Has the Government Lowered the Hours Worked? Evidence from Japan

Ko, Jun-Hyung

April 2011

Has the Government Lowered the Hours Worked? Evidence from Japan

Jun-Hyung Ko *

April 2011

Abstract

Why does the hours worked show a decreasing pattern in the postwar Japanese economy? This paper answers this question in the background of the changing pattern of government spending and tax-imposing behaviors. We construct and simulate a standard optimal growth model with the following key features: various taxes and subsidies. Our main findings are as follows. First, we quantitatively find that the increasing pattern of taxes on labor income played a crucial role in influencing the declining pattern of hours worked in Japan. Second, consumption tax and subsidy have a limited role in explaining the labor supply because they cancel each other out. Third, pension benefit may influence the retirement of the people in their sixties but has a minor effect on the hours worked. Fourth, the legal reduction in the workweek length in 1990 can explain the low level of the hours worked since 1990. Fifth, subsistence consumption can account for the slope of hours worked but cannot explain the long-run level.

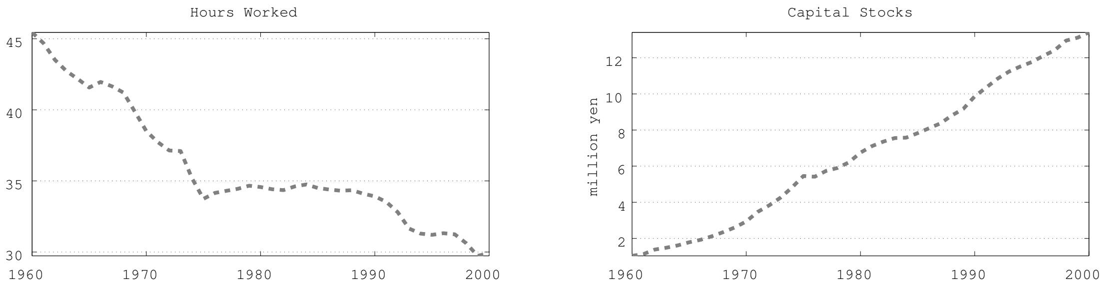
Keywords: marginal tax rate, subsidy, hours worked, pension benefit
JEL classification: E24; E32

*Graduate School of Economics, Hitotsubashi University

1 Introduction

The number of hours worked in the postwar Japanese economy has been dramatically decreasing consistently. The left panel in Figure 1 shows the hours worked between 1960 and 2000. Japan experienced a decline of more than 30 percent during this period. The objective of this paper is to find the main factors explaining the decreasing patterns observed in the data.

Figure 1: Hours Worked and Capital Stocks in the Postwar Japanese Economy



Note: The hours worked is measured by multiplying the average weekly hours with the employment rate. The employment rate is the fraction of workers in the population aged 20-69. The aggregate capital stock is divided by the GNP deflator and the working-age population. Following Hayashi and Prescott (2002), the aggregate capital stock is measured by summing the stock of the corporate sector and non-corporate sector, and the foreign capital.

A good starting point is to compare the economic conditions in the 1950s with those in the 2000s, based on a simple growth model. For example, King, Plosser, and Rebelo (1988) argue that in an economy with low initial capital, there are three effects that influence labor supply: (i) the initial wealth is low relative to its steady state level, (ii) the marginal product of labor is low relative to the stationary level, and (iii) the marginal product of capital is relatively high. The first and third factors induce the household to work additional hours while the second factor exerts the opposite influence. They show that the hours worked are relatively higher than the steady state level in a standard growth model because the first and third factors dominate before reaching the steady state. The right panel in Figure 1 displays the sequence of capital stocks in the postwar period. The capital stock in 1960 is less than 10 percent of the level in 2000.[1]

The second apporach to explain the historical movements of macro variables including the hours worked is total factor productivity (TFP). Chen, İmrohoroğlu, and İmrohoroğlu (2006, hereafter CII) find that the Japanese saving rates in the postwar economy are attributed to the time-varying growth rates of TFP as well as the low initially capital levels.[2] In their model, the time-varying TFP growth rates and the low initial stocks of capital successfully explain most of the postwar savings variation: the high level of savings in the 1960s and its decreasing pattern. However, as we will show in the latter sections, their model fails to replicate the decreasing pattern of hours worked. This indicates that the time-varying TFP and low initial capital levels are not extirely responsible.

What is the other factor that results in the decreasing pattern of labor supply? Prescott (2004) finds that the differences in the hours worked are consistent with the

[1]For example, Christiano (1989) and King and Rebelo (1993) also focus on the low initial stocks of capital in the postwar Japanese economy.

[2]Hayashi and Prescott (2002, hereafter HP) also argue that the decline in technology explains the lost decade in Japan, in particular, the output decline.

differences in labor income taxes and consumption taxes across time and G7 countries. Ohanian, Raffo, and Rogerson (2008, hereafter ORR) extend Prescott's work to 15 OECD countries and more time periods. They also find that differences in hours worked are consistent with differences in labor taxes and consumption taxes across time and the 15 OECD countries. Extending Prescott's work, Miyazawa (2010) finds that pension benefit plays an important role in explaining Japanese labor supply. However, they have some caveats. They calculated the tax effect using only the static intra-temporal equation of the household, and hence, cannot fully discuss the dynamic inter-temporal effect or the indirect effects from other sources in the general equilibrium model.

Otsu (2009) criticizes their results because the measured labor wedge in Japan hardly fits the sequence of the labor income tax. Instead, introducing the Stone-Geary utility function into the dynamic general equilibrium model, he finds that the decline in labor during the rapid growth period can be attributed to an income effect.[3] The households with high subsistence consumption level try to keep their minimum level of consumption. Therefore, they prefer working to enjoying leisure when their income levels are low.

In this paper, we show that the Japanese government's behaviors depressed the labor supply in the postwar Japanese economy. To accomplish this task, we extend the existing literature in several ways. First, rather than focusing only on the static first-order condition like Prescott (2004) and ORR (2008), we solve an entire model given the exogenous sequences of fiscal policy. In this spirit, we extend a standard optimal growth model of CII (2006).[4] In particular, we explicitly introduce government taxes such as labor income tax and consumption tax. Second, the model incorporates government subsidies.[5][6] In the existing literature, government transfer was assumed to be delivered to households only in the lump-sum form. In this paper, we separate government transfer into three components: consumption subsidy, leisure subsidy, and lump-sum transfer. Third, I compare the results of ORR (2008) and Otsu (2009), consolidating their key factors into our general equilibrium model. We identify which factor is quantitatively more important force between labor income tax and subsistence consumption.

The tax rates on factor incomes are taken from Gunji and Miyazaki (2011). Prescott (2004) assumed that the marginal tax rates in Japan are 1.6 times as large as the average tax rates. Kunieda (2010) criticizes that the marginal tax rates do not deviate much. Furthermore, the past works that identified the detrimental factor of the Japanese economy in the 1990s and the 2000s used average tax rates instead of marginal tax rates.[7] Therefore, Gunji and Miyazaki (2011) estimate the average marginal tax rates on the factor incomes in Japan from 1963 to the recent period. I use their tax rates on labor and capital incomes.

[3]Braun, Ikeda, and Joines (2008) introduce another important factor: the change in family scale. Using an overlapping generations model, they show that the decline in family sizes increases the representative family's utility weight on leisure relative to average consumption.

[4]CII (2006) only introduce the capital income tax in their model and assume that the other government revenues come from the lump-sum tax.

[5]With a slight abuse of notation, we use the terms "subsidy" and "transfer" interchangably in this paper. Thus in the definition of subsidy, we include government transfers such as national health insurance, laborer's insurance, and pensions.

[6]İmrohoroğlu and Sudo (2010) explicitly introduce many kinds of taxes but they degenerate labor supply and do not include government subsidies.

[7]For example, HP (2002).

The main findings are as follows. First, the changing dynamics of government taxes and subsidies have actually lowered the hours worked in the postwar Japanese economy. Second, among these changes, the increasing sequence of labor income taxes is quantitatively the most important factor in explaining the decreasing path of labor supply. Third, leisure subsidies such as unemployment compensation play a negligible role because of the relatively small volume. Fourth, the tax and subsidy on consumption expenditure cancel each other out, and seem to not have a direct relationship with the decreasing pattern of labor supply. Overall, our simulation of the hours worked in the benchmark model can capture the decreasing pattern of actual hours, though there is a slight discrepancy in the 1950s.

In the robustness check, we conduct three additional experiments. First, we consider the retirement behavior and pension benefit of the old generation. In the benchmark case, we assume that the public benefit is transfered to the households in the lump-sum form. We relax this assumption and allow the people in their 60s to quit jobs when the pension benefit increases. In the second experiment, following HP (2002), we introduce the reduction in the workweek length in 1990 in our model. We find that the pension benefit effect is minor, while the law effect is sizable. Third, we find that the relatively high level of hours worked in the 1960s can be explained by the income effect as discussed by Otsu (2009). Subsistence consumption can account for the slope of hours worked but cannot explain the actual level especially in the long run.

The paper proceeds as follows. Section 2 presents the model. Section 3 explains the data and calibration. Section 4 displays the benchmark results. Section 5 does a robustness check. Section 6 concludes.

2 Model

To compare our result with that of the existing literature such as CII (2006), we use the same type of a Cass-Koopmans growth model as used by these works. There is no difference between investment and savings because we assume a closed economy.

2.1 Technology

The representative firm operates as per the constant-returns-to-scale Cobb-Douglas production function:

$$Y_t = A_t K_t^{\theta} H_t^{1-\theta} = K_t^{\theta}(A_t^{\frac{1}{1-\theta}} H_t)^{1-\theta}, \tag{1}$$

where Y_t is the aggregate output, K_t is the aggregate capital, and $H_t(\equiv h_t N_t)$ is the aggregate labor input in date t.[8] A_t and $A_t^{\frac{1}{1-\theta}}$ denote the TFP and labor augmenting technology, respectively. The growth rate of labor augmenting technology is defined as $\gamma_t \equiv (A_{t+1}/A_t)^{\frac{1}{(1-\theta)}}$. The output share of capital is θ. The capital stock evolves according to the law of motion:

$$K_{t+1} = (1-\delta_t)K_t + X_t, \tag{2}$$

[8] h_t denotes the hours worked per working-age-person. It can be divided into the average weekly working hours and employment rate. However, this paper focuses on the decreasing pattern of the hours worked per working-age-person as a whole.

where X_t is the aggregate investment and δ_t is the depreciation rate of capital at time t.

To produce output, the firm rents capital and labor from the household. The maximization of profits yields the following factor prices:

$$r_t = \theta A_t K_t^{\theta-1} H_t^{1-\theta}, \tag{3}$$

$$w_t = (1-\theta) A_t K_t^{\theta} H_t^{-\theta}. \tag{4}$$

2.2 Household

The utility function of the representative household is given by

$$\sum_{t=0}^{\infty} \beta^t N_t \Big[\log(c_t - \bar{c}) + \xi \log(T - h_t) \Big], \tag{5}$$

where $\beta \in (0,1)$ is a subjective discount factor and N_t denotes the working population in date t. c_t denotes the consumption in date t and $\bar{c}$ is the subsistence level of consumption. T denotes the total hours and h_t is the labor supply.

The purchase of consumption-service is financed by the incomes on labor and capital, the government lump-sum transfer, and subsidies. The flow budget constraint for all t is given by

$$\begin{aligned}&(1+\tau_{c,t} - s_{c,t}) c_t N_t + X_t = \\ &(1-\tau_{h,t}) w_t h_t N_t + r_t K_t - \tau_{k,t}(r_t - \delta_t) K_t + TR_t - \tau_t N_t + s_{h,t}(T - h_t) N_t,\end{aligned} \tag{6}$$

where $\tau_{c,t}$, $\tau_{h,t}$, and $\tau_{k,t}$ denote the tax rates on consumption, labor and capital income, respectively, in date t. τ_t is the lump-sum tax whereas TR_t is the aggregate lump-sum transfer. $s_{c,t}$ and $s_{h,t}$ are the subsidy rates on consumption and leisure, respectively.

2.3 Government

The government imposes taxes on consumption and income from labor and capital along with a tax on lump-sum, and finances the exogenous streams of government purchases G_t, the lump-sum transfer TR_t, and the subsidies on consumption $s_{c,t}C_t$ and leisure $s_{h,t}(TN_t - H_t)$. Therefore, the government budget constraint in date t is as follows:

$$G_t + TR_t + s_{c,t}C_t + s_{h,t}(TN_t - H_t) = \tau_{h,t} w_t H_t + \tau_{k,t}(r_t - \delta_t) K_t + \tau_{c,t} C_t + \tau_t N_t. \tag{7}$$

2.4 Competitive Equilibrium

Given the government's fiscal policy $\{G_t, TR_t, s_{c,t}, s_{h,t}, \tau_{h,t}, \tau_{k,t}, \tau_{c,t}, \tau_t\}_{t=0}^{\infty}$, a competitive equilibrium consists of a set of allocations $\{C_t, H_t, X_t, K_{t+1}, Y_t\}$ and prices $\{w_t, r_t\}$ such that (i) the allocation solves the household's problem, (ii) the allocation solves the firm's profit maximization problem given the prices, (iii) the government budget is satisfied, and (iv) the goods market clears: $C_t + X_t + G_t = Y_t$.

3 Data and Calibration

We calibrate the model to the Japanese economy using the data provided by HP (2002) for the major variables.[9] Our simulation considers the actual capital output ratio in the initial period.[10] We use the data for the actual time path of the TFP and the population growth rates, depreciation rates, and government expenditure share. Following CII (2006), we set four parameters time-invariantly: the capital share of output, θ, the subjective time discount factor, β, the total discretionary hours in a week, T, and the share of leisure in the utility function, ξ.

3.1 Government Data

The actual subsidy data are obtained from 68SNA and 93SNA. The components of each subsidy are listed in Tables 1 and 2. Health insurances forms the biggest component of the consumption subsidies.[11] Unemployment compensation is included in the leisure subsidies. We use the information of the proportions among the total subsidy because we only have a fiscal-year data for each components. We assume that these fractions are the same as those for the calendar-year data.[12]

Table 1. Consumption Subsidy: $s_{c,t}C_t$

Health insurance and day laborers' health insurance
+ National health insurance
+ Old-age medical care
+ Health insurance run by private mutual associations
+ Children allowances

Data sources: 68SNA and 93SNA

Table 2. Leisure Subsidy: $s_{h,t}(T - h_t)N_t$

Laborers' insurance
- Workmen's accident compensation insurance

Data sources: 68SNA and 93SNA

The tax rates on factor incomes are taken from Gunji and Miyazaki (2011).[13] The consumption tax rates are obtained from Mendoza, Razin, and Tesar (1994).[14]

Figure 2 compares the capital income tax rates in Gunji and Miyazaki (2011) and Mendoza et al. (1994). CII (2006) and many other previous studies use the average tax rates taken from Mendoza et al. (1994). HP (2002) constantly set tax rates for capital incomes to 0.48. Esteban-Pretel et al. (2010) also set constant labor and capital income

[9] I updated some data following HP (2008).

[10] As the starting value for 1956, we take 0.77 for the capital-output ratio inclusive of the foreign capital, while CII (2006) take 1.37 exclusive of the foreign capital. There is a slight change in the saving rates in the 1950s and the 1960s. However, the main results are not affected by these two initial values.

[11] As discussed by Rogerson (2006), health insurance can be considered as a consumption subsidy because hospital burdens lower consumption expenditure.

[12] The total subsidy is defined as social security benefits. The inclusion of social assistance grants and unfunded employee welfare benefits does not change the result.

[13] The data can be downloaded as Excel files from their website.

[14] They only cover years 1965-1996. Following CII (2006), we assume that the tax rates for 1956 and 1964 equal their values in 1965 and that those for the 1997 and 2000 tax rates equal their values in 1996.

tax rates as 0.28 and 0.44. In these existing works, average tax rates were used in stead of marginal tax rates. Prescott (2004) assumes that the marginal tax rate is 1.6 times the average tax rate. In our model, we use marginal tax rates estimated by Gunji and Miyazaki (2011) because marginal tax rates are consistent with the model. Figure 2 shows that the average marginal tax rates in Gunji and Miyazaki (2011) are higher than the average tax rates. In particular, there is a bigger gap in the 1960s than in the 1990s. Both curves are increasing in the sample period.

Figure 2: Capital Income Tax Rates

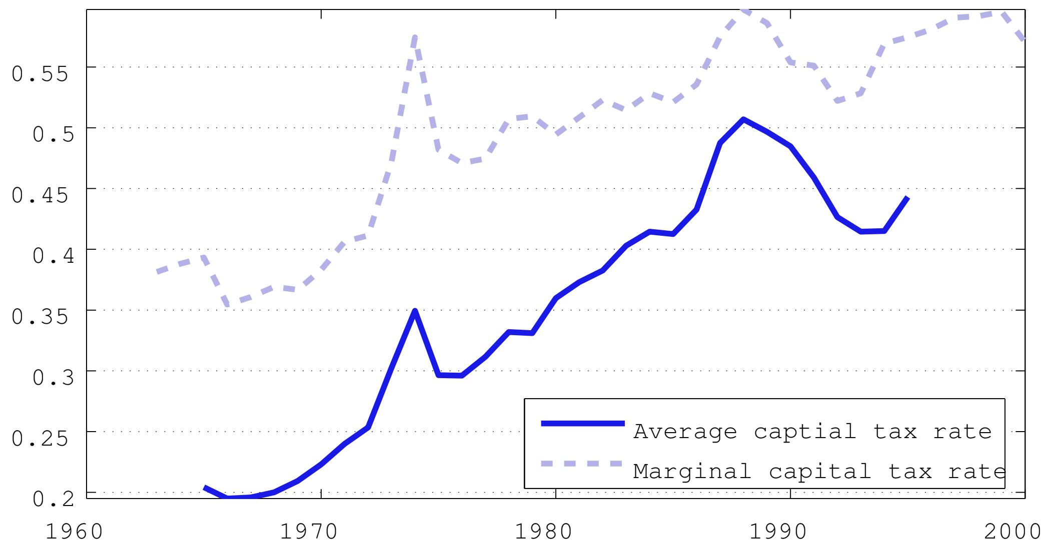


Figure 3: Taxes and Subsidies for Labor Income and Consumption

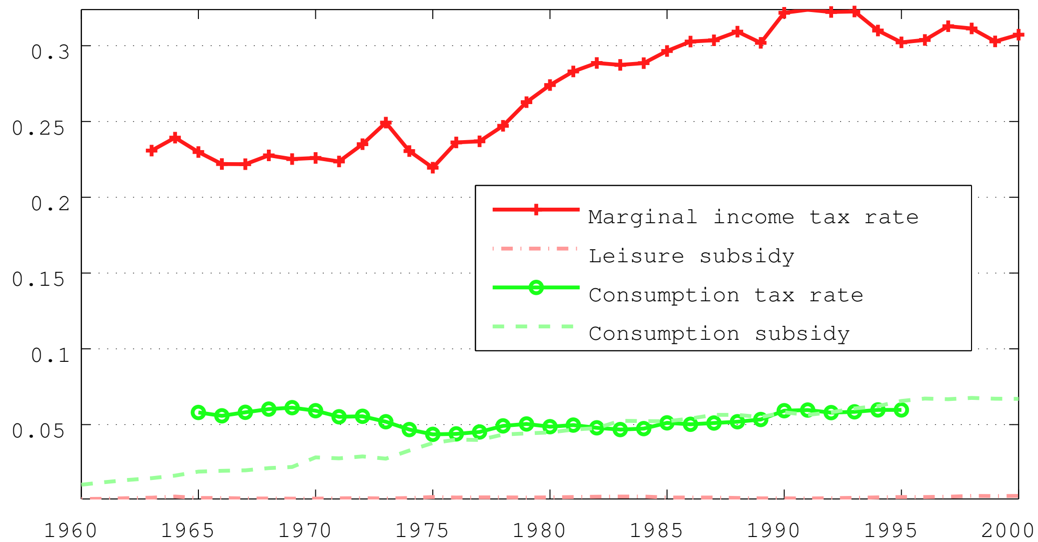


Figure 3 shows the taxes and subsidies on labor income and consumption expenditure. The average marginal tax rate on labor income starts to increase in the mid-1970s. This is because the social security burden increased in this period. The consumption tax rate is stable at around 5 percent. If we detrend the government subsidies, $s_{c,t}C_t$ and $s_{h,t}(TN_t - H_t)$, it becomes

$$\frac{s_{c,t}c_t}{A_t^{\frac{1}{1-\theta}}} = s_{c,t}\tilde{c}_t, \tag{8}$$

$$\frac{s_{h,t}(T - h_t)}{A_t^{\frac{1}{1-\theta}}} = \tilde{s}_{h,t}(T - h_t), \tag{9}$$

where $\tilde{s}_{h,t} \equiv s_{h,t}/A_t^{\frac{1}{1-\theta}}$.[15] The consumption subsidy is increasing because the amount of health insurance has risen. The leisure subsidy is also increasing throughout the sample period but the relative size is small. Furthermore, its volume is detrended by the TFP factor.

3.2 Subsistence Level

For subsistence consumption, a range of values have been assumed in the existing literature. For example, ORR (2008) and Christiano (1989) respectively set the subsistence level as 10 and 60 percent of the steady state consumption level. HP (2008) set the same as 85 percent of the agriculture consumption in 1985 in their analysis of the prewar Japanese economy. King, Plosser, and Rebelo (1993) set the value as 90 percent of the initial output. In our benchmark model, we follow Otsu (2009) who set the subsistence level in 1952 as 35 percent of the steady state consumption.

In the benchmark simulation, we use the actual time series data of tax rates and subsidies, and compare it with the artificial path under counterfactual simulations. If the subsidies on consumption and leisure are defined to be zero, it means that they are considered as lump-sum transfers. The following sections present the main numerical results. First, we show our benchmark results with various taxes and subsidies, and compare with the findings obtained in the existing literature. Second, as a counterfactual experiment, we conduct several simulations of partially taxed or subsidized cases.

4 Quantitative Findings

In this section, we present our main result with government taxes and subsidies. A comparison with CII (2006) is also made. Figure 4 displays the hours worked. The gray dashed line indicates the actual data. The red dash-dotted line is our benchmark result while the blue line is the result of CII (2006). Compared to CII (2006), we can observe more decreasing patterns of the hours worked in our benchmark model. This is mainly due to the fact that the explicit incorporation of taxes and subsidies lowers the steady state level of the hours worked. However, our simulated levels for the hours worked have some limitations with regard to explaining the actual data. The actual data shows a more steep slope until the mid-1970s, while the simulated path reaches the same level in the early 1980s. Moreover, the actual path shows a decline again in 1990. The historical events related to working hours reduction are a possibility, but are not considered in the

[15] For further details of detrending, see Appendix A.

benchmark model. For example, the adoption of five- or six-day workweek had spread by 1974.[16] Between 1988 and 1993, the number of hours worked was legally reduced.[17]

Figure 4: Hours Worked

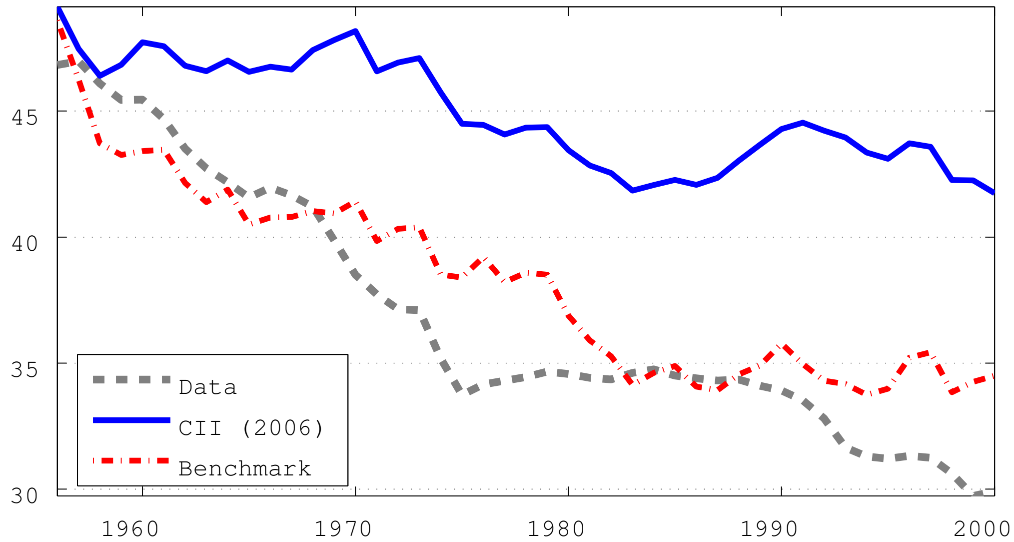
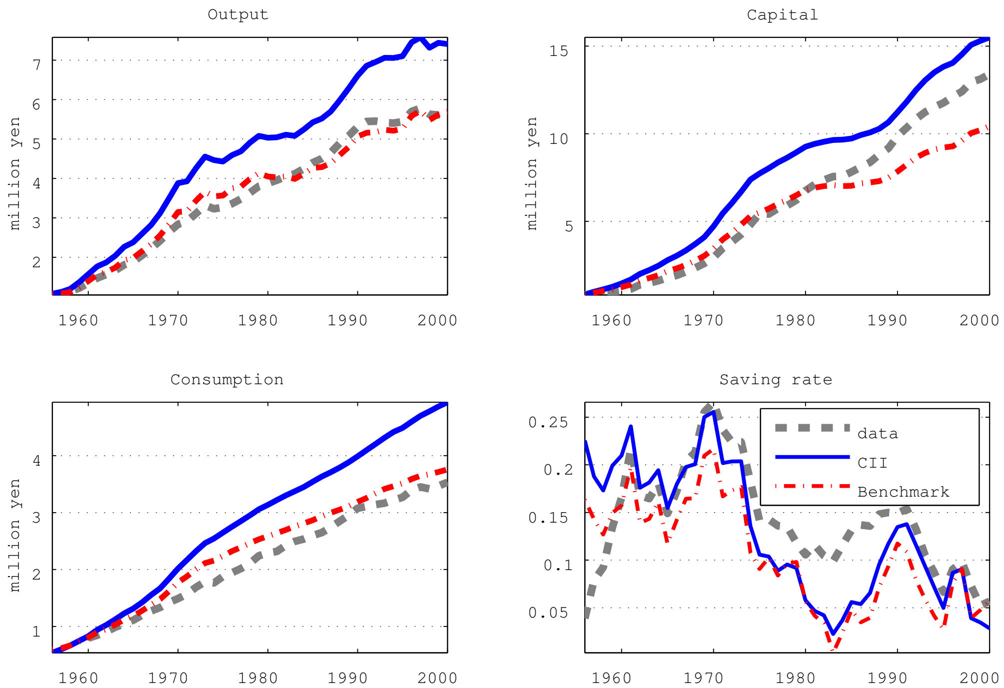


Figure 5 shows output, capital, consumption, and saving rate between 1960 and 2000.

Figure 5: Benchmark Results



Note: All macro variables are in terms of per working-age-person, divided by the GNP deflator and the working population. The defintion of the savings is the same as CII (2006).

[16] For details, see Watanabe (2006).
[17] For more discussion, see HP (2002).

The benchmark model captures the movements of the output and consumption more accurately than CII (2006) in all sample periods. Slight discrepancies between the data and benchmark results are seen in the 1970s and 1980s.[18] The model-generated output and consumption closely follow the actual data movements in the 1990s. Again, one of the main reasons is that distortionary taxes and subsidies lower the steady state and bring it close to the actual data series. Simulated capital closely follows the data until the early 1980s but became lower from then onwards. This is because the marginal tax rate on capital income is high. The saving rates of the two models are almost the same.

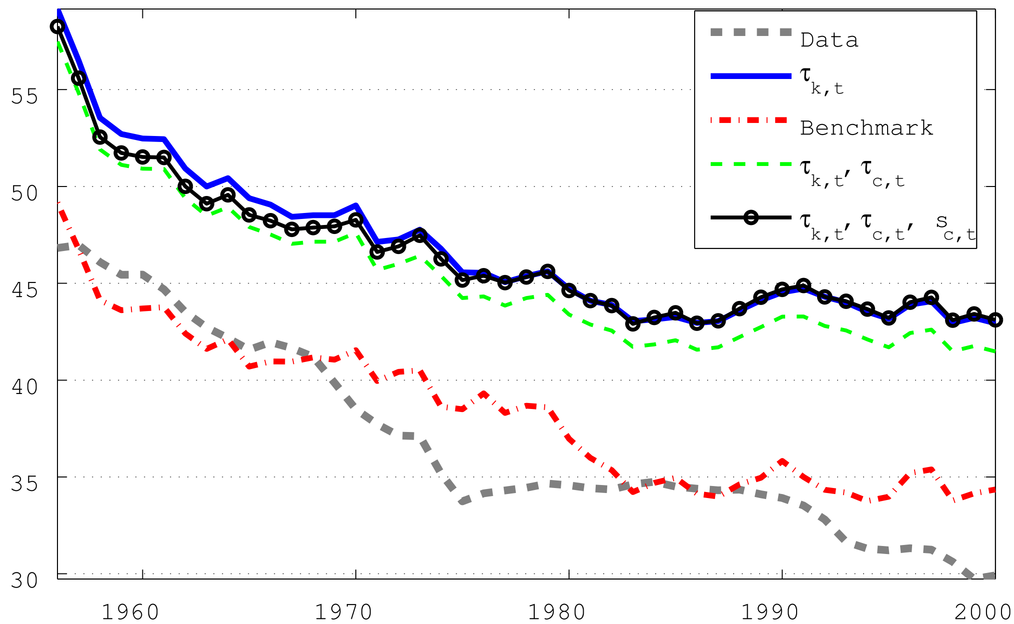
5 Counterfactual Simulation

In the previous subsection, we confirmed that the taxes and subsidies are important in explaining the decreasing pattern of hours worked. Now, we assess the relative importance of each tax and subsidy in explaining the decreasing pattern of hours worked. The analysis is conducted with the following modifications: (i) tax on labor income and leisure subsidy are excluded from the benchmark model and (ii) tax and subsidy on consumption expenditure are excluded from the benchmark model. These counterfactual experiments can identify which factor contributes the most to the benchmark result.

5.1 Importance of Consumption Tax and Subsidy

The first counter-factual simulation involves neither labor income tax nor leisure subsidy: $\tau_{h,t} = s_{h,t} = 0$ for all t. Figure 6 displays the hours worked with counterfactual simulations.

Figure 6: Counterfactual Simulation



Note: $\tau_{h,t}$ is the time-varying labor income tax rate. τ_c is the consumption tax rate. $\tilde{s}_h$ is the detrended leisure subsidy. s_c is the consumption subsidy.

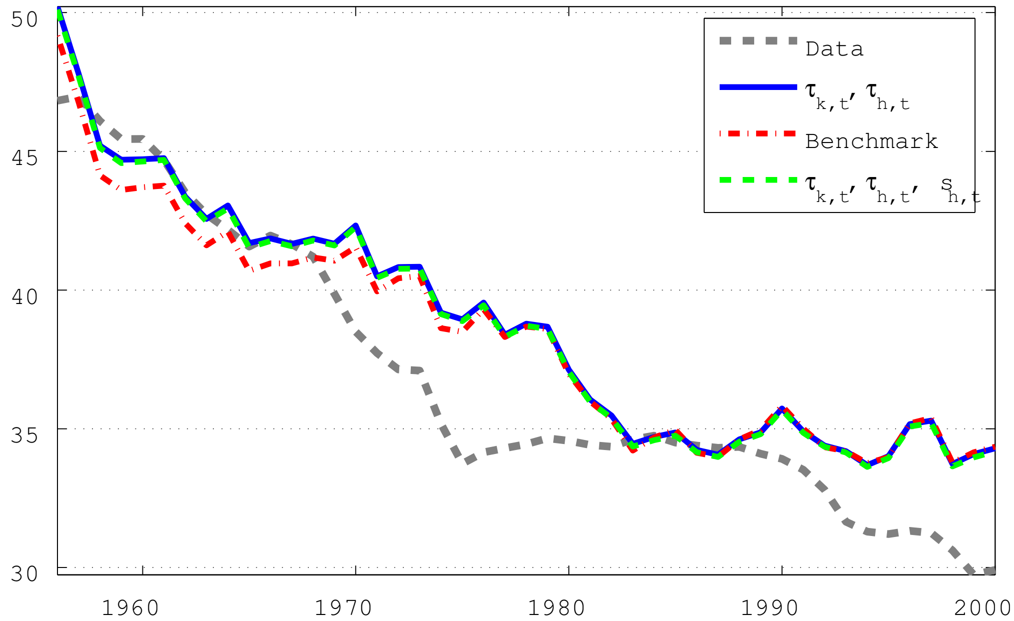
[18]HP (2002) show that the TFP contribution to the output is the lowest in 1973 and 1983.

There are two additional findings. First, neither consumpton tax nor consumption subsidy can explain the actual level of hours worked. In particular, the simulated level in 2000 deviates from the actual level by more then 10 hours. This is because the consumption tax and subsidy do not distort the Euler equation in the long run. Second, consumption tax and subsidy have opposite effects and cancel each other out. The actual volumes of consumption tax and subsidy are almost the same from the mid-1970s.

5.2 Importance of Labor Income Tax and Leisure Subsidy

The second counter-factual simulation involves neither consumption tax nor consumption subsidy: $\tau_{c,t} = s_{c,t} = 0$ for all t. Figure 7 displays the hours worked with counterfactual simulations.

Figure 7: Counterfactual Simulation



Note: $\tau_{h,t}$ is the time-varying labor income tax rate. τ_c is the consumption tax rate. $\tilde{s}_h$ is the detrended leisure subsidy. s_c is the consumption subsidy.

The figure yields at least two interesting findings. First, the increasing pattern of the tax rates on labor income can explain most of the decreasing pattern of labor supply. The tax rates on labor income in our model include the social security burden. Most of the increasng pattern of labor income tax rates can be explained by the social security burden, and hence, it is a crucial factor in the decreasing pattern of hours worked. Second, the results are insensitive to leisure subsidy because the actual volume of leisure subsidy is very limited.

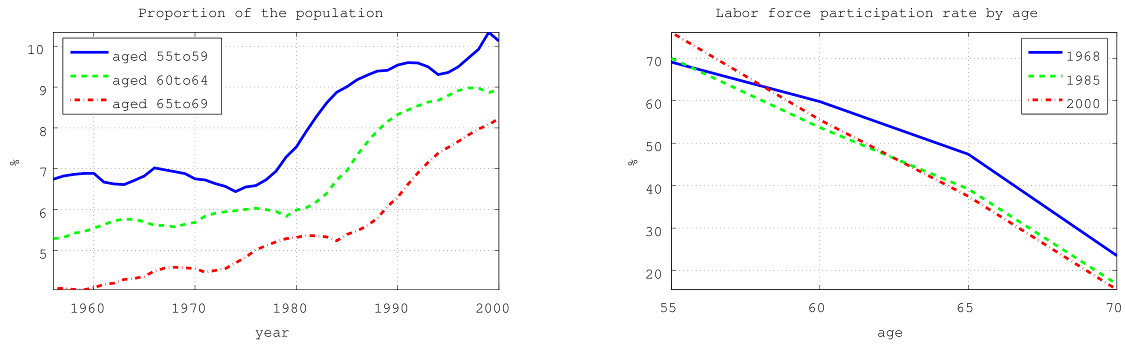
6 Robustness Check

In this section, we explore the sensitivity of our results. First, we study the relationship between retirement and pension benefit. Second, we incorporate the legal reduction in the workweek length in 1990. Third, we perform a sensitivity analysis of the subsistence level of consumption.

6.1 Social Security and Retirement

Japan has been experiencing demographic changes. The Japanese working-age population has been generally declining while the share of population in their 60s has been increasing. Moreover, the labor force participation rate of these older persons has been lowered. Figure 8 shows the increasing share of the people in their sixties among the 20 and 69 working-age population and the historical trend of the labor force participation rates by age group from 1968 to 2000.

Figure 8: Pension and Retirement



Note: The population data are taken from the Census. The labor force participation rate data are taken from the Labor Force Survey.

The share of those aged sixty and above generally declined during this period. Social security and retirement have a positive relationship.[19] Hongawa and Mori (1981) estimate that the elasticities of pension benefit to employment are between -0.15 and -0.291 for the age group 60-64 and between -0.601 and -0.68 by age group 65-69.

As such, we study how important the retirment decision of the people in their sixties is in accounting for the decreasing pattern in the sample period. Such people's retirement directly lowers the hours worked and hence, the pension benefits to them are assumed to be leisure subisidy. Rather than using the elasticity from the previous literature, we allow people aged 60 to 69 among the household members to respond to the pension benefit in our model. The data sources for the additional leisure subsidy are reported in Table 3.

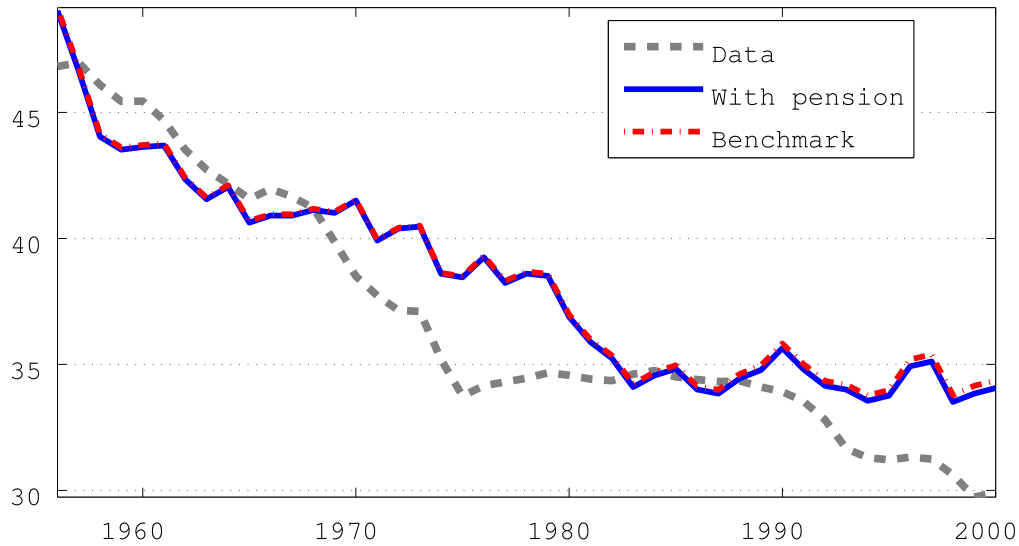
Table 3. Additional Leisure Subsidy: $s_{h,t}(T - h_t)N_t\frac{N_{60s,t}}{N_t}$

$s_{h,t}(T - h_t)N_t$:	Welfare pension
	+ National pension
	+ Laborers' insurance
	- Workmen's accident compensation insurance
	+ Seamen's insurance
	+ Mutual benefit association
	+ Pension Funds
	- Funds for casualty compensation
$N_{60s,t}$	Population of the people in their sixties

[19] For example, see Oshio and Yashiro (1999).

Data sources: 68SNA and 93SNA, Labor Force Survey, Tachibanaki and Shimono (1994), Yamagami (1996). I calculated the additional leisure subsidies by two age groups, 60 to 64 and 65 to 69. This is because the elasticity of employment probability to pensions is different.

Figure 9: Pension and Hours Worked



As we can see in Figure 9, the retirement effect of pension benefit does not generate a significant change in the hours worked in the Japanese economy. We can observe that the hours worked decreased slightly in the latter period than in the benchmark case. This result indicates that pension benefit may affect the retirement decision of the people in their sixties but the aggregate impact is not necessarily large.

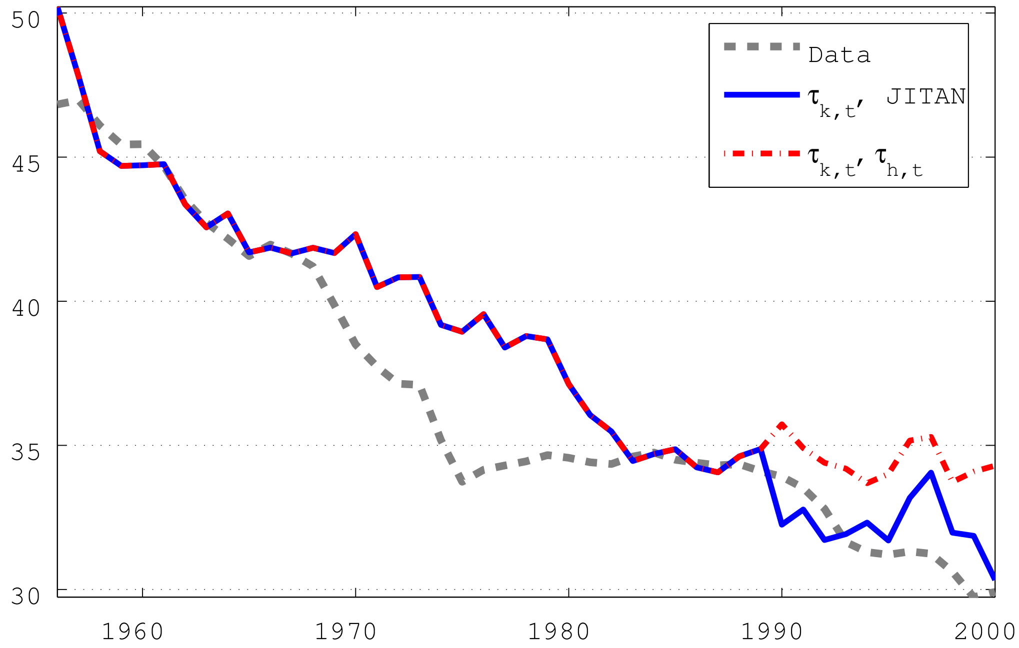
6.2 Revisiting HP (2002)

HP (2002) examine the Japanese economic stagnation in the 1990s. Besides the low productivity growth rate, they also consider the reduction in the workweek length from 44 hours to 40 hours between 1988 and 1993, called *Jitan*, brought about by the 1988 revision of the Labor Standards Law. The reduction in working days from six to five changed the aggregate variables including the hours worked. To analyse the effect of this law, HP (2002) divide hours worked into two parts: average working hours and employment rate. They assume that labor is indivisible and hence, a person either works or does not work at all. When the average working hours remained near 40, we can take a linear approximation of labor disutility around h = 40. Thus, we incorporate the effect of this law in the 1990s following HP (2002).[20]

Figure 10 displays the law effect. As discussed in HP (2002), Figure 10 indicates that the reduction in workweek length with shortened working hours is important to account for the shift in the hours worked in the 1990s.

[20]The simulation is conducted as follows. The economy solves the problem as in the benchmark case. In the early 1990, there is a sudden reduction in the workweek length. Thus, the households and firms reoptimize to converge to the new steady state. For further details of the model from 1990, see HP (2002).

Figure 10: Reduction in the Workweek Length



6.3 Income Effect

Otsu (2009) insists that taxes may be not the main force influencing labor decline in Japan. Calculating the labor wedge through business cycle accounting, he shows that the sequences of taxes and labor wedge are rather different. He shows that the model with Stone-Geary preferences can explain the labor decline during the rapid growth period through the strong income effects generated from the TFP growth and intratemporal non-homotheticity in consumption and leisure. Therefore, to examine the role of subsistence level in our model, we re-simulate the model for different subsistence levels.

Figure 11: Hours Worked with Various Subsistence Levels

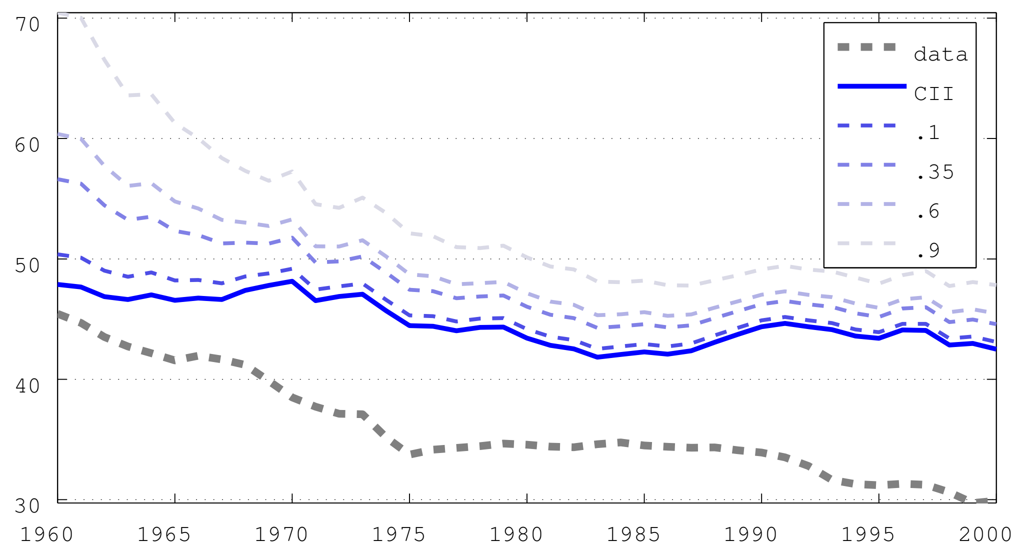


Figure 11 displays the results under various subsistence levels. In all cases, the hours worked converges to the zero subsistence consumption case. More importantly, the effect in the short run can be huge when the wealth is very low. Thus, the subsistence level of consumption may be important especially when explaining the observations in the 1960s.

Why does this happen?[21] This is because the steady state value is the same as in CII (2006). The detrended equilbrium conditions with the Stone-Geary utility function become

$$\frac{\tilde{c}_{t+1} - \tilde{\bar{c}}_t}{\tilde{c}_t - \tilde{\bar{c}}_t} = \frac{(1 + \tau_{c,t} - s_{c,t})}{(1 + \tau_{c,t+1} - s_{c,t+1})\gamma_t} \beta [1 + (1 - \tau_{k,t+1})(\theta \kappa_{t+1}^{\theta-1} - \delta_{t+1})], \tag{10}$$

$$\frac{\xi(\tilde{c}_t - \tilde{\bar{c}}_t)}{T - h_t} = (1 - \theta)\kappa_t^{\theta} \frac{(1 - \tau_{h,t})}{(1 + \tau_{c,t})(1 - s_{c,t})} - \tilde{s}_{h,t}, \tag{11}$$

where $\tilde{\bar{c}}_t = \bar{c}/A_t^{\frac{1}{1-\theta}}$. The intra-temporal equation as well as the Euler equation are now influenced by the subsistence level. Note that $\tilde{\bar{c}}_t$ converges to zero because the denominator is time-increasing. Therefore, the household does not care about $\tilde{\bar{c}}_t$ in the long run, and consumption converges to the steady state level of CII (2006).

7 Concluding Remarks

We have studied the role of government subsidies and taxation on the hours worked in the standard neo-classical growth model. In the presence of increasing sequences of labor-income tax, lump-sum transfer, and several subsidies, the labor supply may decrease. Hence, the government may have a close relationship with the labor market. The fundamental contribution of this paper is as follows. First, from the simulation of a general equilibrium model, we find that the increasing pattern of taxation on labor income actually leads to the decreasing pattern of the hours worked. Second, the expenditure on social security such as unemployment subsidy played a negligible role because of its small size. Third, we find a small contribution of taxes and subsidy on consumption on the hours worked because they cancel each other out.

We also perform three robustness checks: (i) the relationship between retirement and pension benefit, (ii) the law-enforced reduction in workweek length, and (iii) the sensitivity of subsistent consumption level. I find that legal reduction can explain large proportion of hours worked in the 1990s but pension benefit has a minor role. Moreover, we find that the subsistence level alone cannot explain the long-run level of hours worked.

There are several remaining issues that need to be resolved in the future. First, in this paper, we only focus on the supply side. The demand side or labor market structures can influence the hours worked.[22] Second, our representative household model cannot explain the inter-generational effect. The intergenerational effects including pension problems may have important role especially in the future. Third, the anticipation

[21] Otsu (2009) has two major differences from our model. First, there is no government in his model. For example, consumption in his model consists of government as well as private consumption. Government investment is also included in the gross domestic capital formation. Second, the simulation method is different. He uses the method of undetermined coefficients to compute the linear decision rules of the detrended endogenous variables.

[22] Esteban-Pretel, Nakajima, and Tanaka (2010) analyze the demand side of labor market with search frictions. However, working hours are exogenous in their model.

impacts of taxation and subsidies may be important. For example, Watanabe, Watanabe, and Watanabe (2001) find that 80 percent of the Japanese consumers respond tax changes at the time of their implementation and not at the time of policy announcement. Future work should analyze how these additional factors can account for the unexplained parts.

References

[1] Braun, R. A., D. Ikeda, and D. Joines, 2009, "The Saving Rate in Japan: Why it has fallen and why it will remain low," *International Economic Review* 50(1), pp. 291-321.

[2] Chen, K., A. İmrohoroğlu, and S. İmrohoroğlu, 2006, "The Japanese Saving Rate," *American Economic Review*, 96 (5), pp. 1850-1858.

[3] Chen, K., A. İmrohoroğlu, and S. İmrohoroğlu, 2007, "The Japanese Saving Rate between 1960 and 2000: Productivity, Policy Changes, and Demographics," *Economic Theory*, 32, pp. 87-104.

[4] Christiano, L., 1989, "Understanding Japan's Saving Rate: The Reconstruction Hypothesis," *Federal Reserve Bank of Minneapolis Quarterly Review*, 13 (Spring), pp. 10-25.

[5] Esteban-Pretel, J., R. Nakajima, and R. Tanaka, 2010, "TFP growth slowdown and the Japanese labor market in the 1990s," *Journal of the Japanese and International Economies*, 24 (1), pp. 50-68.

[6] Gunji, H. and K. Miyazaki, 2011, "Estimates of Average Marginal Tax Rates on Factor Incomes in Japan," *Journal of the Japanese and International Economies* forthcoming.

[7] Hayashi, F. and E. Prescott, 2002, "The 1990s Japan: A Lost Decade," *Review of Economic Dynamics*, 5 (1), pp. 206-235.

[8] Hayashi, F. and E. Prescott, 2008, "The Depressing Effect of Agricultural Institutions on the Prewar Japanese Economy," *Journal of Political Economy*, 116 (4), pp. 573-632.

[9] Hongawa, A. and T. Mori, 1981, "Kounenreisyano Syuugyourituehenkani Kansuru Youinbunseki," *Roudoutoukeichousageppou*, 38, pp. 4-21. (in Japanese)

[10] İmrohoroğlu, S. and N. Sudo 2010, "Productivity and Fiscal Policy in Japan: Short Term Forecasts from the Standard Growth Model," *IMES Discussion Paper Series*, No. 2010-E-23.

[11] King, R., C. Plosser, and S. Rebelo, 1988, "Production, Growth and Business Cycles: I. The Basic Neoclassical Model," *Journal of Monetary Economics*, 21 (2-3), pp. 195-232.

[12] King, R. and S. Rebelo, 1993, “Transitional Dynamics and Economic Growth in Neoclassical Economies,” *American Economic Review*, 83 (4), pp. 908-931.

[13] Mendoza, E., A. Razin, and L. Tesar, 1994, “Effective Tax Rates in Macroeconomics: Cross Country Estimates of Tax Rates on Factor Incomes and Consumption”, *Journal of Monetary Economics*, 34 (3), pp. 297-323.

[14] McDaniel, C., 2006, “Effective Tax Rates for 15 OECD Countries: 1950-2003,” Arizona State University, mimeo.

[15] Miyazawa, K., 2010, “Pension Benefit and Hours Worked,” Research Institute of Economy, Trade and Industry (RIETI), Discussion papers 10004.

[16] Ohanian, L., A. Raffo, and R. Rogerson, 2008, “Long-Term Changes in Labor Supply and Taxes: Evidence from OECD Countries, 1956-2004,” *Journal of Monetary Economics*, 55 (8), pp. 1353-1362.

[17] Oshio, T., and N. Yashiro, 1999, “Social Security and Retirement in Japan, ” *NBER Chapters*, in: Social Security and Retirement around the World, pp. 239-267.

[18] Otsu, K., 2009, “A Neoclassical Analysis of the Postwar Japanese Economy,” *The B.E. Journal of Macroeconomics*: 9 (1), contributions, Article 20.

[19] Prescott, E. C., 2004, ”Why do Americans work so much more than Europeans? *Federal Reserve Bank of Minneapolis Quarterly Review*, 28 (1), pp. 2-13.

[20] Rogerson, R., 2006, “Understanding differences in hours worked,” *Review of Economic Dynamics*, 9 (3), pp. 365-409.

[21] Watanabe, K, T. Watanabe, T. Watanabe, 2001, “Tax Policy and Consumer Spending: Evidence From Japanese Fiscal Experiments,” *Journal of International Economies*, 53 (2), pp. 261-281.

[22] Watanabe, S, 2006, “Roles of Technology and Nontechnology Shocks in the Business Cycles,” *IMES*, No. 06-E-11.

Appendix A: Equilibrium Conditions

For convenience, if we define $\kappa_t \equiv \frac{K_t}{A_t^{\frac{1}{1-\theta}} H_t} = \frac{k_t}{A_t^{\frac{1}{1-\theta}} h_t}$, the capital return and wage rates are given as

$$r_t = \theta \kappa_t^{\theta-1}, \tag{12}$$

$$w_t = (1-\theta) A_t^{\frac{1}{1-\theta}} \kappa_t^{\theta}. \tag{13}$$

Optimal allocation and implication

The first-order conditions of the representative household are as follows

$$\frac{c_{t+1} - \bar{c}}{c_t - \bar{c}} = \frac{(1 + \tau_{c,t} - s_{c,t})}{(1 + \tau_{c,t+1} - s_{c,t+1})} \beta [1 + (1 - \tau_{k,t+1})(\theta \kappa_{t+1}^{\theta-1} - \delta_{t+1})], \tag{14}$$

$$\frac{\xi (c_t - \bar{c})}{T - h_t} = w_t \frac{(1 - \tau_{h,t})}{(1 + \tau_{c,t} - s_{c,t})} - s_{h,t}, \tag{15}$$

$$\lim_{t \to \infty} \lambda_t \beta^t k_t = 0. \tag{16}$$

The resource constraint becomes

$$K_{t+1} = (1 - \delta_t) K_t + (1 - \Psi_t) A_t K_t^{\theta} H_t^{1-\theta} - C_t, \tag{17}$$

where $\Psi_t \equiv \frac{G_t}{Y_t}$.

We consider a transition from the given condition to a balanced growth path at which the per working-age-person variables grow at the rate $A_t^{\frac{1}{(1-\theta)}}$. For an aggregate variable Z_t, its detrended version is given by $\tilde{z}_t = \frac{Z_t}{A^{\frac{1}{1-\theta}} N_t}$. The equilbrium conditions become[23]

$$\frac{\tilde{c}_{t+1} - \tilde{\bar{c}}_{t+1}}{\tilde{c}_t - \tilde{\bar{c}}_t} = \frac{(1 + \tau_{c,t} - s_{c,t})}{\gamma_t (1 + \tau_{c,t+1} - s_{c,t+1})} \beta \{1 + (1 - \tau_{k,t+1})(\theta \kappa_{t+1}^{\theta-1} - \delta_{t+1})\}, \tag{18}$$

$$\tilde{k}_{t+1} n_t \gamma_t = [(1 - \delta_t) + (1 - \Psi_t) \kappa_t^{\theta-1}] \tilde{k}_t - \tilde{c}_t. \tag{19}$$

$$\frac{\xi (\tilde{c}_t - \tilde{\bar{c}}_t)}{T - h_t} = (1 - \theta) \kappa_t^{\theta} \frac{(1 - \tau_{h,t})}{(1 + \tau_{c,t} - s_{c,t})} - \tilde{s}_{h,t}. \tag{20}$$

Appenidx B: Steady State

Are the characteristics in the steady state different from that in the existing literature? The equations (18), (19), and (20) in the steady state become

$$\gamma = \beta \{1 + (1 - \tau_k)(\theta \kappa^{\theta-1} - \delta)\}, \tag{21}$$

$$\tilde{k} n \gamma = [(1 - \delta) + (1 - \Psi) \kappa^{\theta-1}] \tilde{k} - \tilde{c}. \tag{22}$$

$$\frac{\xi \tilde{c}}{T - h} = (1 - \theta) \kappa^{\theta} \frac{(1 - \tau_h)}{(1 + \tau_c - s_c)} - \tilde{s}_h. \tag{23}$$

---

[23] Since $Y_t = \left(\frac{K_t}{A_t^{\frac{1}{1-\theta}} H_t} \right)^{\theta-1} K_t = \kappa_t^{\theta-1} K_t$, $\frac{Y_t}{A^{\frac{1}{1-\theta}} N_t} = \kappa_t^{\theta-1} \tilde{k}_t$.

Alternatively $\tilde{y}_t = \frac{Y_t}{A_t^{\frac{1}{1-\theta}} N_t} = A_t \left(\frac{K_t}{A^{\frac{1}{1-\theta}} N_t} \right)^{\theta} \frac{H_t^{1-\theta}}{(A_t^{\frac{1}{1-\theta}} N_t)^{1-\theta}} = \tilde{k}_t^{\theta} h_t^{1-\theta}$.

The first and second equations are the same as in CII (2006). However, the intra-temporal constraint is distorted by both the taxes on labor income and consumption expenditure and the subsidies on leisure and consumption.

The right-hand side of equation (23) is increasing in the higher values of s_c and decreasing in the higher values of τ_h, τ_c, and $\tilde{s}_h$. The left-hand side of equation (23) determines the relative choice of consumption and leisure. Therefore, if the government imposes higher taxes on labor income and consumption expenditure or provides a bigger subsidy on leisure, the household chooses leisure rather than consumption in the long run. This is quite unlike the lump-sum tax and transfer.

Appendix C: Equilibrium Conditions under the Economy as Considered in HP (2002)

In the spirit of HP (2002), we incorporate the reduction in working hours to around 40 hours and the decrease in days of work. We assume that the labor disutility can be written as follows:

$$g_t(l_t; z_t)e_t, \tag{24}$$

where $g_t(l_t; z_t)$ is the distutility of labor dependent on working hours, l_t, and days of work, z_t, and e_t is the employment rate. The intra-temporal condition of the representative household is thus given as follow

$$g_t(l_t; z_t)(c_t - \bar{c}) = w_t \frac{(1-\tau_{h,t})}{(1+\tau_{c,t}-s_{c,t})} l_t - s_{h,t} l_t. \tag{25}$$

If we consider the assumption made by HP (2002), the disutility function becomes $g_t(l_t; z_t) = \frac{\alpha}{40} l_t$. Following HP (2002), we also assume that the steady state is influenced by the reduction in the workweek length. We calibrate α such that the steady state level of hours worked is 30 hours. Consequently, detrended equilbrium conditions become

$$\frac{\alpha}{40}(\tilde{c}_t - \tilde{\bar{c}}_t) = (1-\theta)\kappa_t^{\theta} \frac{(1-\tau_{h,t})}{(1+\tau_{c,t}-s_{c,t})} - \tilde{s}_{h,t}. \tag{26}$$

Therefore,

$$\kappa_t = \left\{ \left[\frac{\alpha}{40}(\tilde{c}_t - \tilde{\bar{c}}_t) + \tilde{s}_{h,t} \right] \frac{(1+\tau_{c,t}-s_{c,t})}{(1-\theta)(1-\tau_{h,t})} \right\}^{\frac{1}{\theta}}. \tag{27}$$

The inter-temporal condition and the resource constraint are the same as before:

$$\frac{\tilde{c}_{t+1} - \tilde{\bar{c}}_{t+1}}{\tilde{c}_t - \tilde{\bar{c}}_t} = \frac{(1+\tau_{c,t}-s_{c,t})}{\gamma_t(1+\tau_{c,t+1}-s_{c,t+1})} \beta\{1 + (1-\tau_{k,t+1})(\theta\kappa_{t+1}^{\theta-1} - \delta_{t+1})\}, \tag{28}$$

$$\tilde{k}_{t+1} n_t \gamma_t = [(1-\delta_t) + (1-\Psi_t)\kappa_t^{\theta-1}]\tilde{k}_t - \tilde{c}_t. \tag{29}$$

Simulation

Since 1956, the economy solves the benchmark model. In 1990, there is a sudden exogenous reduction in the work week length. The economy evolves under this changed scenario. The simulation is conducted until the path converges to the new steady state.