have no intention of arguing that the Tokyo metropolitan area is representative of Japan. Regardless of the inevitable reasons, we admit that our results based on the data confined to the Tokyo metropolitan area are extremely biased. According to the 1989 NSFIE (National Survey of Family Income and Expenditure), the average land value of a household in Tokyo as of 1989 is around four times higher than that of the Japanese average. That in Chiba is 1.2 times, Kanagawa is 1.7 times, and Saitama is 1.2 times. Thus, the inequality between the owners and renters should be more serious in the Tokyo metropolitan area and this bias is critical. However, the land problem in Japan is at its most serious in the Tokyo metroplitan area, and focusing on the Tokyo metropolitan area may allow us to comprehend the extent of the Japanese land problem.

In measuring the effect of the tax system on income redistribution, data on tax payments are required. Unfortunately, the Nikkei Rader does not contain a questionnaire on tax payments. Tachibanaki and Yagi (1994), however, attempted to estimate the total tax for each household using the information about household attributes. In calculating capital income, interest incomes are calculated for each type of financial asset. In the separate tax system, 20 percent of interest income is charged as a capital tax. Income tax is calculated by using information about household attributes, such as age, sex, occupation, marital status, supported families and supported children. This information enables us to calculate the amount of deducted income and taxable income. In the survey, the income of the spouse is not reported. Thus, the deduction for the spouse is calculated from information on the type of workers such as whether he/she is a part-time or full-time employee. If the spouse does not work, the deducted income is 700,000 yen. If the spouse is a part-time worker, the deducted income is 350,000 yen. Social security contributions are calculated from annual earnings, age and occupation, and deducted from income. The survey includes the year of house purchase and annual housing loan payments for each household. Using this information, the deducted income for the housing loan is calculated. Finally, the total tax payment is calculated by using marginal tax rates and taxable income (the marginal tax rate for taxable income bracket 3–5 million yen is 10 percent, 5–7 million yen is 20 percent, 7–9 million yen is 30 percent, 9–12 million yen is 40 percent and 12 million yen is 50 percent).

3.3. *Inequality Between Income With and Without Imputed Rent*

In Tachibanaki and Yagi, the Gini coefficient is calculated for both income including imputed rent and income excluding it. Total income consists of earned income and income through financial assets. For simplicity, total income is called "pre-rent income," while total income which includes income through imputed rent is called "post-rent income."

The results shown in Table 3 suggest a large difference between the Gini coefficient measured for "pre-rent income" and that for "post-rent income." It indicates that the Gini coefficient has increased from 0.32 for "pre-rent income" to 0.371 for "post-rent income." This is a large increase in the inequality of income

TABLE 3

COMPARISON OF DEGREE OF INCOME INEQUALITY BEFORE AND AFTER ADDING IMPUTED RENT

	Whole Sample	20–39	40–59	60 -
Before adding imputed rent income	7,641	5,903	9,155	7,349
Before adding imputed rent Gini coefficient	0.320	0.270	0.300	0.391
After adding imputed rent income	9,574	6,907	11,540	10,780
After adding imputed rent Gini coefficient	0.371	0.308	0.348	0.437

Source: 1990 Nikkei Rader.
Note: Unit of income is one thousand yen.

distribution. The greatest inequality in income distribution is observed for the oldest age class (60 years old and older); its Gini coefficient for "after-rent income" reaches 0.437. These results are based on the assumption that land prices do not include any portion of bubbles. Noguchi (1989) finds that about 50% percent of the land prices in Tokyo are due to the so-called bubbles. However, even after accepting Noguchi's claim, we find that the inequality of income is not dramatically altered by the bubbles (Gini coefficient decreased only 0.018 for the whole sample). One explanation for this result is that the bubble only expanded the inequality between owners and renters, and the inequality within owners is not much affected by the bubble.

In Table 4, income inequality in Japan is decomposed by income sources, such as earned income, capital income and imputed rent income [see Fei, Ranis and Kuo (1978) for the decomposition analysis]. As shown in the table, the amount of capital income is around one seventh of imputed rent income. This is one reason why we mainly pay attention to the imputed rent income in the following analysis.

TABLE 4

DECOMPOSITION OF INCOME INEQUALITY BY INCOME SOURCE

Age Class	Income Source	Mean Income	Gini Coefficient	Quasi Gini Coefficient	Degree of Contribution to Total Inequality
Whole sample	Earned income	765.73	0.289	0.277	0.9067
	Imputed rent	76.9	0.397	0.188	0.0618
	Capital income	11.18	3.77	0.668	0.0319
	Total income	853.81	0.277	0.274	1
20–39	Earned income	589.43	0.212	0.206	0.9020
	Imputed rent	48.89	0.604	0.279	0.1012
	Capital income	−6.35	−4.502	0.0694	−0.0033
	Total income	631.97	0.214	0.213	1
40–59	Earned income	868.11	0.254	0.247	0.9124
	Imputed rent	84.64	0.328	0.141	0.0508
	Capital income	6.47	6.539	1.303	0.0359
	Total income	959.22	0.246	0.245	1
60–	Earned income	725.98	0.401	0.386	0.9136
	Imputed rent	97.03	0.282	0.123	0.0389
	Capital income	53.39	0.981	0.279	0.0486
	Total income	876.4	0.352	0.35	1

Source: 1990 Nikkei Rader.

3.4. *The Effect of Taxation on Income Redistribution*

Under the current tax system in Japan, imputed rent is not integrated formally as part of the tax base, but is taxed separately as a form of wealth income. Thus, much research on the effect of taxation on income redistribution has been based on income that does not include imputed rent [see, for example, Itaba and Tachibanaki (1987)].

Table 5 presents a measurement of the effect of taxes on income redistribution. The effect is measured by comparing the Gini coefficient for pre-tax income (A) with that for post-tax income (B). The coefficient of income redistribution is defined by,

$$\textit{The coefficient of income redistribution} = \frac{A - B}{A} \times 100.$$

The estimated coefficient of earned income for all samples is 10.53. For the 40–59 year old age-group, it is 12.01. This will eventually undergo the greatest redistribution.

We examine income that includes both income from imputed rent and income from financial holdings (i.e. capital income). The estimated Gini coefficient for pre-tax income for all samples is 0.371, which is significantly higher than 0.304 for pre-tax earned incomes. This implies that when both incomes through imputed rent and capital incomes are added to earned incomes, the degree of income inequality in pre-tax incomes is significantly increased.

The estimated Gini coefficient for post-tax income, including financial wealth income and imputed rent, is 0.353 under the present tax system. This inequality is fairly high, and the coefficient of income redistribution is only 4.85, which is quite small.

These results suggest the following conclusions. When all income sources (including both income through imputed rent and capital income, i.e., property income) are taken into consideration, income distribution is significantly unequal for pre-tax income. Furthermore, although the present tax system works as an instrument for a fairly strong redistribution of earned income, its role is very minor for all income sources, including the above two sources.

4. Tax Reform to the Comprehensive Tax System

4.1. *Motivation for the Analysis*

The results obtained by Tachibanaki and Yagi revealed that taxes on financial wealth income and imputed rent play a relatively small role in redistributing income when compared with taxes on earned income. This difference implies that owners of financial wealth and land receive a favourable treatment under the separated tax system. Since there is no obvious justification for this inequality in the tax system, the validity of the current tax system should be questioned. We, therefore, consider a tax reform from the separated tax system to the comprehensive income tax system so that all the income sources would be taxed in an equal manner. Under the proposed comprehensive income tax system, all income sources would be combined and taxed at a single tax rate.

The consequences of the differential tax treatment of owners and renters have been examined by some researchers in the U.K. King (1983) considers the effect of taxation on the distribution of imputed rent under a revenue-neutral lump-sum subsidy. King's study examines both the first and second round effects of tax reform. The first round effect on land price and demand for land are examined with a market equilibrium model. The second round effect is examined to evaluate the precise changes in social welfare. Hills and Sutherland (1991) examine the effect of the new Council tax, which replaced the old poll tax and taxes imputed rent.

Our research differs from these studies because it investigates the effect of changes in the tax system on income distribution. Another difference arises from the fact that it pays closer attention to the incidence of tax reform. In the earlier part of this section, we focus on the first round effect and examine the distributional effect of the tax reform. In the last sub-section, we implement estimating the second round effect and examine the welfare implication of the tax reform.

4.2. *Simulation Method*

Our first task is to evaluate the tax reform by examining its effect on income redistribution. We will do this by simulating a change in the tax burden for each household in the 1990 Nikkei-Rader. For our proposed comprehensive income tax system, we only consider one type of income tax that applies to total income, including earned income, financial wealth income, and imputed rent.

In simulating a change caused by a shift to the comprehensive tax system, we set the tax rate so that tax revenue is constant before and after the tax reform. To determine such a tax rate, we apply the iteration method. The adjustment process for the iteration is as follows. First, we calculate tax revenue given the initial tax rate. If tax revenue for the new system is greater than the original tax revenue, the tax rate is decreased, and vice versa. Since the tax rate varies according to income bracket, the marginal tax rate of each bracket under the current tax system is shifted so that total tax is kept constant. In our study, approximately 70 percent of the original marginal tax rates are applied to each income bracket. Total tax for each household under the comprehensive income tax system is calculated using these tax rates.

Before the tax reform, the mean tax payment per household is 962,400 yen, the standard deviation is 1,618,728 yen, the median is 508,500 yen, and the range of the first and third quartile is 758,130 yen. After the tax reform, the mean tax amount per household is the same with that of before tax reform. The standard deviation is 1,958,333 yen, the median is 396,000 yen, and the range of the first and third quartile is 705,310 yen.

4.3. *Changes in the Income Redistribution Effect*

Table 5 summarizes the Gini coefficient for total post-tax income, and compares the tax systems' redistribution effects through the coefficient of income redistribution. In this section, we define total income as the sum of earned income, financial wealth income and imputed rent. The Gini coefficient for the total post-tax income of the whole sample decreases from 0.353 for the separated tax system

to 0.344 for the comprehensive income tax system. The coefficient of income redistribution improves from 4.85 to 7.28. The improvement of the coefficient of income redistribution through the tax reform is remarkable for the middle and old age groups. The coefficient of income redistribution improves from 5.46 to 8.62 for the middle age group, and improves from 3.43 to 7.55 for the old age group.

The dramatic improvement in income redistribution for the middle and old age groups arises from the differential inequality of financial wealth and land holding. As shown in Table 2, the inequality of financial wealth and land holding measured by standard deviation increases with age. The remarkable improvement for the middle and old age groups basically stems from the relatively large inequality of financial wealth and land holding. The simulation results suggest that the comprehensive income tax system redistributes wealth income and imputed rent more effectively than the separated tax system, and decreases the degree of inequality observed in the middle and old aged groups.

Another important feature of the simulation results given in Table 5 is the income redistribution for large and small loan holders. In this paper, we assume that loan interest payments are deducted from imputed rent. This makes taxation neutral between renters and land owners. Since a reform from the separated tax system to the comprehensive income tax system increases the effective tax rate on the imputed rent, it decreases the tax burden for land holders with larger loans and decreases it for land holders with smaller loans. The tax reform, therefore, improves the income redistribution effect of the tax system and decreases the inequality between land holders who bought land on loan and land holders who acquired land by inheritance.

As is shown in Table 2, the variation of loan holding is the largest for the middle age group. One reason for the dramatic improvement in the income redistribution effect of the tax system for the middle-aged may be that the comprehensive income tax system treats land holders favourably according to the size of their loans. If this is the case, then this tax reform can be supported in terms of equity.

4.4. *Who Benefits from the Tax Reform?*

In this sub-section, we examine the incidence of the tax reform. We attempt to determine which households are better-off, and which are worse-off. Table 6 describes the incidence of the tax reform by age class, type of tenure and loan size. In the tenure column, renters are represented by 0, and loan holders by 1.

We define the rate of tax change as follows

$$\textit{Rate of tax change} = \frac{C-S}{S} \times 100,$$

where C is total tax under the comprehensive income tax system, and S is total tax under the separated tax system. Negative values for the rate of tax change indicate that tax burden decreases through the tax reform, and vice versa.

Keeping the tax revenue constant, the tax reform decreases the tax rate on earned income and increases it for imputed rent. This change decreases the burden

TABLE 5

COMPARISON OF THE REDISTRIBUTIVE EFFECTS OF THE SEPARATED TAX SYSTEM AND THE COMPREHENSIVE INCOME TAX SYSTEM

	Whole Sample	20–39	40–59	60–
Gini coefficient for pre-tax earned income	0.304	0.259	0.283	0.380
Gini coefficient for post-tax earned income	0.272	0.240	0.249	0.339
The coefficient of income redistribution	10.53	7.34	12.01	10.79
Gini coefficient for pre-tax income	0.371	0.308	0.348	0.437
Gini coefficient for post-tax income under the separated tax system	0.353	0.295	0.329	0.422
The coefficient of income redistribution	4.85	4.22	5.46	3.43
Gini coefficient for post-tax income under the comprehensive income tax system	0.344	0.291	0.318	0.404
The coefficient of income redistribution	7.28	5.51	8.62	7.55

Note: The coefficient of income redistribution is defined by,

$$\textit{The coefficient of income redistribution} = (A - B)/B \times 100,$$

where A is the Gini coefficient for before-tax income and B is the Gini coefficient for after-tax income.

for renters. This decrease is shown by the negative value of the tax change for renters. It should be noted that the tax burden for renters decreases for all age groups.

The tax burden decreases the most for young renters, an average of 41 percent for this class. These households rent their homes, and their earned income is relatively low. Thus, their living conditions are often difficult and the tax reform should improve their welfare.

The tax burden increases the most for young loan-free home owners, an average of 75 percent for this class. This group is not taxed heavily under the separated system since the tax on imputed rent is relatively low. This change in tax burden might be justified because while the heads of these households are often young, they have no loan owing on their land, which was obtained through inheritance or as a gift. This statement would be still valid even after considering the stiff inheritance tax system in Japan because the value of real estate for inheritance tax is assessed at around only half the market value and a large part of the house value for average house sizes are deductable.

Some policy-makers might draw attention to the changes in the tax burden of the elderly. Taxation of imputed rent is expected to undergo strong opposition from aged land owners with low earned income. We will address this point by focusing on the effect on loan-free aged land owners and on aged renters. The sample size for elderly loan holders is too small to derive a statistically significant conclusion. This suggests that it is most often the case in Japan that aged land owners complete paying back their loans before retirement. Furthermore, while the tax burden for aged renters decreases by 35 percent in size, the tax burden for aged land owners increases by 18 percent. The importance of this 18 percent increase is debatable. Some researchers claim that the aged in Japan are wealthier than any other age group [see Takayama (1994)]. In that case, the 18 percent tax increase might not be intolerable. On the other hand, the 35 percent decrease in the tax burden of the aged renter appeals to our sense of fairness, because they

not only have low earned income but also little financial wealth. Tachibanaki and Yagi (1990) showed that aged land owners possess more than twice the financial wealth and about eight times the combined financial and real estate wealth of aged renters. The situation faced by aged renters is particularly difficult, and many have argued for the urgent implementation of remedial policy. The tax reform is one possible means to relieve the suffering endured by aged renters.

Finally, we shall examine the relationship between annual loan payments and the changes in total tax. In this simulation, the interest rate paid by loan holders is deducted from the income to be taxed. Thus, one would expect the tax rate to decrease as the annual loan payment increases. The result does not necessarily support this intuition. In many cases, the tax burden for loan holders increases under the tax reform. While this pattern seems to be counter-intuitive, it may arise from a positive correlation between land values and loan payments. The coefficients of correlation between land values and loan payments are 0.15 for 20–39 year olds, 0.13 for 40–59 year olds and 0.32 for those over 60 years old. There is a positive relation between these two variables, especially for the oldest group. The tax burden increases as land value increases, while it decreases as loan payment increases. It is possible that the positive effects of land value on the changes in total tax dominate the negative effects of loan payments.

TABLE 6

WHO BENEFITS FROM THE TAX REFORM

Age Class	Tenure	Loan	Frequency	Rate of Tax Change
20–39	0	0	749	−0.41
	1	0	117	0.75
		1	21	−0.04
		2	64	−0.02
		3	41	−0.11
40–59	0	0	536	−0.35
	1	0	404	0.15
		1	132	0.01
		2	179	−0.09
		3	68	0.12
60–	0	0	96	−0.35
	1	0	190	0.18
		1	10	−0.02
		2	11	0.39
		3	11	0.41

Note 1: The data in the column "Tenure" represent the following.
Renter: 0
Land holder: 1

Note 2: The data in the column "Loan" represents the following.
No loan: 0
The ratio of annual loan payment to annual income is less than 0.1: 1
The ratio of annual loan payment to annual income is less than 0.2: 2
The ratio of annual loan payment to annual income is more than 0.2: 3

Note 3: The rate of tax change is defined by

$$\textit{Rate of tax change} = (C - S)/S$$

where C represents tax payment under the comprehensive income tax system, and S represents tax payment under the separated tax system.

4.5. *Second Round Effect of the Tax Reform and its Welfare Implication*

4.5.1. Theoretical Model for Estimating the Second Round Effect

In the above sub-section, we considered only the first round effect of the tax reform, and neglected the behavioural responses to the tax reform. In this sub-section, we evaluate the welfare change of the tax reform by incorporating the behavioural responses to the tax reform. The theoretical model of estimating the second round effect is presented by King (1983). The first round effect is called cash gain (CG). Cash gain is defined by

$$\text{CG} = y^p - y^0 - (p_H^p - p_H^0)x_H^0, \tag{3}$$

where y^0 is the original income, p_H^0 is the original tax inclusive price of housing services, p_H^p is the post-reform tax inclusive price of housing services, x_H^0 is the original quantity of housing services consumed and y^p is an estimate of the post-reform income consistent with a revenue-neutral reform given unchanged behaviour. For a revenue-neutral reform, the mean value of cash gain is zero. Since the cash gain is measured by ignoring behavioural responses, the cash gain provides only the information about the distributional consequences of the tax reform, and gives no information about efficiency aspects of the reform. In order to incorporate the behavioural responses, we introduce the concept of *equivalent gain* (EG) which is defined by,

$$v(y^0 + \text{EG}, p_H^0, p_C) = v(y^p, p_H^p, p_C), \tag{4}$$

where p_C is the tax-inclusive price of the composite commodity. This measures the welfare gain of the tax reform.

To implement the measuring equivalent gain, we specify the indirect utility function by the homothetic translog indirect utility function [see King (1980)]:

$$\log v = \log\left(\frac{y}{p_C}\right) - \beta_1 \log\left(\frac{p_H}{p_C}\right) - \beta_2\left[\log\left(\frac{p_H}{p_C}\right)\right]^2. \tag{5}$$

Using the Roy's identity, we obtain the demand function,

$$x_H = \frac{y}{p_H}\left[\beta_1 + 2\beta_2 \log\left(\frac{p_H}{p_C}\right)\right]. \tag{6}$$

Once the parameters β_1 and β_2 are estimated, we may solve for the equivalent gain from (4) and (5):

$$\text{EG} = \pi y^p - y^0, \tag{7}$$

where

$$\pi = \left[\frac{p_H^0}{p_H^p}\right]^{(\beta_1 + \beta_2 \log z)} \tag{8}$$

and

$$z = \frac{p_H^0 p_H^p}{p_C^2}. \tag{9}$$

4.5.2. Empirical Implementation for Estimating the Equivalent Gain

Unfortunately, Nikkei-Rader contains only the information about land value and no information about land size, land price and consumption expenditure. Thus, we estimate β_1 and β_2 by using aggregate time series data on Japanese land demand. The estimation procedure is as follows. First, we produce the time series data on land prices by using time series land price index and land price data in the Tokyo area for 1993. The data source of land price is "Todofuken Chika Chousa (Survey of Land Prices by Prefecture)" by the National Land Agency. In order to calculate the tax-inclusive price of housing services (i.e. the service price of one unit of land) from land price data, we use the arbitrage condition (1), growth rate of rental price g_p in (2) and long-run average nominal interest rate. The values employed in this section are the same as those in the previous section. Before the tax reform, only the property tax is levied. The property tax rate is 1.4 percent. However, 50 percent of the tax payment is deducted if the land is used for living and around 20 percent of land value is used for the tax calculation. Since the land value is around 40 times as large as imputed income, the pre-reform effective tax rate on imputed income is around 5.6 percent. Thus, the tax-inclusive price of housing service is calculated by multiplying 1.056 on the imputed income per square metre. The quantity of housing service consumed is proxied by the average land area per household who owns land. The data on land area comes from "Tochi Kihon Chosa (Basic Survey on Land)" by the National Land Agency.

Second, we produce the tax-inclusive price of the composite commodity. The composite commodity considered in this study is the household total consumption expenditure (excluding land rent). The data on consumption expenditure include taxes on goods. The quantity of the composite commodity consumed is set to be one. The data are based on the Family Income and Expenditure Survey by the Management and Coordination Agency.

Third, we directly get the time series data on post-tax household income from the aggregate family income data and data on the number of households. The number of households is given by the Housing Survey by Management and Coordination Agency. The data source of income is the same as that of consumption expenditure. It should be reminded that income used in this model includes the imputed income, and is not the same as the income actually received.

After the data of y, x_H, p_H, p_C, x_C are generated, β_1 and β_2 are estimated by using (6). The estimation result is given as follows: $\beta_1 = 2.7204$ (t-value = 4.22[prob = 0.000]), $\beta_2 = 0.1683$ (t-value = 4.08[prob = 0.001]). The adjusted R-Squared value is 0.792. We conducted the unit root test for the explained and explanatory variables in (6) and the cointegration test for those variables by using the time series analysis package *Microfit*. We applied the unit root test proposed by Dickey and Fuller (1979, 1981), often referred as to DF and ADF test statistics. The null hypothesis of the ADF test is the existence of the unit root, and the ADF test statistics in Table 7 show that the existence of a unit root cannot be rejected under 95 percent critical values and the variables are $I(1)$. The number of cointegrating vectors is estimated to be 3 by using Johansen's maximum likelihood method since the test statistics for cointegration (the null hypothesis assumes the number of cointegration vectors is less than 2 and the alternative hypothesis

assume that the number is 3) is 4.067 with the 95 percent critical value 3.76 [see Johansen and Juselius (1990)]. Thus, it is safe to conclude that the estimated parameters and test statistics derived by using OLS method are valid.

Finally, we evaluated the equivalent gain of the tax reform from the separate tax system to the comprehensive tax system from (7). Since the Nikkei Rader does not include the land size, land price, and consumption expenditure, it is difficult to evaluate the equivalent gain directly from the Nikkei Rader. Thus, we utilized information contained in the aggregate data. In order to examine the difference of equivalent gain among different types of households, we paid attention to the following six types of households: 1. Young and renter, 2. young and house owner, 3. middle age and renter, 4. middle age and house owner, 5. old and renter, and 6. old and house owner. The average income for each type of households and portion of each type of household is available from the Nikkei-Rader.

Table 8 summarizes the welfare change arising from the tax reform. Post reform post-tax income that includes post-tax imputed rent is calculated by multiplying post reform income tax rate that is 70 percent of the original tax rate with pre-tax income. The value 70 percent is derived in the simulation analysis of the early part of this section. The equivalent gain is calculated by equation (7). The weighted average of the equivalent gain for the whole classes is −95,054 yen, and the relative size of the equivalent gain to post reform income is −2.38 percent. The tax reform increases the tax rate on housing services, which induces the welfare loss of the house owner. Our analysis suggests that the welfare loss of house owners exceeds the welfare gain of renters, although the average relative size of the welfare loss is not large enough to invalidate the equity improvement caused by the tax reform discussed in the above sub-section.

5. Concluding Remarks

The results obtained in our analysis raise various issues concerning income and wealth inequality and taxation. During the bubble economy in Japan, land prices soared, and many land holders enjoyed huge amounts of accrued income. The increase in land prices caused an increase in rental prices, which raised the value of imputed rent for land holders. On the other hand, others were forced to spend about half of their annual earnings for loan payments or for rent. This situation is contrary to principles of social fairness, and might lead to an eroding work ethic. It would have negative effects especially on children, who might be discouraged in their future ambitions by their knowledge of this inherited inequality. Land is an important source of inherited inequality from generation to generation, and this can be an obstacle for equal opportunity.

The tax reform proposed in this paper would improve the effect of the tax system on income redistribution, especially concerning imputed rent. The results of our simulation analysis appeal to our sense of equity in the following two points. First, the tax levied on low income renters decreases, while the tax levied on households who inherited land increases. Second, the tax levied on households who bought their land by loan does not necessarily increase. The tax reform

TABLE 7

UNIT ROOT TEST FOR VARIABLES

Statistics	No. of Obs.	x_H		q_1		q_2		95% Critical Values	
		No Trend	Trend	No Trend	Trend	No Trend	trend	No Trend	Trend
DF	22	−0.965	−1.523	−0.644	−1.432	−0.656	−1.437	−3.004	−3.633
ADF(1)	21	−1.903	−3.189	−1.631	−2.906	−1.634	−2.914	−3.012	−3.645
ADF(2)	20	−0.588	−2.448	−1.615	−3.522	−0.621	−3.556	−3.020	−3.659
ADF(3)	19	−0.486	−3.726	−1.118	−3.560	−1.107	−3.649	−3.029	−3.675
Statistics	No. of Obs.	D_{xH}		D_{q1}		D_{q2}		95% Critical Values	
		No Trend	Trend	No Trend	Trend	No Trend	Trend	No Trend	Trend
DF	21	−1.876	−1.757	−2.076	−1.962	−2.111	−2.002	−3.012	−3.645
ADF(1)	19	−2.756	−2.578	−2.979	−3.170	−3.037	−3.242	−3.020	−3.659
ADF(2)	19	−2.189	−2.053	−1.844	−1.559	−1.865	−1.600	−3.029	−3.675
ADF(3)	18	−4.162	−3.278	−3.578	−2.005	−3.655	−2.086	−3.040	−3.692

Note 1: The number of the parenthesis of ADF( ) is a chosen lag length.

Note 2: $q_1 \equiv y/p_H$ and $q_2 \equiv 2(y/p_H) \log (p_H/p_C)$.

Note 3: The operator D placed before the variables represents the time difference.

TABLE 8

WELFARE CHANGE FROM THE TAX REFORM

Age Class	Tenure	Portion	y^0	y^p	EG	EG/y^p
20–39	Renter	0.285	4,001,985	4,110,057	108,072	0.0075
20–39	Owner	0.092	5,422,754	5,418,192	−231,475	−0.0427
40–59	Renter	0.204	5,545,616	5,785,074	239,458	0.0084
40–59	Owner	0.298	6,966,383	6,905,063	−452,488	−0.0655
60–	Renter	0.036	4,688,359	4,885,746	197,386	0.0015
60–	Owner	0.084	6,109,126	6,054,012	−304,482	−0.0503

decreases the tax burden for households whose housing cost depresses their standard of living.

This simulation analysis is significant because it reveals who is favored by the current tax system. Under the proposed tax reform, the land owner who acquires land through inheritance or as a gift would be required to pay more taxes. However, even for these households, economic efficiency would not suffer, because the tax on earned income would decrease. Increasing tax on fixed factors such as land would not decrease economic efficiency. Thus, we can expect that the tax reform would improve overall economic efficiency, and decrease inequalities caused by inheritance.

REFERENCES

Asako, K., S. Kano, and H. Sano, Kabuka to Baburu (Stock Prices and Bubbles, in Japanese), in *Nihon no Kabuka- Chika*, Nishimura, K. and Y. Miwa (eds.), pp. 57–86, University of Tokyo Press, Tokyo, 1990.

Callen, T., Taxing Imputed Income from Owner-Occupation: Distributional Implications of Alternative Packages, *Fiscal Studies*, Vol. 13, No. 4, 58–70, 1992.

Dickey, D. and W. Fuller, Distribution of the Estimators for Autoregressive Time Series with a Unit Root, *Journal of American Statistical Association*, Vol. 74, 427–31, 1979.

———, Likelihood Ration Statistics for Autoregressive Time Series with a Unit Root, *Econometrica*, Vol. 49, 1057–72, 1981.

Fei, J. C. H., G. Ranis, and S. W. Y. Kuo, Growth and the Family Distribution of Income by Factor Components, *Quarterly Journal of Economics*, Vol. 92, 17–53, 1978.

Hashimoto, K., F. Otake, N. Atoda, S. Saito, and M. Homma, Japan's Tax Reform, *Japanese Economic Studies*, Vol. 18, No. 4, 3–18, 1990.

Hills, J. and Sutherland, H., The Proposed Council Tax, *Fiscal Studies*, Vol. 12, No. 4, 1–21, 1991.

Homma, M. and M. Atoda, *Empirical Research on Tax Reform* (in Japanese), Toyo Keizai Shinpo sha, Tokyo, 1990.

Ishi, J., Effects of Taxation on the Distribution of Income and Wealth in Japan, *Hitotsubashi Journal of Economics*, Vol. 21, No. 1, 27–47, 1980.

Itaba, Y. and T. Tachibanaki, Measurement of Tax Progressivity When the Forms of Both Income Distribution and Tax Function are Given, *The Economic Studies Quarterly*, Vol. 38, No. 2, 97–106, 1987.

Ito, T., Public Policy and Housing in Japan, in *Housing Markets in the United States and Japan*, Noguchi, Y. and J. M. Poterba (eds.), pp. 215–37, The University of Chicago Press, Chicago and London, 1994.

Johansen, S. and K. Juseliu, Maximum Likelihood Estimation and Inference of Cointegration with Applications to the Demand for Money, *Oxford Bulletin of Economics and Statistics*, Vol. 52, 169–210, 1990.

Kikutani, T. and T. Tachibanaki, The Taxation of Income from Capital in Japan: Historical Perspectives and Policy Simulations, in *Productivity Growth in Japan and the United States*, Hulten, C. R. (ed.), University of Chicago Press, Chicago, 1990.

King, M. A., An Econometric Model of Tenure Choice and Demand for Housing as a Joint Decision, *Journal of Public Economics*, Vol. 14, 137–59, 1980.
———, The Distribution of Gains and Losses from Changes in the Tax Treatment of Housing, in *Behavioural Simulation Methods in Tax Policy Analysis*, Feldstein, M. S. (ed.), pp. 109–32, Chicago University Press, Chicago, 1983.
Noguchi, Y., *Tochi no Keizaigaku* (in Japanese, Economics of Land), Nihon Keizai Shinbunsha, 1989.
———, Land Prices and House Prices in Japan, in *Housing Markets in the United States and Japan*, Noguchi, Y. and J. M. Poterba (eds.), pp. 11–28, The University of Chicago Press, Chicago and London, 1994.
Rosen, H., Housing Subsidies, in Auerbach, A. and M. Feldstein (eds.), Vol. I, pp. 375–420, *Handbook of Public Economics*, North-Holland, Amsterdam, 1985.
Skinner, J., Housing Wealth and Aggregate Saving, NBER Working Paper No. 2842, 1989.
Tachibanaki, T. and T. Yagi, Behavior of the Aged Under Uncertainty-Theory and Empirical Evidence, KIER Discussion Paper No. 251, 1990.
———, Recent Trends of Income Inequality in Japan: The Effect of Imputed Rent on Income Inequality and the Measurement of Accrued Income from Stock, in Nihonno Shotokuto, Tomino Bunpai, and Ishikawa, T. (eds.), (in Japanese) *Income and Wealth Distribution in Japan*), pp. 23–58, Tokyo University Press, Tokyo, 1994.
Takayama, N. and F. Arita, The Distribution of Household Wealth and its Historical Changes, in Nihonno Shotokuto, Tomino Bunpai, and T. Ishikawa, (eds.), (in Japanese) *Income and Wealth Distribution in Japan*), pp. 59–78, Tokyo University Press, Tokyo, 1994.
Ueda, K., Are Japanese Stock Prices Too High? *Journal of the Japanese and International Economies*, Vol. 4, 351–70, 1990.
Yoshida, A., Demand for Residential Land: A Time-Varying Time Preference Rate Approach, *Journal of the Japanese and International Economies*, Vol. 7, 277–96, 1993.