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Estimates of Average Marginal Tax Rates on Factor Incomes in Japan, 1980–2003*

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Abstract

In this paper, we estimate average marginal tax rates on factor incomes in Japan from 1980 to 2003. We adapt the method of Joines (1981) [Estimates of effective marginal tax rates on factor incomes. The Journal of Business 54 (2), 191–226.] to the Japanese tax and social security system. Average marginal tax rates on labor incomes without social security premiums decreased from 21% to 17% from the early 1990s, whereas the rates on incomes with social securities have remained slightly above 30% since the late 1980s. Tax rates on capital incomes have fluctuated, ranging from 44% to 55%. We also compare our estimates with average tax rates and the wedges from business cycle accounting.

Key words: Average marginal tax rates; Japan; Social security; Business cycle accounting
JEL classifications: E20; E62; H20; O5

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1 Introduction

Tax is often introduced into economic models to increase their realism, and sometimes to evaluate quantitatively welfare levels and policy effects. For accurate evaluation, estimating effective tax rates in the macroeconomy is crucial. The average marginal tax rate, which is a weighted average of the marginal tax rates of economic agents with different incomes, is more appropriate as an effective tax rate for macroeconomic analysis than is the average tax rate, which is simply the ratio of total tax revenues to national income. In this paper, we estimate Japanese average marginal tax rates.

Many researchers have estimated average marginal tax rates for the United States. Joines (1981) and McGrattan et al. (1997), updating the Joines series, used the amounts of income and tax revenue for each income bracket to estimate a series of tax rates on labor and capital incomes. Making fewer assumptions, Seater (1985) and Stephenson (1996), updating the Seater series, adopted the same method to calculate a series of tax rates on total incomes. Barro and Sahasakul (1983, 1986) used the statutory rate to compute a series of tax rates on total incomes. Akhand and Liu (2002) used a nonparametric approach to estimate a series of average marginal rates on income.

Following Joines (1981), most researchers into average marginal taxes have attempted to relax these assumptions, but have computed tax rates only on total incomes. In many studies in which dynamic macroeconomic models have been calibrated, the Joines (or its updated) series has been used so that the effects of taxes on each factor income can be evaluated separately.[1]

[1]For example, McGrattan (1994), McGrattan et al. (1997), Cole and Ohanian (1991), Chari et al. (2000), Siu (2006), and McGrattan and Ohanian (2007) used Joines' series.

To assist macroeconomists investigating the Japanese economy in a similar way, in this paper we compute average marginal tax rates on capital and labor incomes by using the methodology of Joines.

To determine the factors that were detrimental to the Japanese economy after 1990, many researchers have simulated Japanese business cycles in the 1990s by using neoclassical macroeconomic models that incorporate income tax. Hayashi and Prescott (2002) used a constant capital income tax rate of 0.480. Braun et al. (2006) set the labor income tax rate to 0.24, and Esteban-Pretel et al. (2009) set the labor and capital tax rates to 0.28 and 0.44, respectively. In these studies, average tax rates were used as marginal tax rates; it is important to estimate Japanese marginal tax rates accurately.

To our knowledge, the only estimated average marginal tax rates on factor incomes for Japan are those obtained by McKee et al. (1986).[2] The paucity of studies may be a product of the Japanese tax system. Many OECD countries adopt the withholding income tax system, under which wages and salaries are taxed at source, and employees usually file a final tax return to make a year-end tax adjustment. In Japan, however, most employees have no such incentive because employers are obliged to make year-end tax adjustments for their employees. This makes it difficult to determine average marginal tax rates for all taxpayers.

To be specific, we divide Japanese taxpayers into three categories: workers not filing a final tax return; workers filing a final tax return; and other taxpayers filing a final tax return. The first two are withholding income

[2]McKee et al. calculate tax rates for 1979, 1981, and 1983 only, without using time series data.

taxpayers, and the last two are self-assessment income taxpayers. For the US, where most are self-assessment income taxpayers, the *Statistics of Income* published by the Internal Revenue Service can provide data on almost all taxpayers' tax revenues for each income bracket. In Japan, the *Sample Survey for Self-assessment Income* (Shinkoku Shotoku Zei Hyohon Chosa) and the *Statistical Survey of Actual Status for Salary in the Private Sector* (Minkan Kyuyo Jittai Tokei Chosa), published by the National Tax Agency, present tax data for each income bracket. Thus, with some assumptions, one can construct series of average marginal tax rates for both self-assessment income taxpayers and withholding income taxpayers. The challenge is to estimate average marginal tax rates for all taxpayers by combining these series. In Japan, workers filing a final tax return are both self-assessment and withholding income taxpayers, and they are included in both surveys.

To overcome this difficulty in estimating average marginal tax rates, we use a weight to estimate total average marginal tax rates. The weight is chosen so that the *average* tax rate on total income is equal to a weighted sum of *average* tax rates on self-assessment incomes and *average* tax rates on withholding incomes. By using this weight, we treat the weighted sum of the average marginal tax rates for self-assessment taxpayers and those for withholding income as the total average marginal tax rates. Furthermore, one can broadly consider social security premiums as a component of taxes on labor income. We calculate average marginal social security premiums rates and add them to the average marginal tax rates on labor incomes.

Our results can be summarized as follows. Although average marginal tax rates without social security premiums have declined from 21% to 17% since

the early 1990s, the tax rates including social security payments are generally about 10 percentage points higher, and have remained slightly above 30% since the late 1980s. Therefore, when calibrating the Japanese economy, it is reasonable to set the parameter for the labor tax rate to 0.3. Average marginal tax rates on capital incomes range from 44% to 55%, and have fallen by 10 percentage points since 2003 because of the cut in corporation tax.

In addition, we make two comparisons. We first compare our results with the series of Japanese average tax rates obtained by Mendoza et al. (1994). Their average rates on labor incomes are higher than our marginal tax rates because of Japan's regressive social security contributions. Their average rates without contribution rates are lower than ours by around 1 percentage point. This can be interpreted as the effect of the progressiveness of income tax. The average rates on capital income obtained by Mendoza et al. are slightly lower than ours.

Second, we compare our results with the Japanese labor and capital wedges from business cycle accounting (BCA) obtained by Kobayashi and Inaba (2006). The average marginal taxes on labor incomes account for 70% of labor wedges in terms of level and correlation. The difference, however, is getting wider. This may be the result of shorter working hours, as suggested by Hayashi and Prescott (2002), or may be the result of the recent rapidly accumulating fiscal deficit. The average marginal tax rates on capital incomes cannot capture the fluctuations in the capital wedge.

This paper is organized as follows. In Section 2 (resp. 3), we compute average marginal tax rates on labor and capital incomes excluding (resp. includ-

ing) social security premium rates. In Section 4, we compare our estimated tax rates with the average tax rates computed by Mendoza et al. (1994). In Section 5, we compare our rates with the labor and capital wedges from BCA obtained by Kobayashi and Inaba (2006). In Section 6, we offer concluding remarks.

2 Average Marginal Tax Rates excluding Social Security Premium Rates

In this section, we calculate average marginal tax rates without including social security premium rates. The average marginal tax rates on labor and capital incomes are denoted by $MTRL$ and $MTRK$, respectively. Economic agents comprise two types of taxpayers: self-assessment taxpayers and withholding taxpayers. We calculate the average marginal tax rates for both types of taxpayers. By combining these figures with an appropriate weight, we estimate the total average marginal tax rates. In Section 2.1, we explain the calculation of average marginal tax rates for self-assessment income taxpayers. In Section 2.2, we explain the calculation of the average marginal tax rates for withholding income taxpayers. In Section 2.3, we report the average marginal tax rates for the macroeconomic level.

Before describing our procedure, we comment on our sample period. Our estimated marginal average tax rates on factor incomes in Japan cover the period from 1980 to 2003. The main reason for using this sample period is to allow us to use data from the 1993 System of National Accounts (93SNA),

with the base year as 1997. Although the 68SNA has data from 1950, the data only go up to 2000. Using the 93SNA (base 2002) to extend the series limits our series to starting at 1994. Furthermore, data on local taxes are only available up to 2006. Thus, we use 93SNA (base 1997) to compute marginal average tax rates from 1980–2003.

2.1 Average marginal tax rates for self-assessment income taxpayers

In this subsection, we consider the average marginal tax rates for self-assessment income taxpayers. We calculate these by using the methodology of Joines (1981). For computing average marginal tax rates for self-assessment taxpayers, our main data source is the *Sample Survey for Self-assessment Income Tax* produced by the National Tax Agency. This survey provides data on several types of incomes for each income bracket. We classify these incomes into labor and capital incomes, and then estimate the average tax rates for each income bracket. For other taxes, only total revenues are available. Each tax item is classified as a proportional tax on either capital income or total income. Adding the proportional taxes to the average marginal tax rates for the self-assessment incomes yields the average marginal tax rates for self-assessment income taxpayers.

We assume that taxpayers are homogeneous for each income bracket. The total income of group i ($i = 1, \ldots, N$) is denoted $y_i = y_{li} + y_{ki}$, where y_{li} and y_{ki} represent labor and capital incomes, respectively. Following Joines

(1981), the amount of tax revenues of group i, $t^s(y_i)$ is:

$$t^s(y_i) = \tau y_i + \tau_k y_{ki} + f(\tilde{y}_i),$$

where τ denotes the proportional tax rate on total income, τ_k is the proportional tax rate on capital income, $f(\cdot)$ represents the progressive tax function, $\tilde{y}_i = \gamma_i y_i$ denotes the income that is progressively taxed, and γ_i is the fraction of taxable income of group i. In this subsection, there are no proportional taxes on labor incomes. Joines (1981) considered two progressive tax functions for labor and capital incomes and assumed the fraction of taxable income to be constant for each income. By contrast, we consider one progressive tax function, but assume that the fraction of taxable income depends on i.

The marginal tax rates of group i on labor and capital incomes are:

$$\begin{aligned} dt^s(y_i)/dy_{li} &= \tau + \gamma_i f_i' \\ dt^s(y_i)/dy_{ki} &= \tau + \tau_k + \gamma_i f_i', \end{aligned}$$

where f_i' represents the progressive tax rates schedule. Each marginal rate of income tax is divided into proportional and nonproportional rates.

We aggregate the marginal rates across groups to calculate the average marginal tax rates on labor and capital incomes (that is, $MTRL^s$ and $MTRK^s$, respectively). Letting total tax revenues be $T^s = \sum_{i=1}^{N} t^s(y_i)$, letting total labor income be $Y_l = \sum_{i=1}^{N} y_{li}$, and letting total capital income be

$Y_k = \sum_{i=1}^{N} y_{ki}$, we obtain:

$$\begin{aligned} MTRL^s &= \frac{dT^s}{dY_l} = \sum_{i=1}^{N} \frac{dt^s(y_i)}{dY_l} = \sum_{i=1}^{N} \frac{dt^s(y_i)}{dy_{li}} \frac{dy_{li}}{dY_l} \\ MTRK^s &= \frac{dT^s}{dY_k} = \sum_{i=1}^{N} \frac{dt^s(y_i)}{dY_k} = \sum_{i=1}^{N} \frac{dt^s(y_i)}{dy_{ki}} \frac{dy_{ki}}{dY_k}. \end{aligned}$$

Following Joines (1981), we assume that $dy_{li}/dY_l = y_{li}/Y_l$ and $dy_{ki}/dY_k = y_{ki}/Y_k$. The assumption simplifies the above equations to:

$$MTRL^s = \tau + \sum_{i=1}^{N} \gamma_i w_{li} f_i' \tag{1}$$

$$MTRK^s = \tau + \tau_k + \sum_{i=1}^{N} \gamma_i w_{ki} f_i', \tag{2}$$

where $w_{li} = y_{li}/Y_l$ and $w_{ki} = y_{ki}/Y_k$. $MTRL^s$ and $MTRK^s$ are weighted averages of the marginal tax rates on labor and capital incomes for group i, with w_{li} and w_{ki} respectively. The weights w_{li} and w_{ki} represent the shares of labor and capital incomes that are subject to nonproportional taxes.

We now investigate how the available Japanese data can be used to calculate τ, τ_k, γ_i, f_i', w_{li}, and w_{kl} in (1) and (2). We then report our results for the average marginal tax rates of self-assessment taxpayers.

2.1.1 Estimation of τ

The proportional tax rate on total income τ is:

$$\tau = \frac{\text{amounts of proportional tax on total incomes}}{\text{amounts of total incomes}}.$$

To compute the denominator, one can use nominal national product (NNP) or national income at market prices from the *Annual Reports on the National Accounts* (Kokumin Keizai Keisan Nenpo), which is produced by the Economic and Social Research Institute, the Cabinet Office. An alternative to NNP would be national income (NI) at factor cost. However, as Joines (1981) explains, NI excludes net indirect tax, which is the difference between NNP and NI, in taxable income, which, in theory, allows tax rates that exceed 100%. Hence, we follow Joines and use NNP for total income.

The numerator, the total amount of proportional tax, is:

$$\begin{aligned}&\text{total national tax revenues} - \text{income tax} - \text{corporation tax}\\ &\qquad -\text{land tax} - \text{securities transaction tax} + \text{local proportional tax}.\end{aligned}$$

Except for those on local proportional tax, we can obtain all the required data from Chapter 1 (Overview) of the *National Tax Agency Annual Statistics Reports* (Kokuzeicho Tokei Nenposho). We subtract self-assessment and withholding income taxes and national proportional tax on capital income from the total amount of national tax revenue, and add local proportional tax to obtain the total amount of proportional tax. Land taxes, introduced in 1996, have been suspended since 1998. Securities transaction taxes were abolished in 1999. Local proportional taxes are computed by subtracting

local proportional taxes on capital income from total local taxes, as follows:

$$\begin{aligned}&(\text{total prefectural tax revenues} - \text{business tax} - \text{real property acquisition tax})\\ &+ (\text{total municipal tax revenues} - \text{fixed asset tax} - \text{mine production tax}\\ &\qquad - \text{special landholding tax} - \text{enterprise tax}).\end{aligned}$$

Data on these items can be obtained from the *Annual Statistical Reports on Local Government Finance* (Chiho Zaisei Tokei Nenpo), produced by the Ministry of Internal Affairs and Communications.

2.1.2 Estimation of τ_k

Similarly to τ, the proportional tax rates on capital incomes τ_k are computed from the following:

$$\tau_k = \frac{\text{amounts of proportional tax on capital incomes}}{\text{amounts of capital incomes}}.$$

We interpret the denominator as θNNP, where $1-\theta$ is labor's share in NNP, which is given by:

$$\begin{aligned}(1-\theta)\text{NI} =& \text{compensation of employees}\\ &+ (1-\theta)\text{unincorporated enterprises income}.\end{aligned}$$

The incomes of unincorporated enterprises are the sum of their operating surpluses and net receivable incomes. Net indirect taxes (=NNP−NI) and the total income of unincorporated enterprises are intermingled and difficult to divide into distinct capital and labor incomes. Therefore, we allocate them

to labor and capital incomes based on the shares of labor and capital in total income.

The numerator, the amount of proportional tax on capital incomes, is the amount subtracted from total tax revenues excluding income tax when calculating τ. That is:

$$\begin{aligned}&\text{corporation tax} + \text{land tax} + \text{securities transaction tax}\\&+\text{local proportional tax on capital income.}\end{aligned}$$

The local proportional tax on capital incomes is:

$$\begin{aligned}&(\text{business tax} + \text{real property acquisition tax})\\&+(\text{fixed asset tax} - \text{mine production tax} + \text{special landholding tax} - \text{enterprise tax}).\end{aligned}$$

The source for all data (except for data on the local proportional tax on capital income) is Chapter 1 (Overview) of the *National Tax Agency Annual Statistics Reports.* For calculating the local proportional tax on capital income, we use the *Annual Statistical Reports on Local Government Finance.*

2.1.3 Estimation of γ_i

The ratio of taxable income to total income for each income bracket i, γ_i, is estimated for each income group i from Section 2-5 (Results of Sample Survey for Self-assessment Income Tax, excerpt) of the *National Tax Agency*

Annual Statistics Reports:

$$\gamma_i = \frac{\text{amounts of taxable income}}{\text{total income}}.$$

2.1.4 Estimation of f_i'

The derivative of the progressive tax function for each income bracket i, f_i', is calculated from the following formula:

$$f_i' = \frac{(r_i/n_i) - (r_{i-1}/n_{i-1})}{(\tilde{y}_i/n_i) - (\tilde{y}_{i-1}/n_{i-1})},$$

where r_i is the amount of income tax, n_i is the number of taxpayers, and $\tilde{y}_i$ is the amount of taxable income for each income bracket i. These figures are taken from Section 2-5 of the *National Tax Agency Annual Statistics Reports*. To compute r_i, we use the sum of withholding and self-assessment income taxes in Table 1 of Section 2-5. This is because there is a subtle discrepancy *between* the amount of tax minus the amount of tax credit *and* the amount of withholding income tax plus the amount of self-assessment income taxes in the table.

2.1.5 Estimation of w_{li} and w_{ki}

To estimate the distribution of labor and capital incomes subject to the nonproportional taxes, w_{li} and w_{ki}, we must determine whether each type of assessment income is either labor or capital income. Having divided all incomes into three (labor income (y_{li}), capital income (y_{ki}), and miscellaneous income (y_{mi})), Joines (1981) considered two cases: one in which y_{mi} belongs

to labor income and the other in which it belongs to capital income.[3] Our allocation of y_{mi} based on labor and capital income shares is novel.

Specifically, the reported income items in Table (3) of Section 2-5 (Results of Sample Survey for Self-assessment Income Tax, excerpt) of the *National Tax Agency Annual Statistics Reports* are classified into the following three types of income:

1. Labor income (y_{li}): employment income and retirement income;

2. Capital income (y_{ki}): interest income, dividend income, real estate income, comprehensive capital gains, short-term separate capital gains, long-term separate capital gains, and capital gains from stocks, etc.;

3. Miscellaneous income (y_{mi}): business income, farm income, miscellaneous income, timber income, and occasional income.

Capital gains on stocks, etc. have been taxed since 1989. Our classification closely follows that of Joines (1981). Having discussed including capital gains in capital incomes, Joines (1981) computed marginal tax rates both with and without their inclusion. However, in most studies based on Joines' data, tax rates are based on including capital gains. We consider only the case in which capital gains are included in capital incomes.[4]

We further divide the case with capital gains into three subcases: in the first, miscellaneous incomes are allocated to labor income; in the second, they are allocated to capital income; in the third case, they are allocated to

[3] In most studies based on Joines' data, miscellaneous income is classified as labor income.

[4] Our estimated tax rates based on excluding capital gains are available from the authors on request.

both incomes based on factor shares. Joines (1981) used only the first two subcases. Because the first two are extreme cases, we next explain the third case.

Total labor incomes of self-assessment income taxpayers are denoted by $Y_l^s = \sum_{i=1}^{N} y_{li}$. The total amount of capital income is denoted by $Y_k^s = \sum_{i=1}^{N} y_{ki}$. The total amount of miscellaneous incomes is denoted by $Y_m^s = \sum_{i=1}^{N} y_{mi}$. We suppose that the income shares of each income bracket are the same as the macroeconomic income shares. By using the labor share $1-\theta$, we assume that miscellaneous incomes of $(1-\theta)y_{mi}$ and θy_{mi} are attributed to labor and capital incomes, respectively. Then, the distributions of labor and capital incomes subject to nonproportional taxes are:

$$w_{li} = \frac{y_{li} + (1-\theta)y_{mi}}{Y_{li} + (1-\theta)Y_{mi}} \qquad \text{and} \qquad w_{ki} = \frac{y_{ki} + (1-\theta)y_{mi}}{Y_{ki} + (1-\theta)Y_{mi}}.$$

When $\theta = 0$, all miscellaneous incomes are treated as labor incomes, and when $\theta = 1$, all are treated as capital incomes.

2.1.6 Estimation of the average marginal tax rates of self-assessment income taxpayers

The above computations can be used to calculate the average marginal tax rates of self-assessment income taxpayers on labor incomes ($MTRL^s$) and capital incomes ($MTRK^s$). As already explained, we consider three cases relating to the treatment of miscellaneous incomes. The average marginal tax rates computed are defined as follows:

1. $MTRL_0^s$ and $MTRK_0^s$: based on miscellaneous incomes being allocated

to labor incomes;

2. $MTRL_1^s$ and $MTRK_1^s$: based on miscellaneous incomes being allocated to capital incomes;

3. $MTRL_\theta^s$ and $MTRK_\theta^s$: based on miscellaneous incomes being allocated to both incomes based on factor shares.

The results are summarized in Table 1. The tax rates $MTRL_\theta^s$ and $MTRK_\theta^s$ lie between the two extreme cases. Below, we designate $MTRL_\theta^s$ and $MTRK_\theta^s$ as our main results.

+++ INSERT TABLE 1 HERE. +++

Figure 1 plots the average marginal tax rates $MTRL_\theta^s$ and $MTRK_\theta^s$, in which miscellaneous incomes are allocated to labor and capital incomes according to factor shares. The average marginal tax rate on capital income exceeded 70% in 1987, since when it gradually declined. The average marginal tax rate on labor incomes declined throughout the period.

+++ INSERT FIGURE 1 HERE. +++

2.2 Average marginal tax rates for withholding income taxpayers

In this subsection, we calculate the average marginal tax rates of self-assessment income taxpayers. The *Statistical Survey of Actual Status for Salary in the Private Sector*, published by the National Tax Agency, provides data on the

amounts of taxes for each income bracket. However, this survey only provides such detailed information for employees working in the private sector throughout the year. One cannot obtain sufficient data for workers in the public sector. Because this survey includes data on individual companies, it does not cover employees working in more than one company. In addition, it does not cover withholding income taxpayers, who do not earn wages and salaries.

Because of such data limitations, we make the following five assumptions.

1. We treat withholding taxes on income except wages and salaries as proportional taxes.

2. The income distribution of workers in the public sector is the same as that in the private sector.

3. The income distribution of employees working throughout the year is the same as that for employees who only work for part of the year.

4. We ignore employees who earn their salaries from more than one company.

5. We ignore withholding taxpayers who do not earn wage and salaries.

Given these assumptions, we can estimate the average marginal tax rates of self-assessment income taxpayers.

Because the salaries of Japanese public servants are determined based on the salaries of large-scale private corporations, the second assumption would make the estimated rates lower than the actual rates. On the other hand, the third assumption might make the estimated rates higher than the actual

rates. We suggest that the numbers of taxpayers to whom the fourth and fifth assumptions apply are negligible for calculating total average marginal tax rates.

Note that most employees do not file a final tax return. Under the Japanese system, withholding income taxation is the responsibility not of employees but of the employers, who make year-end tax adjustments to pay for withholding income taxpayers. When employees earn their employment income from more than one company or receive income in addition to employment incomes, they should make a year-end tax adjustment. Thus, some withholding income taxpayers are also self-assessment income taxpayers. This issue is discussed in Section 2.3, in which we calculate the overall average marginal tax rates on labor and capital incomes.

Below, we explain the computation of average marginal tax rates for withholding income taxpayers. As are self-assessment income taxpayers, withholding income taxpayers are assumed to be homogeneous for each income bracket. The tax revenue of group i, $t^w(y_i)$, is:

$$t^w(y_i) = \tau y_i + \tau_k y_{ki} + \tau_k^w y_{ki} + \tau_l^w y_{l1i} + g(y_{l2i}),$$

where τ and τ_k are as defined in the previous subsection, τ_k^w is the additional rate of proportional taxation on the capital incomes of withholding taxpayers, τ_l^w is the rate of proportional taxation on labor incomes except employment incomes, y_{l1i} is labor income except employment income, y_{l2i} is employment income (that is, $y_{li} = y_{l1i} + y_{l2i}$), and $g(\cdot)$ represents the progressive tax function for employment income. Unlike self-assessment income tax, withholding

income tax is assumed to be represented by: $\tau_k^w y_{ki} + \tau_l^w y_{l1i} + g(y_{l2i})$. This is because the available data only record the amount of tax for each income bracket.

The marginal tax rates of group i are:

$$\begin{aligned} dt^w(y_i)/dy_{li} &= \tau + \tau_l^w \frac{dy_{l1i}}{dy_{li}} + g_i' \frac{dy_{l2i}}{dy_{li}} \\ dt^w(y_i)/dy_{ki} &= \tau + \tau_k + \tau_k^w. \end{aligned}$$

We assume that $dy_{l1i}/dy_{li} = y_{l1i}/y_{li}$ and $dy_{k1i}/dy_{ki} = y_{k1i}/y_{ki}$. Therefore, similar to the previous subsection, letting total tax revenues be $T^w = \sum_{i=1}^N t^w(y_i)$, letting total labor incomes be $Y_l = \sum_{i=1}^N y_{li}$, and letting total capital be $Y_k = \sum_{i=1}^N y_{ki}$, we obtain:

$$\begin{aligned} MTRL^w &= \tau + \tilde{\tau}_l^w + \sum_{i=1}^N \tilde{w}_{li} g_i' \\ MTRK^w &= \tau + \tau_k + \tau_k^w, \end{aligned}$$

where:

$$\tilde{\tau}_l^w = \tau_l^w \frac{\sum_{i=1}^N y_{l1i}}{Y_l} \quad \text{and} \quad \tilde{w}_{li} = \frac{y_{l2i}}{Y_l}.$$

In what follows, we explain how to use the available data to calculate average marginal tax rates. Because τ and τ_k are as defined in the previous subsection, we explain how to use the available data to construct $\tilde{\tau}_l^w$, τ_k^w, g_i', and $\tilde{w}_{li}$. Then, we report our calculated average marginal tax rates for withholding income taxpayers.

2.2.1 Estimation of $\tilde{\tau}_l^w$ and τ_k^w

To estimate $\tilde{\tau}_l^w$ and τ_k^w, we need data on the amount of taxes for each factor income. As in the previous subsection, miscellaneous incomes are difficult to classify as either capital or labor incomes. We consider three cases: the case in which miscellaneous incomes count as labor incomes; the case in which miscellaneous incomes count as capital incomes; and the case in which these incomes are allocated to labor and capital incomes based on factor shares.

For withholding income taxpayers, all types of income, except for employment income (Y_{l2}), can be classified into one of the following three categories:

1. Labor income, except for employment income (Y_{l1}^w): retirement income;
2. Capital income (Y_k^w): interest income, dividend income, and capital gains on listed stocks;
3. Miscellaneous income (Y_m^w): remuneration, fees, and the incomes of nonresidents.

Let the corresponding total tax revenues be denote by T_{l1}^w, T_k^w, and T_m^w. These figures, as well those for the total amount of employment income, Y_{l2}^w, are available from Section 3-1 (Statistics of Taxation) of the *National Tax Agency Annual Statistics Reports*. Whereas capital incomes are taxed proportionally, retirement incomes are not. Although taxable retirement incomes after deductions are taxed progressively under the Japanese taxation system, because of limited data availability, we assume that retirement incomes are taxed proportionally.

For calculating $\tilde{\tau}_l^w$ and τ_k^w, we consider three cases: the case in which

miscellaneous incomes are treated as labor incomes; the case in which miscellaneous incomes are treated as capital incomes; and the case in which these incomes are treated as either labor or capital incomes in proportion to the corresponding factor shares. Because the first two are extreme cases, we explain the computation of $\tilde{\tau}_l^w$ and τ_k^w in the third case. By using labor's share $1-\theta$, we divide miscellaneous incomes into labor incomes $(1-\theta)Y_m^w$ and capital incomes θY_m^w, respectively. Therefore, $\tilde{\tau}_l^w$ and τ_k^w can be estimated from:

$$\tilde{\tau}_l^w = \frac{T_{l1}^w + (1-\theta)T_m^w}{Y_{l1}^w + Y_{l2}^w + (1-\theta)Y_m^w} \quad \text{and} \quad \tau_k^w = \frac{T_k^w + \theta T_m^w}{Y_k^w + \theta Y_m^w}.$$

When $\theta = 0$, all miscellaneous incomes are treated as labor incomes, and when $\theta = 1$, all miscellaneous incomes are treated as capital incomes.

2.2.2 Estimation of g_i'

The derivative of the progressive tax function for each income bracket i, g_i', is calculated from the following formula:

$$g_i' = \frac{(r_i/n_i) - (r_{i-1}/n_{i-1})}{(y_{l2i}/n_i) - (y_{l2i-1}/n_{i-1})},$$

where r_i is the amount of withholding tax on employment income, n_i is the number of taxpayers, and y_{l2i} is the level of employment income for income group i. These figures are available from Table 6 (Breakdown of the number of employment income earners, total amount of salary and amount of tax by range of salary, employment income earners who worked through a year) of Section 3-2 (The Results of the Statistical Survey of Actual Status for Salary in the Private Sector, excerpt) in the *National Tax Agency Annual Statistics*

Reports.

2.2.3 Estimation of $\tilde{w}_{li}$

To compute the distribution of labor incomes subject to nonproportional taxes, $\tilde{w}_{li}$, we must make some adjustments. The total amount of employment income from Table 6 of Section 3-2 in the *National Tax Agency Annual Statistics Reports*, $\sum_{i=1}^{N} y_{l2i}$, is not the same as that from Table 1 of Section 3-1 (Statistics of Taxation), Y_{l2}^{w}. The former is based on the incomes of those who work throughout the year in the private sector, whereas the latter includes public servants and temporary workers. We assume that the income distribution of public servants and temporary workers is the same as that of earners working throughout the year in the private sector.[5]

Thus, when miscellaneous incomes are allocated to both labor and capital incomes in proportion to the corresponding factor shares, the weight becomes:

$$\tilde{w}_{li} = \frac{y_{l2i}}{Y_{l1}^{w} + Y_{l2}^{w} + (1-\theta)Y_{m}^{w}} \times \frac{Y_{l2}^{w}}{\sum_{i=1}^{N} y_{2li}}.$$

Note that Y_{l1}^{w}, Y_{l2}^{w}, and Y_{m}^{w} are as defined previously. Data on these items can obtained from Table 1 of Section 3-1 in the *National Tax Agency Annual Statistics Reports*. Data on y_{l2i} comes from Table 6 of Section 3-2. When $\theta = 0$ (resp. $\theta = 1$), all miscellaneous incomes are allocated to labor incomes (resp. capital incomes).

[5]The bias generated by making this assumption might be at least partially offset by the fact that, in Japan, public servants earn relatively high incomes and temporary workers earn relatively low incomes.

2.2.4 Estimation of the average marginal tax rates of withholding income taxpayers

Using the calculations obtained above, we calculate the average marginal tax rates on labor incomes ($MTRL^w$) and capital incomes ($MTRK^w$) of withholding income taxpayers. As in the previous section, in calculating average marginal tax rates, we consider the following three treatments of miscellaneous incomes:

1. $MTRL_0^w$ and $MTRK_0^w$: miscellaneous incomes are treated as labor incomes;

2. $MTRL_1^w$ and $MTRK_1^w$: miscellaneous incomes are treated as capital incomes;

3. $MTRL_\theta^w$ and $MTRK_\theta^w$: miscellaneous incomes are allocated to labor and capital incomes in proportion to the corresponding factor shares.

The results are summarized in Table 2.

+++ INSERT TABLE 2 HERE. +++

Figure 2 plots the average marginal tax rates $MTRL_\theta^w$ and $MTRK_\theta^w$ based on miscellaneous incomes being allocated in proportion to factor shares. Average marginal tax rates on labor incomes peaked at the beginning of the 1990s. This coincides with the period in which the Japanese government introduced substantial tax cuts to stimulate the economy. Compared with Figure 1, the average marginal tax rates on both factor incomes for withholding income taxpayers are below those of self-assessment income taxpayers.

+++ INSERT FIGURE 2 HERE. +++

2.3 Estimation of total average marginal tax rates

We have divided taxpayers into two types, and computed the marginal tax rates on both factor incomes. Based on these computations, we estimate total average marginal tax rates at the macroeconomic level. As already discussed, some withholding taxpayers make year-end tax adjustments. Thus, the withholding income taxpayers who make declarations are included in both the *Sample Survey for Self-assessment Income Tax* and the *Statistical Survey of Actual Status for Salary in the Private Sector*. Ideally, one would divide taxpayers into those paying only self-assessment income tax, those paying only withholding income tax, and those paying both types of tax. In addition, one should take into account the numbers of self-assessment and withholding taxpayers and of the income levels and taxes in all income brackets, and then, to compute average marginal tax rates, one should use as weights the proportions of self-assessment and withholding taxpayers.

However, data limitations prevent us from applying these procedures, and all we can do is compute the average marginal tax rates of self-assessment income taxpayers and withholding income taxpayers. We also use an alternative weight to compute the average marginal tax rates, denoted by α. When miscellaneous incomes are allocated to labor and capital incomes according to factor shares, the total average marginal tax rates on factor incomes can be computed from:

$$\begin{aligned} MTRL_\theta &= \alpha MTRL^s_\theta + (1-\alpha) MTRL^w_\theta, \\ MTRK_\theta &= \alpha MTRK^s_\theta + (1-\alpha) MTRK^w_\theta. \end{aligned}$$

When $\theta = 0$ ($\theta = 1$), all miscellaneous incomes are treated as labor (capital) incomes.

The weight α is chosen so that the average tax rate on total income is equal to a weighted average of the average tax rate on self-assessment income and that on withholding income. That is:

$$\frac{\text{total income tax}}{\text{total income}} = \alpha \frac{\text{self-assessed income tax}}{\text{self-assessed income}} + (1-\alpha) \frac{\text{withholding income tax}}{\text{withholding income}}.$$

The denominator on the left side of the above equation can be calculated from the *Annual Reports on the National Accounts* prepared by the Economic and Social Research Institute, the Cabinet Office. The data required to compute the other terms are available from the *National Tax Agency Annual Statistics Reports*.

Using the sum of the total incomes of self-assessment and withholding income taxpayers to compute the denominator on the left side would lead to double counting. Thus, for total income, we sum up the compensation of employees, the property incomes of households, and the incomes of enterprises and unincorporated enterprises from Table 2 (Distribution of National Income and National Disposable Income) in Chapter 4 (Main Time Series) of Part 1 (Flow) of the *Annual Reports on the National Accounts*.

The numerator on the left side is the sum of the total amount of self-assessment income tax from Table 1 of Section 2-5 in the *National Tax Agency Annual Statistics Reports*. The total amount of withholding income tax is from Table 1 of Section 3-1 of the same source. Note that the total amount of self-assessment income tax in Table 1 has already subtracted from the

total amount of withholding income. The denominator of the first term on the left side is computed from the total amount of income in Table 1 of Section 2-5, and the numerator is obtained from the sum of self-assessment and withholding income taxes in the same table. The denominator of the second term is calculated from the sum of the payment amounts for each income type in Tables 4 to 9 of Section 3-1. The numerator is taken from the total amount of withholding income taxes in Table 1 of the same section.

Based on the weight α for each fiscal year, we compute weighted averages of the average marginal tax rates of self-assessment and withholding income taxpayers to obtain the total average marginal tax rates on labor and capital incomes. The results are presented in Table 3. Figure 3 illustrates $MTRL_\theta$ and $MTRK_\theta$. Total average marginal tax rates are similar to those for withholding income taxpayers, because more weight is assigned to withholding taxpayers than to self-assessment income taxpayers.

The average marginal tax rate on labor income generally increased until the early 1990s and peaked at 21%. Since then, the rate fell to reach 17% in 2003. As discussed in the previous subsection, this decline is arguably the result of Japan's lengthy economic slump (the so-called "lost decade") and of tax-cutting reforms designed to stimulate the Japanese economy. Note that these tax rates do not incorporate social security premiums. As discussed in the introduction, social security contributions can be broadly considered as taxes on labor incomes. In the next section, we calculate average marginal tax rates that incorporate social security premium rates.

The average marginal tax rate on capital incomes is at least 30% higher than the average marginal tax rate on labor incomes, mainly because of

corporation tax. Tax rates on capital have fluctuated between 46% and 57% and peaked twice during the sample period; first in 1987–89 and again in 1995–2001. Rates fell in 1990 and 2003, perhaps because the tax system was reformed in both years.

+++ INSERT TABLE 3 AND FIGURE 3 HERE. +++

3 Average Marginal Tax Rates including Social Security Premium Rates

As noted in Section 1, social security premiums can be broadly interpreted as taxes. In this section, we estimate the average marginal tax rates including social security premiums, denoted by $MMTRL$. The five types of social security payments considered are pension insurance, health insurance, employment insurance, accident compensation insurance, and long-term care insurance. In the following subsections, we calculate the average marginal premium rates for each security payment. In the final subsection, we add up those rates to obtain total marginal average rates of social security premiums, $MSST$. We then estimate $MMTRL$ by adding $MMST$ to the marginal average rates excluding social security premiums, $MTRL$, estimated in the previous section. In addition, we estimate the average rates of social security premiums, $ASST$, and compute $AMTRL = ASST + MTRL$. This is done to enable us to examine the regressive effect of social security payments and the progressive effect of tax rates (excluding social security).

Before estimating the premium rates on labor incomes for each type of

social security, we address three issues. First, the average marginal rates of social security premiums, $MSST$, are smaller than the average rates $ASST$. In Japan, labor incomes are subject to the five social security payments listed above. Premiums for employment insurance, accident compensation insurance, and long-term care insurance are proportional to labor incomes and, accordingly, the marginal and average premiums rates are equivalent. By contrast, some types of pension and health insurance require contributors to pay flat fees, in which case the marginal premium rates are zero.

Second, $MSST$ and $MTRL$ are based on different weights. We use the income ratio as the weight for $MTRL$. However, for the $MSST$ weight, because of limited data availability, we use the ratio of the number of insured persons to the total number of workers (the labor force). Insured persons paying lump-sum contributions are generally low incomes earners. Therefore, total average marginal rates based on the numbers of insured persons are below those based on income levels.

Third, social security payments for employees are paid by both employees and employers. Thus, the effective rates for social security premiums should be estimated in the following way. Let w^B and w^A denote the before-tax and after-tax wage rates, respectively. This means that $w^B = (1 + \tau_e)w^A$, where τ_e is a tax on employers' payments of wages. The before-tax wage rate for employees is $w^A = w^B/(1 + \tau_e)$, so the after-tax wage rate is as follows:

$$(1 - \tau_l)w^A = \frac{1 - \tau_l}{1 + \tau_e}w^B = \left(1 - \frac{\tau_l + \tau_e}{1 + \tau_e}\right)w^B.$$

Therefore, the effective tax rate paid by both employers and employees is

$(\tau_l + \tau_e)/(1 + \tau_e)$.

3.1 Average marginal premium rates for pension insurance

In this subsection, we estimate the average marginal rates of pension insurance. Pension insurance is classified into: (i) the National Pension; (ii) Employees' Pension Insurance; and (iii) the Mutual Aid Associations' Pension. The Mutual Aid Associations consist of (ii-1) the Mutual Aid Association of National Government Employees; (ii-2) the Mutual Aid Association of Local Government Employees; (ii-3) the Mutual Aid Corporation of Private School Personnel; (ii-4) the Agriculture, Forestry, and Fisheries Organization Employees Mutual Aid Association; (ii-5) the Mutual Aid Associations of Public Corporation Employees; (ii-6) the Seamen's Insurance; and (ii-7) the Farmer Pension Fund.[6] Every Japanese person above the age of 20 is required by law to join one of these associations. We use the statutory rates and the number of members covered by each type of insurance to calculate the weighted average of these premium rates. The marginal premium rate is the corresponding statutory rate when the premium is proportional to the income level, and the weight is the ratio of the number of persons covered by each type of insurance to the total labor force. Data on the numbers of insured persons and the statutory insurance premium rates are from the *Social Security Year Book* (Shakai Hosho Nenkan) published by the National Federation of Health Insurance Societies.

[6]The last three associations (ii-5)–(ii-7) were liquidated in 1983, 1985, and 1985, respectively.

In calculating the average marginal rates of pension insurance, two points require careful attention. First, the national pension is different from the other pensions. The premium for the national pension is constant and independent of the level of income and, thus, the marginal premium rate should be set to zero. In addition, contributors to the national pension are not necessarily part of the labor force. We therefore consider the contributors to the national pension to comprise the labor force excluding the contributors to other pension funds.[7] This allows us to make the sum of the contributors to these pension funds equal to the labor force. Labor force data are fiscal year averages from the *Labour Force Survey* (Rodoryoku Chosa) published by the Ministry of Internal Affairs and Communications.

Second, except for the case of the national pension, adjustments are required when using statutory rates on employment incomes. Employment incomes are divided into regular earnings and special earnings, and the latter, paid twice a year, typically accounts for a large share of overall labor incomes in Japan. Before 2002, the statutory premium rate was imposed only on regular earnings,[8] and another, much lower, rate is imposed on special earnings. Since the introduction of the total remuneration system in 2003, both types of earnings are subject to the same rate of pension insurance. Thus, we must

[7]For the number of contributors to the national pension, one could also use the number of insured persons in class 1 who are neither members of the employees' pension insurance scheme nor members of a mutual aid association and are not dependent spouses of any member of the national pension scheme. In this case, the marginal premium rate is zero because the number of people in the labor force minus all pension contributors is same as the number of uninsured people, or the unpaid labor force. Therefore, the estimation is unaffected.

[8]To be precise, the monthly amount of the premium was calculated from the product of the statutory rates and the index of monthly regular earnings, which rounds off fractions of actual monthly payments.

recalculate the premium rate on total employment incomes. Unfortunately, we cannot obtain data on the amounts of special earnings or on the premium rate on special earnings for each pension fund from the *Social Security Year Book*.

To recalculate the premium rates, we assume that the premiums on special earnings before 2002 were zero. We then construct the ratio of employment earnings to total earnings from a different data source. We estimate the rates of pension insurance (except for the national pension) on labor incomes by using the product of the statutory rates and the adjustment coefficient ρ, defined as:

$$\rho = \frac{\text{annual cash earnings}}{\text{annual cash earnings} + \text{annual special earnings}}.$$

Annual earnings are computed from the sum of the monthly contractual cash earnings in each year. The data on cash earnings and special earnings are from the *Basic Survey on the Wage Structure* (Chingin Kozo Kihon Tokei Chosa Houkoku) published by the Ministry of Health, Labour and Welfare.

3.2 Average marginal premium rates for health insurance

In this subsection, we estimate the average marginal rates of health insurance. The five types of health insurance are: the health insurance managed by government and by associations; National Health Insurance; Employees' Insurance; Day-Laborers' Health Insurance; Seamen's Insurance; and Mu-

tual Aid Association Insurance.[9] As in the case of pension insurance, every Japanese person aged over 20 is required to join one of these associations by law. We use the statutory rates and the numbers of insured members to calculate the weighted average of these premium rates. The marginal premium rate is the corresponding statutory rate when the premium is proportional to the income level, and the weights are the ratios of the numbers of insured members to the total labor force. The data used for our calculations are available from the *Social Security Year Book*, the *Labour Force Survey*, and the *Basic Survey on the Wage Structure*.

For calculating the marginal rates for health insurance, two points require careful consideration. First, as in the previous subsection, national health insurance is different from the other types of insurance. Because the premium is effectively constant, we set its premium rate to zero. Because contributors are not necessarily part of the labor force, we assume that the number of contributors to the national health insurance scheme can be obtained by subtracting the number of contributors to other health insurance schemes from the total labor force.

Second, as in the previous subsection, adjustments are needed when using statutory rates on employment incomes. The total remuneration system was introduced into health insurance in 2003, and different rates were imposed on regular earnings and special earnings before 2002. Fortunately, data on insurance premium rates on special earnings for health insurance are available. Therefore, our estimates of the average marginal premium rates before

[9] As described in the previous subsection, the Mutual Aid Association consists of seven associations: (ii-1)–(ii-7). However, because of limited data availability, we use the first four associations to calculate the average marginal premium rates.

2002 are:

$$\rho \times (\text{rate on regular earnings}) + (1 - \rho) \times (\text{rate on special earnings}).$$

where ρ is as defined in the previous subsection. According to this equation, the premium rate is the insurance rate on cash earnings plus that on special earnings.

3.3 Average marginal premium rates for employment insurance

In this subsection, we estimate the average marginal rates for employment insurance. The three types of employment insurance are: Employment Insurance for General Persons; Day-Laborers' Insurance; and Seamen's Insurance. We use the statutory rates and the numbers of insured members in each scheme to calculate the weighted average of these premium rates. The marginal premium rate is the corresponding statutory rate when the premium is proportional to the income level, and the weights are the ratios of the numbers of insured members to the labor force. These data are taken from the same sources as those used in the previous subsections.

Not every worker is insured. Therefore, unlike for pension and health insurance, we need information on the numbers of uninsured workers. We specify this as the difference between the total labor force and the total number of insured persons. Furthermore, the insurance premium for day-laborers' insurance is in the form of a lump sum and is independent of the level of income. For day-laborers' insurance contributors and for uninsured

workers, the marginal premium rate is zero.

3.4 Average marginal premium rates for accident compensation insurance

In this subsection, we estimate the average marginal rates of accident compensation insurance. We classify accident compensation insurance into Workmen's Accident Compensation Insurance, Accident Compensation for National Government Employees, and Accident Compensation for local Government Employees. The premium rate for Workmen's Accident Compensation Insurance varies by industry, but we have no time series data on these rates. Thus, we use the ratio of the payments for these types of insurance to labor income as the average premium rate. Data on insurance payments are from the *Annual Report on Social Security Statistics* (Shakai Hosho Tokei Nenpo) published by the National Institute of Population and Social Security Research. As in Section 2.1.2, labor incomes are calculated as $(1-\theta)$NNP.

3.5 Average marginal premium rates for long-term care insurance

Long-term care insurance was introduced in 2000. Persons aged 40 to 65 (termed class 2 persons) must pay this insurance premium. Data on the number of insured persons and the insurance premium rate are taken from the *Social Security Year Book*. For uninsured persons, the marginal premium is zero. The number of uninsured persons is the difference between the labor force and the number of insured persons. We compute the weighted aver-

age of the rates for the insured and uninsured by using the shares of the corresponding groups as weights.

3.6 Average marginal tax rates including all social security premium rates

The average marginal premium rates for each type of social security are shown in rows 2 to 6 of Table 4. The pension insurance rate increases gradually, but there is little change in the other four rates. Note that the rates of employment insurance, accident compensation insurance, and long-term care insurance are no more than 1%.

+++ INSERT TABLE 4 HERE. +++

Now, we can estimate the average marginal tax rates including social security premiums $MMTRL$. Let $MSST$ be the sum of all of the social security premium rates, presented in column 7 of Table 4. When miscellaneous incomes multiplied by the capital share θ are allocated to capital incomes, we obtain:

$$MMTRL_\theta = MTRL_\theta + MSST.$$

When $\theta = 0$ ($\theta = 1$), miscellaneous incomes are treated as labor (capital) incomes.

The solid line in Figure 4 represents the time series for $MTTRL_\theta$. The rates excluding social security premiums (represented by the broken line, $MTRL_\theta$) range from 17% to 22% and declined from 1994. Social security

premiums boost the rate by around 10 percentage points, and the rates including premiums have not decreased, even since the 1990s.

+++ INSERT FIGURE 4 HERE. +++

Premiums for the national pension, which accounts for a large share of social security, is independent of income; that is, the marginal premium rate is zero. This might reduce the progressiveness of the marginal tax rate on labor income. To take this effect into account, we also estimate the *average* social security tax rate,

$$ASST = \text{social insurance premiums/labor incomes.}$$

The figures for social insurance premiums are the sum of contributions by employees and employers from the *Annual Reports on Social Security Statistics*. Labor income is calculated as $(1-\theta)$NNP.

Column 8 of Table 4 reports $ASST$. In addition, Table 5 and Figure 4 report the sum of $ASST$ and $MTRL$ ($AMTRL_\theta = MTRL_\theta + ASST$), which is extensively used in the next section to examine the effect of the progressiveness of taxation excluding social securities on labor income. The average rate for social security, $ASST$, ranges from 11% to 17%. Another type of average marginal tax rate, $AMTRL_\theta$, ranges from 29% to 35% and is about five percentage points above $MMTRL$.

+++ INSERT TABLE 5 HERE. +++

4 Comparing our Tax Rates with Existing Average Tax Rates

In this section, we compare our series of average marginal tax rates with the average tax rates calculated by Mendoza et al. (1994). They used data on tax revenues from the OECD's *Revenue Statistics* and data on income and expenditures from the OECD's *National Accounts of OECD Countries*. They present a series of average tax rates on consumption, labor, and capital for seven OECD countries for the period 1965–96.[10] In this section, we compare our series with their Japanese series. In Figure 5, we compare our average marginal tax rates on labor income, $MMTRL$, with the corresponding average tax rates presented by Mendoza et al. (1994), $ATRL$.[11] Whereas in the early 1980s the average and marginal tax rates on labor income were similar, after that, the average rate exceeds the marginal rate. However, apart from 1989–91, the marginal tax rate with average social security premium rates, $AMTRL$, exceeds the average rates.

+++ INSERT FIGURE 5 HERE. +++

The fact that marginal average tax rates are lower than average tax rates is the product of the Japanese tax and social security system. Generally, average marginal tax rates are raised if income is taxed progressively but lowered

[10] They originally estimated a series for 1965–86; a series that extends to 1996 is available from E. G. Mendoza's Web site:

`http://econ.server.umd.edu/~mendoza/pp/newdata.pdf`.

We cannot construct further updated series because some definitions in *Revenues Statistics* changed in 1997.

[11] Because of data construction, our average marginal tax rates on labor income should be compared with the sum of their average tax rates on consumption and labor income.

if there are lump-sum taxes. As already noted, whereas the Japanese social security system levies social security contributions on most employers in proportion to their wages, it imposes lump-sum taxes on others, including the self-employed. In Figure 5, we also present an alternative version of our estimated series ($AMTRL_\theta$), which is obtained by assuming that social security contributions are average, rather than marginal, premium rates. This series exceeds the average tax rate ($ATRL$) by about one percentage point. One interpretation of the difference between $AMTRL_\theta$ and $ATRL$ is that it reflects the progressiveness of income tax.

It is interesting that the progressiveness of income tax has a small effect. In referring to Feenberg and Coutts (1993), Prescott (2004) assumed that the ratio of marginal tax rates excluding social security contribution rates to the average tax rates of Mendoza et al. (1994) was 1.6 for the US. Our results indicate that, in Japan, the ratio is lower, at around 1.1. This difference arises because the minimum taxable level of personal income is higher in Japan than in the US.

In Figure 6, we compare our average marginal tax rates with average tax rates on capital income. Until 1987, average marginal tax rates ($MTRK_\theta$) were slightly above average tax rates, but in 1988–91, they were similar. After that, the marginal tax rate exceeded the average rate. This suggests that Japanese taxes on capital income are as progressive as taxes on labor income without social security premiums.

+++ INSERT FIGURE 6 HERE. +++

5 Comparison with BCA

In this section, we compare our results with wedges from BCA recently developed by Chari et al. (2007a). In standard calibration analysis, one chooses an appropriate dynamic macroeconomic model with a plausible set of parameters, estimates exogenous shocks from actual data, and conducts a simulation to evaluate the impact of each shock on the endogenous variables. In BCA, one uses a standard dynamic general equilibrium model to estimate the shock variables, called wedges, from actual endogenous variables, and conducts a simulation to investigate the extent to which each wedge contributes to actual business cycles. The BCA wedges are interpreted as taxes that prevent the economy from achieving its Pareto optimum allocations. The four wedges considered by Chari et al. (2007a) are efficiency, labor, government, and investment.

Kobayashi and Inaba (2006) and Otsu (2008) applied BCA to the Japanese economy and concluded that efficiency and labor wedges play an important role in business cycles. These findings are consistent with those of Hayashi and Prescott (2002), who found that technology shocks (known as efficiency wedges in BCA terminology) were the most significant contributors to the 1990s depression, Japan's the lost decade. Prescott (2004) compared labor wedges and marginal average tax rates on labor income for the G7 countries including Japan, and concluded that taxes on labor incomes can almost completely account for labor wedges. For other discussions on wedges, see Golosov et al. (2006) and Shimer (2009).

Taking BCA analyses into account, we compare our estimated tax rates

on labor and capital incomes with labor and capital wedges.[12] Note that we use capital wedges although BCA often uses investment wedges. There is controversy about the relationship between capital and investment wedges. Christiano and Davis (2006) pointed out that, in models with investment adjustment costs, replacing investment wedges by capital wedges may affect the results. In response, Chari et al. (2007b) showed that both wedges are equivalent mathematically. Thus, for comparison with our series, we use capital wedges.

Figure 7 illustrates the average marginal tax rate on labor income ($MMTRL$) and the labor wedge. The labor wedge exceeds the marginal tax rate throughout the period. The difference rises from about five percentage points at the beginning of the period to about 15 percentage points at the end. The labor wedge increased from 1985, whereas the marginal tax rate remained unchanged at around 30%. The correlation coefficient between them is 0.66.

+++ INSERT FIGURE 7 HERE. +++

Overall, the average marginal tax rate explains about 70% of the labor wedge in terms of mean and correlation. Kobayashi and Inaba (2006) and Otsu (2008) argued that the labor wedge is an important contributor to Japanese business cycles. Given their results, the average marginal tax rate would also be a major factor. Our results imply that social security premiums account for much of the upward trend in the marginal tax rate on labor income. As shown in Figure 4, the marginal tax rate excluding social security

[12]We are grateful to Masaru Inaba for providing data on the labor and capital wedges analyzed in this section.

premiums ($MTRL$) declined from 1990, whereas the rate including social security premiums ($MMTRL$) remained steady.

Increased social security burdens might cancel out the effect of tax cuts on the Japanese economy. A rise in the marginal tax rate on labor income raises the relative disutility of labor and, consequently, labor supply declines. In addition, a negative technology shock lowers firms' labor demand. Thus, in the lost decade, not only might slow technology progress have reduced output, but reduced labor demand and increased social security premiums might have lowered labor supply. Both would have negative effects on the Japanese economy in the long run.

The argument that tax plays an important role in explaining the economy is not new. As already mentioned, to simulate labor supply using a simple neoclassical general equilibrium model, Prescott (2004) estimated marginal tax rates for the G7 countries in the periods 1970–74 and 1993–96. On the basis that model predictions are consistent with actual values, Prescott claimed that labor wedges are completely accounted for by marginal tax rates.

However, we disagree with Prescott (2004) to some extent. Prescott used Mendoza et al.'s (1994) series of average tax rates for individual G7 countries, and multiplied each average rate by 1.6 to estimate the marginal rates. Prescott's figure of 1.6 comes from empirical research on the US (Feenberg and Coutts, 1993), and is assumed to apply to all G7 countries including Japan. However, as we showed in the previous section, the ratio excluding social security premiums in Japan is about 1.1. Thus, we argue that the tax rate on labor income accounts for no more than 70% of the labor wedge in

the Japanese economy.

The difference between average marginal tax rates and labor wedges widened from the early 1980s, even based on including social security premiums ($AMTRL$, broken line in Figure 7). This difference may be the result of reduced working hours, as suggested by Hayashi and Prescott (2002). Alternatively, it may be a result of the recent rapidly accumulating fiscal deficit. To stimulate the economy, the Japanese government has continued not only cutting taxes but also issuing bonds. Japan's fiscal deficit as a proportion of GDP is the highest among the OECD countries. According to the Ricardo–Barro effect, current fiscal deficits are essentially future taxes.

Figure 8 illustrates the average marginal tax rate and the capital wedge. Whereas the marginal tax rate stays around 50%, the capital wedge fluctuates substantially, ranging from 33% to over 70%. The average of the marginal tax rate (0.53) is similar to that of the capital wedge (0.47). However, the correlation coefficient between them is -0.15. The first-order autocorrelation coefficient for the capital wedge of 0.12 suggests that fluctuations in the capital wedge could be explained by a short-run shock with a mean of zero; an example is an unexpected monetary shock. According to Kobayashi and Inaba (2006) and Otsu (2008), the investment wedge, which is equivalent to the capital wedge, does not make a significant contribution to Japan's business cycles.

+++ INSERT FIGURE 8 HERE. +++

6 Concluding Remarks

In this paper, we have applied the method of Joines (1981) to estimate average marginal tax rates for Japan from 1980–2003. We considered both self-assessment taxpayers and withholding income taxpayers. We calculated their average marginal tax rates separately, and then combined these tax rates into a weighted average to obtain total average marginal tax rates. Moreover, we included social security tax rates, which consist of pension insurance, health insurance, employment insurance, accident compensation insurance, and long-term care insurance.

We obtained the following results. The average marginal tax rates on labor income without social security premiums increased until 1990 and then decreased. The rates with social security premiums remained around 30% from the mid-1990s. Although the labor tax decreased after the bubble economy of the late 1980s, increased social security premiums kept the marginal tax rate stable. Average marginal tax rates on capital income peaked in the late 1980s and again in the late 1990s.

We also compared our estimates with two existing measures. First, we compared our estimates with Mendoza et al.'s (1996) average tax rates. Whereas the average tax rates on labor income tend to be slightly below the average marginal tax rates with average marginal premium rates of social security, the average rates are about three percentage points higher than the average marginal tax rates with average premium rates. This suggests that social security premiums are regressive and that taxation is progressive, albeit weakly. The average tax rates on capital income were below

the marginal tax rates for the most of the sample period, 1980–2003. This suggests that Japan's capital tax is relatively progressive.

We also compared our estimates with the labor and capital wedges estimated by Kobayashi and Inaba (2006). We found that marginal tax rates on labor incomes account for about 70% of the labor wedge. This implies that, in the context of Japan's business cycles, labor taxes contribute significantly to economic depression. However, because the difference between tax rates and wedges measures has increased, other contributory factors should be considered. Our marginal tax rates cannot explain the fluctuations in capital wedges.

Our estimated average marginal tax rates for Japan are unique. Without them, one cannot use macroeconomic models to investigate the Japanese economy precisely. Researchers have been forced to use average tax rates or sample-period means.[13] We trust that our estimated average marginal tax rates will be widely used in studies of the Japanese economy.

Future research tasks are as follows. First, we intend to expand the sample period. It is possible to extend the 1980–2003 sample at both ends by using a different System of National Accounts (SNA). The *National Tax Agency Annual Statistics Report* is available from the mid-Meiji era without wartime breaks. We are going to maximize the length of the period covered by our estimated tax rates by linking data based on different SNAs with different base years.

Second, we could estimate tax rates more precisely. To estimate tax rates on factor incomes, which are often used in macroeconomic analysis

[13]See, for instance, Hayashi and Prescott (2002).

of the US, we applied the method of Joines (1981), which relies on strong assumptions. Relaxing the assumptions and estimate average marginal tax rates nonparametrically would be preferred. Given that Akhand and Liu (2002) used a nonparametric method to estimate marginal tax rates for the US, it would be worth applying their method to Japanese data.

Third, it would be worth computing marginal taxes from a different data source. Microeconomic data have recently become more accessible in Japan. In particular, it would be useful to estimate taxes by using the *Family Income and Expenditure Survey*, which is carried out by the Ministry of Internal Affairs and Communications. This would enable the estimation of taxes for each household. Comparing microeconomic tax with ours would be intriguing.

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Table 1: Average marginal tax rates of self-assessment income taxpayers

Year	$MTRL_0^s$	$MTRK_0^s$	$MTRL_1^s$	$MTRK_1^s$	$MTRL_\theta^s$	$MTRK_\theta^s$
1980	0.2598	0.6368	0.2708	0.5779	0.2615	0.6115
1981	0.2655	0.6580	0.2814	0.5984	0.2678	0.6344
1982	0.2782	0.6752	0.2902	0.6249	0.2799	0.6564
1983	0.2684	0.6751	0.2861	0.6131	0.2709	0.6510
1984	0.2608	0.6931	0.2793	0.6277	0.2634	0.6673
1985	0.2584	0.6746	0.2777	0.6085	0.2614	0.6477
1986	0.2732	0.7155	0.2994	0.6476	0.2773	0.6890
1987	0.2615	0.7314	0.2808	0.6753	0.2646	0.7104
1988	0.2469	0.7141	0.2740	0.6569	0.2511	0.6910
1989	0.2546	0.6949	0.2852	0.6511	0.2594	0.6785
1990	0.2612	0.6468	0.2908	0.6088	0.2660	0.6326
1991	0.2598	0.6416	0.2918	0.5950	0.2650	0.6248
1992	0.2785	0.6630	0.3168	0.5985	0.2839	0.6377
1993	0.2798	0.6709	0.3130	0.6138	0.2841	0.6510
1994	0.2365	0.6537	0.2662	0.5914	0.2400	0.6325
1995	0.2382	0.6891	0.2661	0.6331	0.2414	0.6709
1996	0.2338	0.6633	0.2599	0.6128	0.2370	0.6464
1997	0.2480	0.6846	0.2751	0.6269	0.2512	0.6655
1998	0.2631	0.6853	0.2847	0.6376	0.2656	0.6712
1999	0.2368	0.6651	0.2619	0.6177	0.2393	0.6513
2000	0.2399	0.6354	0.2655	0.5887	0.2429	0.6206
2001	0.2391	0.6580	0.2610	0.6124	0.2415	0.6443
2002	0.2409	0.6376	0.2653	0.5944	0.2436	0.6248
2003	0.2336	0.5762	0.2568	0.5359	0.2364	0.5634

Table 2: Average marginal tax rates of withholding income taxpayers

Year	$MTRL_0^w$	$MTRK_0^w$	$MTRL_1^w$	$MTRK_1^w$	$MTRL_\theta^w$	$MTRK_\theta^w$
1980	0.1673	0.4531	0.1684	0.4487	0.1676	0.4517
1981	0.1749	0.4783	0.1763	0.4738	0.1752	0.4771
1982	0.1798	0.4960	0.1812	0.4917	0.1801	0.4948
1983	0.1815	0.4854	0.1829	0.4836	0.1818	0.4849
1984	0.1820	0.5012	0.1831	0.5012	0.1822	0.5012
1985	0.1841	0.4798	0.1846	0.4832	0.1842	0.4807
1986	0.1915	0.5111	0.1921	0.5146	0.1916	0.5121
1987	0.1938	0.5372	0.1945	0.5412	0.1940	0.5384
1988	0.1830	0.5370	0.1921	0.5249	0.1851	0.5325
1989	0.1811	0.5453	0.1897	0.5289	0.1831	0.5394
1990	0.1887	0.5004	0.1981	0.4867	0.1910	0.4956
1991	0.1946	0.4793	0.2038	0.4675	0.1967	0.4754
1992	0.1981	0.4930	0.2081	0.4796	0.2001	0.4889
1993	0.1967	0.5003	0.2072	0.4856	0.1986	0.4960
1994	0.1873	0.5085	0.1976	0.4892	0.1891	0.5029
1995	0.1745	0.5575	0.1827	0.5358	0.1758	0.5510
1996	0.1733	0.5561	0.1813	0.5186	0.1747	0.5418
1997	0.1816	0.5435	0.1898	0.5169	0.1829	0.5338
1998	0.1781	0.5359	0.1865	0.5133	0.1794	0.5282
1999	0.1725	0.5511	0.1787	0.5282	0.1734	0.5438
2000	0.1724	0.5464	0.1782	0.5152	0.1733	0.5371
2001	0.1716	0.5639	0.1777	0.5371	0.1725	0.5567
2002	0.1666	0.5359	0.1734	0.5046	0.1676	0.5252
2003	0.1612	0.4683	0.1701	0.4381	0.1626	0.4558

Table 3: Total average marginal tax rates

Year	α	$MTRL_0$	$MTRK_0$	$MTRL_1$	$MTRK_1$	$MTRL_\theta$	$MTRK_\theta$
1980	0.1294	0.1793	0.4769	0.1817	0.4654	0.1797	0.4724
1981	0.1227	0.1860	0.5004	0.1892	0.4891	0.1866	0.4964
1982	0.1252	0.1922	0.5184	0.1948	0.5084	0.1926	0.5151
1983	0.1255	0.1924	0.5092	0.1958	0.4998	0.1930	0.5058
1984	0.1233	0.1917	0.5249	0.1950	0.5168	0.1922	0.5217
1985	0.1236	0.1932	0.5038	0.1961	0.4987	0.1937	0.5014
1986	0.1269	0.2018	0.5370	0.2057	0.5315	0.2025	0.5345
1987	0.1358	0.2030	0.5636	0.2062	0.5594	0.2036	0.5618
1988	0.1365	0.1918	0.5612	0.2033	0.5429	0.1941	0.5541
1989	0.1429	0.1916	0.5667	0.2034	0.5464	0.1940	0.5593
1990	0.1440	0.1992	0.5214	0.2115	0.5043	0.2018	0.5154
1991	0.1388	0.2036	0.5018	0.2160	0.4852	0.2062	0.4962
1992	0.1173	0.2075	0.5129	0.2208	0.4935	0.2099	0.5063
1993	0.1164	0.2064	0.5201	0.2195	0.5006	0.2085	0.5140
1994	0.1083	0.1926	0.5243	0.2050	0.5002	0.1946	0.5169
1995	0.1111	0.1816	0.5721	0.1920	0.5466	0.1831	0.5644
1996	0.1208	0.1806	0.5691	0.1907	0.5300	0.1822	0.5545
1997	0.1107	0.1890	0.5592	0.1992	0.5291	0.1905	0.5484
1998	0.1078	0.1873	0.5520	0.1971	0.5267	0.1887	0.5436
1999	0.1064	0.1794	0.5632	0.1876	0.5377	0.1804	0.5552
2000	0.1039	0.1794	0.5556	0.1873	0.5228	0.1805	0.5458
2001	0.0977	0.1782	0.5731	0.1859	0.5444	0.1792	0.5653
2002	0.1012	0.1742	0.5462	0.1827	0.5137	0.1753	0.5353
2003	0.1043	0.1687	0.4795	0.1792	0.4483	0.1703	0.4670

Table 4: Average marginal tax rates for social security

Year	Pension insurance	Health insurance	Employment insurance	Accident insurance	Care insurance	$MSST$	$ASST$
1980	0.0440	0.0348	0.0062	0.0061		0.0910	0.1137
1981	0.0444	0.0362	0.0063	0.0063		0.0931	0.1193
1982	0.0444	0.0363	0.0064	0.0061		0.0931	0.1218
1983	0.0430	0.0363	0.0064	0.0057		0.0914	0.1231
1984	0.0454	0.0361	0.0064	0.0056		0.0935	0.1238
1985	0.0515	0.0362	0.0065	0.0056		0.0998	0.1290
1986	0.0505	0.0360	0.0064	0.0056		0.0984	0.1316
1987	0.0495	0.0363	0.0064	0.0056		0.0978	0.1318
1988	0.0502	0.0376	0.0067	0.0057		0.1002	0.1316
1989	0.0539	0.0382	0.0068	0.0062		0.1050	0.1350
1990	0.0658	0.0373	0.0069	0.0062		0.1162	0.1419
1991	0.0599	0.0395	0.0070	0.0062		0.1125	0.1412
1992	0.0580	0.0389	0.0069	0.0061		0.1099	0.1414
1993	0.0612	0.0389	0.0057	0.0060		0.1118	0.1431
1994	0.0616	0.0391	0.0057	0.0058		0.1122	0.1449
1995	0.0684	0.0394	0.0057	0.0053		0.1189	0.1535
1996	0.0710	0.0392	0.0057	0.0052		0.1212	0.1550
1997	0.0700	0.0400	0.0057	0.0051		0.1208	0.1566
1998	0.0709	0.0396	0.0057	0.0048		0.1210	0.1584
1999	0.0708	0.0397	0.0057	0.0045		0.1207	0.1577
2000	0.0705	0.0408	0.0057	0.0045	0.0038	0.1252	0.1605
2001	0.0703	0.0404	0.0086	0.0043	0.0069	0.1305	0.1652
2002	0.0698	0.0404	0.0087	0.0042	0.0068	0.1300	0.1674
2003	0.0709	0.0432	0.0088	0.0037	0.0057	0.1323	0.1653

Table 5: Labor tax rates with social security premiums

Year	$MMTRL_0$	$MMTRL_1$	$MMTRL_\theta$	$AMTRL_\theta$
1980	0.2703	0.2727	0.2708	0.2935
1981	0.2791	0.2823	0.2797	0.3059
1982	0.2853	0.2880	0.2858	0.3144
1983	0.2839	0.2873	0.2845	0.3161
1984	0.2852	0.2885	0.2857	0.3160
1985	0.2931	0.2959	0.2936	0.3227
1986	0.3002	0.3041	0.3009	0.3341
1987	0.3008	0.3040	0.3014	0.3354
1988	0.2920	0.3035	0.2944	0.3258
1989	0.2966	0.3084	0.2990	0.3290
1990	0.3154	0.3277	0.3180	0.3437
1991	0.3161	0.3285	0.3187	0.3474
1992	0.3174	0.3307	0.3198	0.3513
1993	0.3181	0.3313	0.3203	0.3517
1994	0.3048	0.3172	0.3067	0.3395
1995	0.3005	0.3109	0.3020	0.3366
1996	0.3017	0.3119	0.3033	0.3372
1997	0.3098	0.3200	0.3113	0.3471
1998	0.3083	0.3181	0.3097	0.3471
1999	0.3000	0.3082	0.3011	0.3381
2000	0.3046	0.3125	0.3058	0.3410
2001	0.3088	0.3164	0.3098	0.3445
2002	0.3042	0.3127	0.3053	0.3427
2003	0.3011	0.3115	0.3026	0.3355

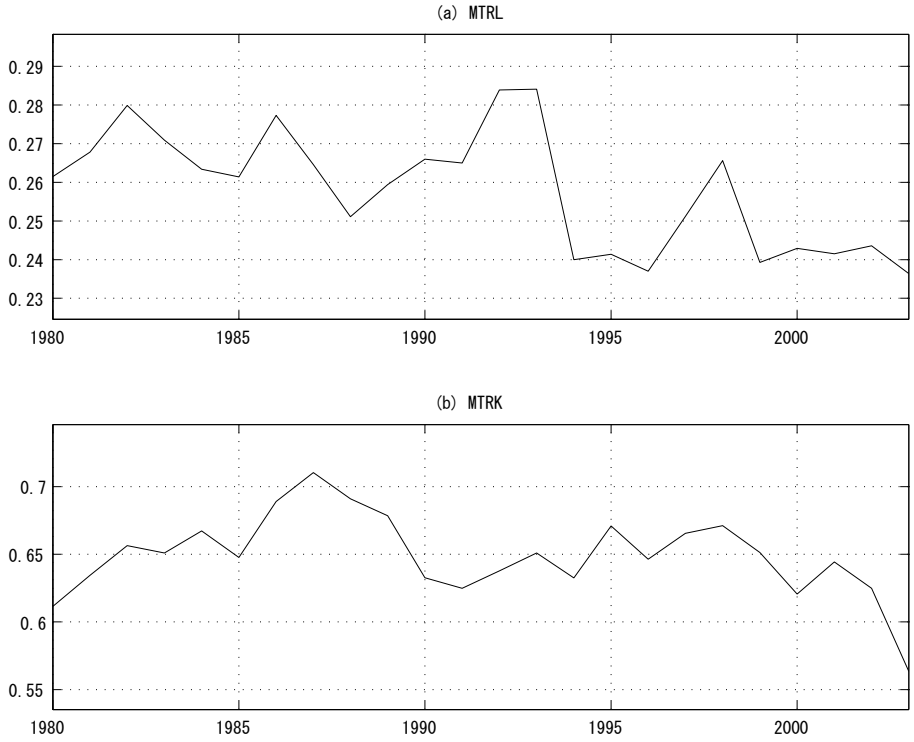

Figure 1: Average marginal tax rates for self-assessment income taxpayers

Note: (a) $MTRL$ and (b) $MTRK$ are the average marginal tax rates of self-assessment income taxpayers on labor and capital incomes, respectively.

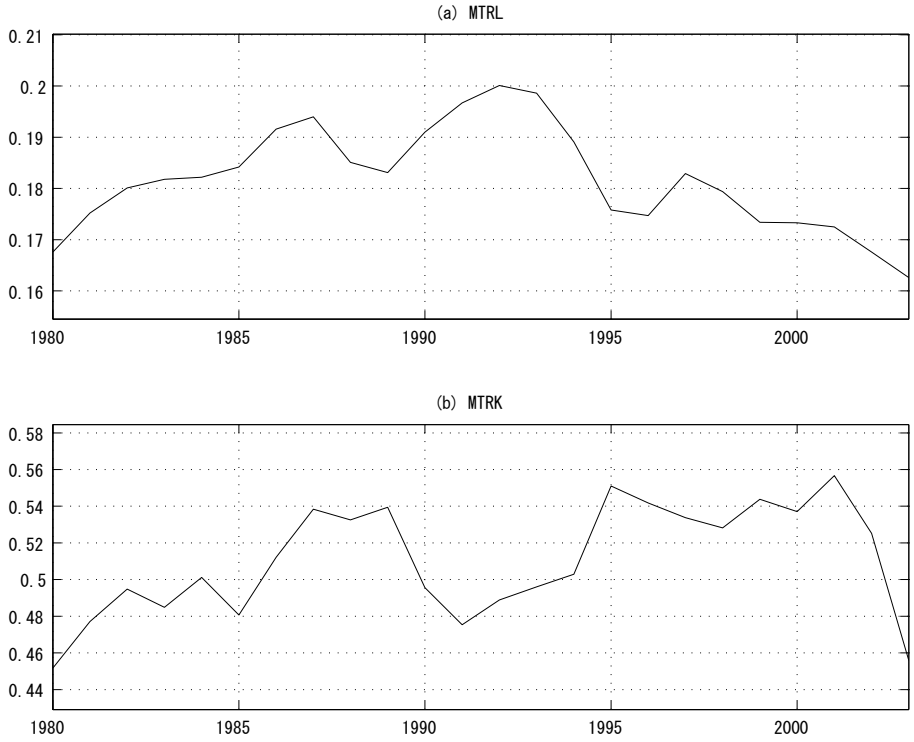

Figure 2: Average marginal tax rates for withholding income taxpayers

Note: (a) $MTRL$ and (b) $MTRK$ are the average marginal tax rates of withholding income taxpayers on labor and capital incomes, respectively.

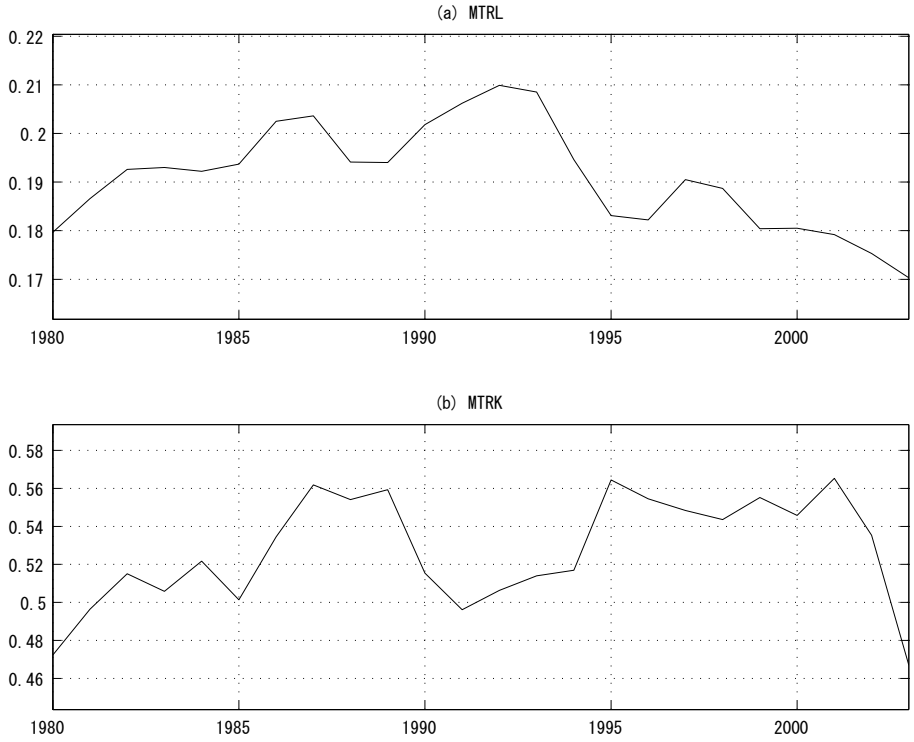

Figure 3: Total average marginal tax rates without social security premiums

Note: (a) $MTRL$ and (b) $MTRK$ are the total average marginal tax rates on labor and capital incomes, respectively.

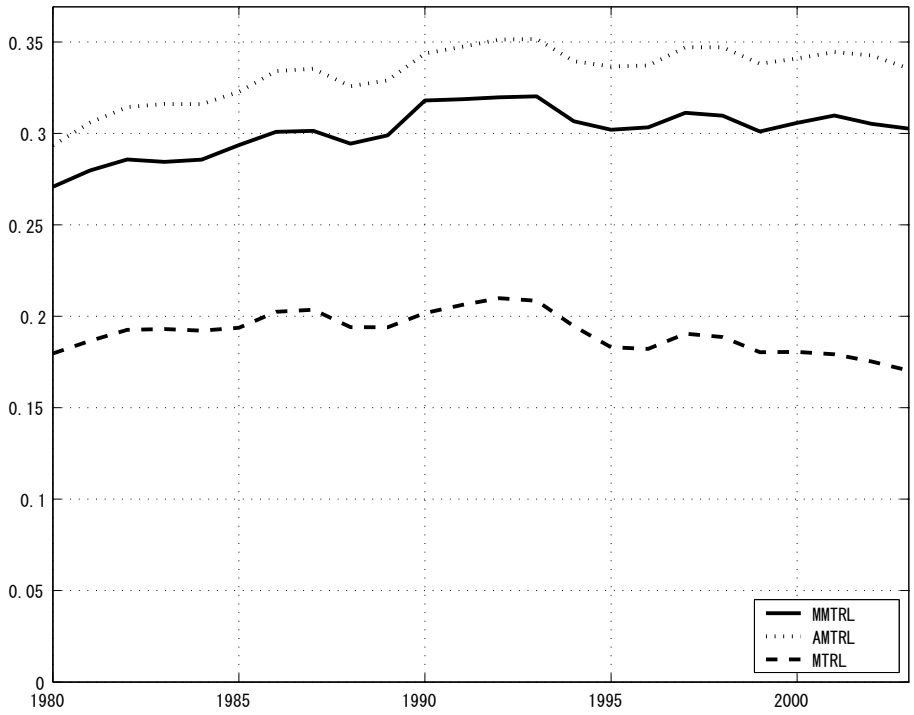

Figure 4: Average marginal tax rates on labor income with social security premiums

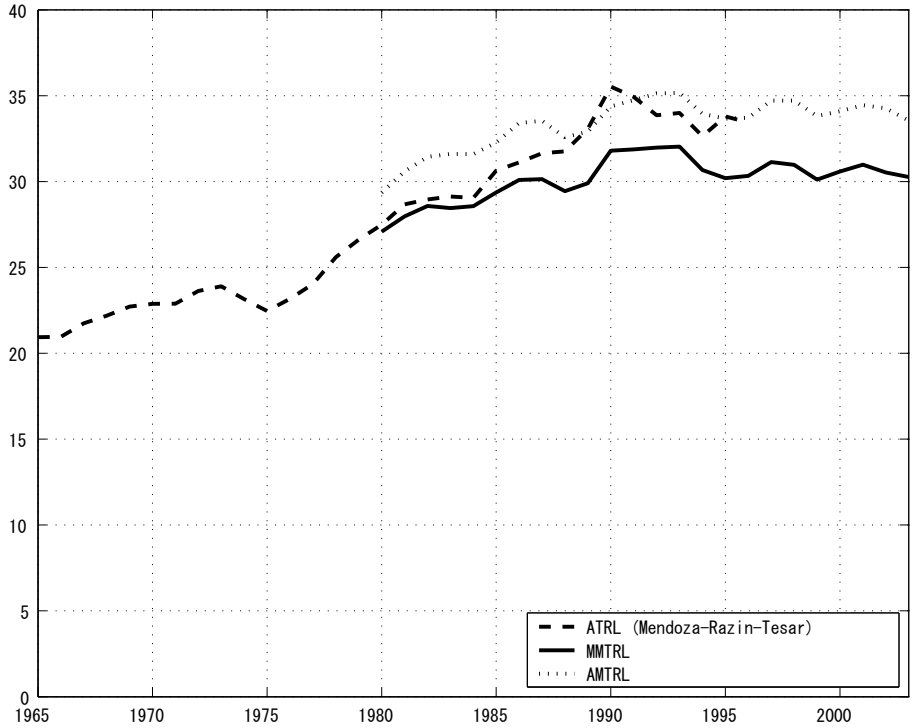

Figure 5: Marginal and average tax rates on labor income

Figure 6: Marginal and average tax rates on capital income

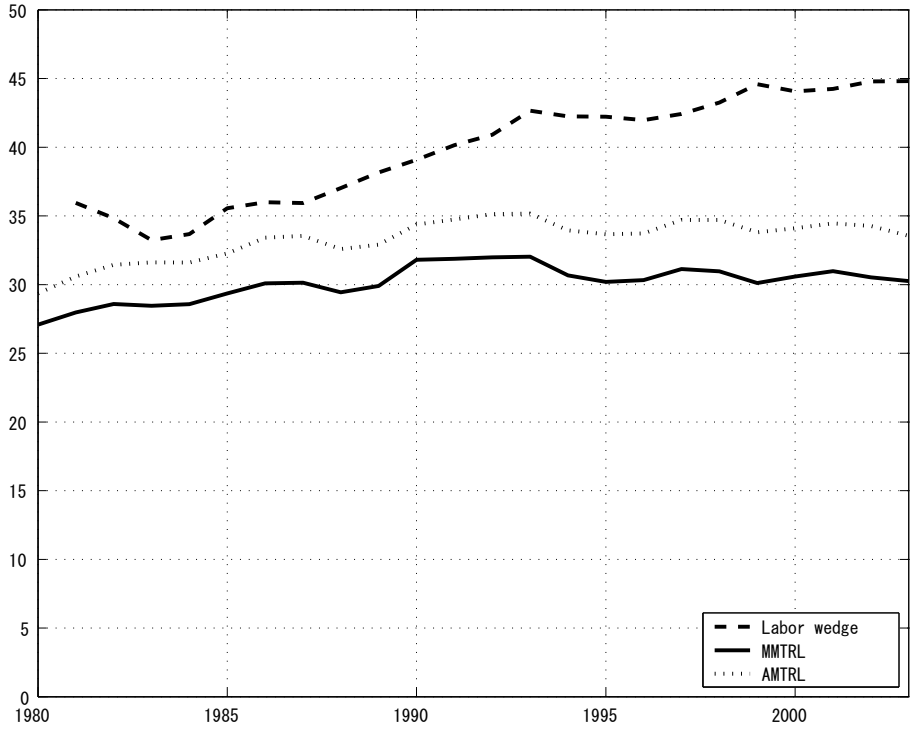

Figure 7: Marginal tax rates on labor income and labor wedges

Figure 8: Marginal tax rates on capital income and capital wedges