論　文

Uninsured Risk, Stagnation and Fiscal Policy*

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Abstract

Japan is in the midst of a protracted spell of depressed economic activity. Japan's economic stagnation has occurred against a background of rising earnings risk. Occupational stability is falling as routine occupations disappear and implicit lifetime employment guarantees are gradually disappearing. At the same time earnings in some high-skilled occupations have continued to grow. The resulting polarization in earnings has also been accompanied by an increase in wealth inequality. We develop a framework that relates these observations. In our model, an increase in uninsured earnings risk depresses output and increases wealth inequality. We then analyze the efficacy of alternative fiscal measures in terms of their ability to increase economic activity, reduce wealth inequality, and improve welfare. We find that a lower tax rate on capital achieves all of these objectives.

JEL Codes：E13, E16, D31
Keywords：Economic Stagnation, Wage Polarization, Wealth Inequality

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非保険リスク、長期停滞と財政政策について

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〈要 旨〉

1990 年代以降、20 年以上にわたって、日本経済は停滞を続ける一方で、所得格差の拡大を経験してきた。安定した職は減少し、終身雇用制が消失しつつある一方で、高度な知識やスキルを必要とする職の賃金は上昇してきた。そのような所得の 2 極化は富の格差の増大にもつながってきた。本論文ではこれらの現象と整合的な理論モデルの構築を行った。我々のモデルでは、所得リスクの増大が GDP の減少と富の格差の増大をもたらす。そのモデルを用いて、様々な財政政策の効果を比較検討した。主要な発見は、資本に対する税率を減らすことで、GDP の上昇、富の格差の減少、そして、経済厚生の改善をもたらしうるということである。

JEL 分類コード：E13，E16，D31
キーワード：長期停滞、所得の 2 極化、富の格差

1. Introduction

Japan finds itself in the midst of a protracted episode of economic stagnation. Per capita GDP growth averaged 0.73% between 1994 and 2014. This figure is low relative to Japan's previous experience in the post WWII period and also low relative to the experience of other advanced economies between 1994 and 2014. Understanding the reasons for Japan's economic stagnation and developing appropriate prescriptions for government policy is of general interest because other advanced economies have also experienced a slowdown in economic growth since the collapse of Lehman Brothers in 2008.

Economic stagnation has occurred against a background of higher earnings risk and wage polarization in other advanced economies. Kamborouv and Manovskii (2008) document a secular decline in occupation stability and a concurrent increase in earnings inequality in the U.S. Autor, Katz and Kearney (2006, 2008) provide evidence of a secular polarization of wages in the U.S. They find that wage inequality at the top of the wage distribution is growing. However, wage inequality in the left tail of the distribution is not. Furthermore, they provide evidence that wage polarization is associated with a decline in the demand for medium-skilled workers in routine occupations. Jaimovich and Siu (2012) show that employment losses in routine occupations are concentrated in recessions in the U.S.

Inequality in earnings and wage inequality has also been increasing in Japan. Lise *et al.* (2012) find that household earnings inequality increased by 3.8 log points between 1991 and 2008. Wage inequality of individuals is also increasing among higher-paid male and female workers. The picture is a bit more complex for lower-paid workers. Wage inequality among lower-paid male workers is increasing, but it is failling among lower-paid women. Kambayashi, Kawaguchi, and Yamada (2012) attribute the decline in wage inequality among these female workers to a concentration of women in minimum wage jobs and to a steady increase in the minimum wage between 1991 and 2008.

Furthermore, Japan is experiencing job losses in medium-skilled routine occupations. Ikenaga and Kambayashi (2010) document a secular reallocation of workers from routine to non-routine skilled jobs between 1960 and 2005. Furukawa and Toyoda (2013) determine that this reallocation is concentrated during recessions periods and

that job losses in routine occupations are responsible for jobless recoveries. These factors have been compounded by an erosion in implicit life-time employment guarantees and an increase in the fraction of workers with temporary jobs.

The final data observation that we wish to point to is rising wealth inequality. Piketty (2014) provides evidence that wealth inequality in advanced economies has risen sharply and suggests that taxes on capital should be increased. Ohtake et al. (2013) confirm this result for Japan. According to their analysis, wealth inequality increased between 1984 and 1989, decreased between 1989 and 1994 and increased again between 1994 and 2004. Lise *et al.* (2013) find a small but steady decline in the share of wealth held by the bottom 10 percent from approximately 0 in 1984 to −1 percent in 2004. The share of wealth held by the top 10 percent, in contrast, rises from 40 to 45 percent over the same period.

Our paper has two objectives. First, we use a model to show that economic stagnation, increasing wealth inequality, and wage polarization could all be related. The research described above suggests that rising earnings inequality is concentrated in medium-skilled routine occupations. Our model reproduces this observation by endowing households with unskilled labor and skilled labor. We assume that the latter form of labor is special because it can be augmented via investment but is subject to household specific non-diversifiable risk. An increase in the variance of this risk produces earnings polarization.

Earnings polarization depresses output because households are risk averse. When the risk of investing in human capital increases, they choose to invest more of their savings in physical capital and less in human capital. The resulting misallocation of investment acts to depress aggregate output and consumption.

In our model, an increase in uninsured earnings risk also increases wealth inequality. Households of all income levels choose to save the same fixed proportion of their earnings. Thus, an increase in the risk of investing in human capital not only produces higher earnings inequality and but also higher wealth inequality. Taken together, these results imply that an increase in earnings polarization can result in both economic stagnation and higher wealth inequality.

Our second objective is to analyze how fiscal policy can ameliorate the negative effects of higher earnings risk on economic activity, inequality and welfare. We compare policies that stimulate output with policies that provide more social insurance to the poor. One way to deal with wage polarization is to reduce tax rates. Lower

tax rates stimulate economic activity, However, if other forms of government spending are held fixed, as we assume, then government transfers to the poor will also decline. An alternative way to deal with wage polarization is for the government to help poor households cope with higher earnings risk by increasing public transfers to the poor. Higher public transfers, however, require additional tax revenue and incerasing tax rates depress economic activity. Using a version of our model that is calibrated to Japan, we find that households prefer lower tax rates and in particular a lower capital tax rate even though this means that households receive less social insurance.

The fact that households prefer lower capital taxes is noteworthy. Carey and Tchilinguirian (2000) update and revise the effective tax rate data of Mendoza, Razin and Tesar (1994) find that Japan has some of the highest overall tax rates on capital income among advanced economies[1]. Based largely on concerns from businesses, the Abe administration has recently legislated reductions in the overall tax rate on capital by reducing corporate profits taxes. Corporate profits taxes are gradually being reduced from 37 percent in 2013 to 29.74 percent in 2018. Although reducing the tax rate on capital, improves the incentives for firms to undertake investment, this policy runs counter to the advice of Piketty (2014) who argues that the capital tax rate should be increased to improve equity.

This leads us to consider what if any tradeoffs arise between efficiency and equity in our model. We find that lowering the overall tax rate on capital in Japan from its current level of about 63 percent, to a level as low as 45 percent increases welfare and reduces wealth inequality.

A lower tax rate on capital increases the ability of agents to self-insure against low earnings because the after tax return on their savings increases. Poverty among the elderly declines, and thereby reducing overall wealth inequality.

The nature of the tradeoff between equity and efficiency depends on the specific instrument. For instance, if the consumption tax rate is reduced, instead wealth inequality increases. We find that the most effective ways to deal with the higher earnings risk faced by Japanese workers are to reduce tax rates on labor and/or capital. Both policies stimulate economic activity, reduce wealth inequality, and increase welfare[2].

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[1] Japan has the second highest overall tax rate on capital using net operating surplus after Canada and the third highest tax rate using gross operating profit after Canada and the U.K.

[2] Large reductions in the capital tax rate to levels below 0.12 result in welfare losses in our model. In other words, the optimal tax rate on capital is positive in our setting.

Our model builds on previous research by Krebs (2003), Angeletos and Panousi (2009), Toda (2014), Gottardi, Kajii, and Nakajima (2015), and Nirei and Aoki (2016). To capture job polarization we assume that households are endowed with two types of labor : skilled and unskilled. Unskilled labor is not risky but earns a low wage rate. Skilled labor can be enhanced over time by investing in human capital; however, these investments are risky and subject to idiosyncratic uninsurable risk. Households can self-insure against their risky investments in human capital by acquiring physical capital. The economy faces no aggregate risk. However, the amount of resources that households are willing to allocate to investing in risky human capital varies with the extent of uninsured risk. If the level of uninsured risk increases, households respond by reducing their investment in human capitall and increasing their investment in physical capitall; this has a depressing effect on output and consumption. To analyze the effects of alternative fiscal policies, we model proportionate taxes on labor income (skilled and unskilled), capital income, and consumption. The government uses this income to finance government purchases, fund public transfer programs, and to pay interest on government debt.

The remainder of the paper is organized as follows. Section 2 describes the model. Section 3 contains our main results, and Section 4 presents our concluding remarks.

2. The model economy

Households

We consider a continuum of households of measure one. Each household dies with a constant probability; as in research by Blanchard (1985), we assume that actuarially fair life insurance is available for everyone. At each instant of time, new households are born so that the population size of each type is constant (unity). There are no aggregate shocks.

At every point in time, each household supplies two types of labor: skilled and unskilled. The amount of unskilled labor is constant and denoted by $L>0$. The amount of skilled labor (in efficiency units) changes over time, which we call "human capital." The accumulation of human capital is a risky activity, and subject to idiosyncratic, uninsurable risks.

Households may hold two types of assets: a risk-free (financial) asset, b, and human capital, h. A new born household is endowed with $h_0>0$ units of human capital but no

financial assets. Consider a household that is born at time s (call it household (i, s)). Her lifetime expected utility is given by

$$E_s\int_s^{\infty} e^{-(\rho+p)(t-s)} \ln c(i, s, t)dt, \tag{1}$$

where $\rho>0$ is the time discount rate; $p>0$ is the death rate; and $c(i, s, t)$ is the amount of consumption at time t of household (i, s).

Let $b(i, s, t)$ and $h(i, s, t)$ be the amount of the risk-free asset and human capital that household (i, s) holds at time t respectively. Each household is subject to different forms of taxes. Let $\tau_c(t)$ denote the consumption tax at time t, $\tau_r(t)$ the tax rate on interest income, and $\tau_w(t)$ the tax rate on labor income (common across skilled and unskilled labor). Furthermore, there are also lump sum public transfers $\tau(t)$, which are identical across (living) households.

Define $r(t)$ to be the before-tax interest rate, $w_h(t)$ the before-tax wage rate for skilled labor; and $w_l(t)$ the before-tax wage rate of unskilled labor. The after-tax rates of these variables are then

$$\begin{aligned} \tilde{r}(t) &\equiv r(t)(1-\tau_r(t)), \\ \tilde{w}_h(t) &\equiv w_h(t)(1-\tau_w(t)), \\ \tilde{w}_l(t) &\equiv w_l(t)(1-\tau_w(t)). \end{aligned} \tag{2}$$

The flow budget constraint at time t is expressed as

$$\begin{aligned} &(1+\tau_c(t))c(i, s, t)dt+dh(i, s, t)+db(i, s, t) \\ &=\left[(\tilde{r}(t)+p)b(i, s, t)+\tilde{w}_l(t)L+\tau(t)+(\tilde{w}_h(t)-\delta_h)h(i, s, t)\right]dt+\sigma h(i, s, t)dz(i, s, t), \end{aligned} \tag{3}$$

where $\delta_h>0$ is the (constant) depreciation rate of human capital. The riskiness of investments in human capital is reflected in the stochastic term $\sigma h(i, s, t)dz(i, s, t)$, where $z(i, s, t)$ is the standard Brownian motion and $\sigma>0$ is the constant that measures the amount of the risk. The risk is idiosyncratic so that $z(i, s, t)$ is independent across households.

Define $T(t)$ by

$$T(t)\equiv\int_t^{\infty}\exp\left\{-\int_t^s\left[\tilde{r}(u)+p\right]du\right\}\left[\tilde{w}_l(s)L+\tau(s)\right]ds, \tag{4}$$

so that

$$T'(t)=-\left[\tilde{w}_l(t)L+\tau(t)\right]+\left[\tilde{r}(t)+p\right]T(t). \tag{5}$$

Now let $a(i, s, t)$ be the total wealth held by household (i, s) at time t:

$$a(i, s, t)\equiv b(i, s, t)+T(t)+h(i, s, t), \tag{6}$$

and let $\eta(i, s, t)$ be the share of human capital:

$$\eta(i, s, t) \equiv \frac{h(i, s, t)}{a(i, s, t)}. \tag{7}$$

Then the flow budget constraint becomes

$$\begin{aligned}(1+\tau_c(t))c(i, s, t)dt + da(i, s, t) \\ = \left[(\tilde{r}(t)+p)(1-\eta(i, s, t)) + (\hat{w}_h(t)-\delta_h)\eta(i, s, t)\right] a(i, s, t)dt \\ + \sigma\eta(i, s, t)a(i, s, t)dz(i, s, t).\end{aligned} \tag{8}$$

Note that the amount of "initial wealth" held by a newborn household at time s is $a(i, s, s) = a_0 \equiv h_0 + T(s)$.

Since there are no aggregate stochastic shocks in the economy, the real interest rate $\tilde{r}(t)$ and the wage rate $\hat{w}_h(t)$ are deterministic processes that depend only on time t. Thus, the value function for each household is expressed as a function $J(a, t)$, which depends on the value of total wealth a and time t. Let $\eta_c = (1+\tau_c)c/a$. The Bellman equation is

$$\begin{aligned}0 = \max_{\eta_c, \eta} \ln\left(\frac{\eta_c a}{1+\tau_c(t)}\right) - (\rho+p)J(a, t) + J_t(a, t) \\ + J_a(a, t)\left[(\tilde{r}(t)+p)(1-\eta) + (\hat{w}_h(t)-\delta_h)\eta - \eta_c\right]a + \frac{1}{2}J_{aa}(a, t)\sigma^2\eta^2a^2.\end{aligned} \tag{9}$$

Let $A(s, t)$ be the average amount of wealth held at time t by households born at time s. Its evolution is given as

$$\frac{dA(s, t)}{dt} = \left[(\tilde{r}(t)+p)(1-\eta(t)) + (\hat{w}_h(t)-\delta_h)\eta(t) - (\rho+p)\right]A(s, t). \tag{10}$$

Let $A(t)$ be the aggregate wealth for the economy at time t. Since each household dies at rate p, aggregate wealth is given by

$$A(t) = \int_{-\infty}^{t} A(s, t)pe^{p(s-t)}ds. \tag{11}$$

Firms

We assume perfectly competitive firms produce a single good with a constant-returns-to-scale technology:

$$F(k, h, l) = zk^{\alpha}h^{\beta}l^{1-\alpha-\beta}, \tag{12}$$

where z is a constant, k is the input of physical capital, h is the input of skilled labor (human capital); l is the input of unskilled labor; and α, β are constant share parameters with $\alpha, \beta > 0$ and $\alpha+\beta < 1$. The aggregate output at time t is

$$Y(t) = zK(t)^{\alpha}H(t)^{\beta}L^{1-\alpha-\beta}, \tag{13}$$

where $K(t)$ and $H(t)$ are aggregate stocks of physical and human capital, respectively. The factor market equilibrium requires

$$\begin{aligned} \hat{r}(t) &= \alpha z K(t)^{\alpha-1} H(t)^{\beta} L^{1-\alpha-\beta} - \delta_k, \\ \hat{w}_h(t) &= \beta z K(t)^{\alpha} H(t)^{\beta-1} L^{1-\alpha-\beta}, \\ \hat{w}_l(t) &= (1-\alpha-\beta) z K(t)^{\alpha} H(t)^{\beta} L^{-\alpha-\beta}. \end{aligned} \tag{14}$$

Government

The government issues debt $D(t)$, consumes goods $G(t)$, makes lump sum public transfers $\tau(t)$, and imposes taxes on consumption, labor, and capital income at the rates $\tau_c(t)$, $\tau_w(t)$, and $\tau_r(t)$, respectively. It follows that the government's flow budget constraint is

$$\begin{aligned} \dot{D}(t) + \tau_r(t) r(t) [K(t) + D(t)] + \tau_w(t) w_h(t) H(t) + \tau_w(t) w_l(t) L + \tau_c(t) C(t) \\ = G(t) + r(t) D(t) + \tau(t). \end{aligned} \tag{15}$$

where $C(t)$ is the aggregate consumption of households.

Equilibrium

Having completed the description of the economy, we can now define a competitive equilibrium.

Definition 1 : Competitive Equilibrium

A competitive equilibrium consists of an allocation $\{c(i, s, t), a(i, s, t), \eta(i, s, t)\}$, a price system $\{r(t), w_h(t), w_l(t), \hat{r}(t), \hat{w}_h(t), \hat{w}_l(t)\}$, and a fiscal policy $\{G(t), D(t), \tau(t), \tau_c(t), \tau_w(t), \tau_r(t)\}$ such that (i) given the price system and fiscal policy, the allocation $\{c(i, s, t), a(i, s, t), \eta(i, s, t)\}$ solves the utility maximization problem for each (i, s) ; (ii) firms maximize profits, that is, (14) holds for all t; (iii) the fiscal policy is feasible, that is, it satisfies the government's flow budget constraint (15) as well as the boundary condition: for each t,

$$\lim_{u \to \infty} \exp\left(- \int_t^u \hat{r}(s) ds \right) D(u) = 0 ;$$

and (iv) all markets clear.

In the analysis that follows, we will consider a particular type of competitive equilibrium in which government policy is constant.

Definition 2 : Steady State Competitive Equilibrium

A steady state equilibrium is a competitive equilibrium in which (i) the fiscal policy is constant: $G(t)=G$, $D(t)=D$, $\tau(t)=\tau$, $\tau_c(t)=\tau_c$, $\tau_w(t)=\tau_w$ and $\tau_r(t)=\tau_r$ for all t; and (ii) the aggregate variables are constant: $C(t)=C$, $\eta(t)=\eta$, $H(t)=H$, $K(t)=K$, $A(t)=A$, $Y(t)=Y$ for all t [3].

Welfare

We will evaluate welfare from the perspective of a newborn household. In the steady state, the value function of an individual with wealth a is given by

$$J(a)=\frac{1}{\rho+p}\ln a+\phi, \tag{16}$$

where

$$\phi=\frac{1}{\rho+p}\left\{\ln\left(\frac{\rho+p}{1+\tau_c}\right)-1\right\}+\frac{1}{2(\rho+p)^2}\left\{\left(\frac{\hat{w}_h-\delta_h-\hat{r}-p}{\sigma}\right)^2+2(\hat{r}+p)\right\}. \tag{17}$$

Thus, the welfare of a new born household in the steady state, $\bar{U}$, is

$$\begin{aligned}\bar{U}&=\frac{1}{\rho+p}\ln(h_0+T)+\phi\\&=\frac{1}{\rho+p}\left\{\ln\left(h_0+\frac{\tau+\hat{w}_l L}{\hat{r}+p}\right)+\ln\left(\frac{\rho+p}{1+\tau_c}\right)-1\right\}\\&\quad+\frac{1}{2(\rho+p)^2}\left\{\left(\frac{\hat{w}_h-\delta_h-\hat{r}-p}{\sigma}\right)^2+2(\hat{r}+p)\right\}.\end{aligned} \tag{18}$$

Wealth Distribution

We are interested in how the distribution of wealth is affected by increases in uninsured earnings risk as well as fiscal policy. The distribution of wealth, $a(i, s, t)$, can be derived using a result by Toda (2014). Using Ito's lemma, the evolution of $\ln a(i, s, t)$ is expressed as

$$d\ln a(i, s, t)=\mu_a\, dt+\sigma_a\, dz(i, s, t), \tag{19}$$

where

$$\begin{aligned}\mu_a &\equiv (\hat{r}+p)(l-\eta)+(\hat{w}_h-\sigma_h)\eta-(\rho+p)-\frac{1}{2}\sigma^2\eta^2,\\ \sigma_a &\equiv \sigma\eta.\end{aligned} \tag{20}$$

Thus, the steady state log wealth distribution $x=\ln a-\ln a_0$ has the density function given by ($a_0\equiv 1+T$)

[3] A complete description of the equilibrium conditions is available from the authors upon request.

$$f(x)=\frac{p}{\kappa\sigma_a}\exp\left(-\frac{\kappa|x|}{\sigma_a}+\frac{\mu_a x}{\sigma_a^2}\right), \tag{21}$$

where

$$\kappa\equiv\sqrt{2p+\frac{\mu_a^2}{\sigma_a^2}}. \tag{22}$$

Its mean and variance are given as follows:

$$\begin{aligned}\text{mean} &= \frac{\mu_a}{p},\\ \text{variance} &= \left(\frac{\sigma_a^2}{\kappa\sigma_a-\mu_a}\right)^2+\left(\frac{\sigma_a^2}{\kappa\sigma_a+\mu_a}\right)^2.\end{aligned} \tag{23}$$

3. Results

Having described the model and derived its steady state equilibrium, we are now in a position to apply the model to investigate the role of uninsured earnings risk in accounting for economic stagnation. Recall from the introduction that recent empirical work in Japan and the U.S. has found that the earnings distribution of medium- and highly skilled occupations is diverging. Wages in medium-skilled routine occupations are declining, whereas wages in higher-skilled nonroutine occupations are increasing. Low-skilled jobs show no evidence of divergence. Wage polarization has been accompanied by a secular increase in wealth inequality. Various economic mechanisms can account for these phenomena in isolation, but we believe that we are the first to provide a comprehensive theory that can account both for this micro-evidence of high earnings and wealth inequality and link it to the macro-economic evidence of stagnation.

Parameterization of the model

Although our model has a rich set of implications, this comes at a cost. We are unable to compute closed-form solutions for the steady state. Instead, we must resort to numerical methods. This, in turn, requires us to assign specific numerical values to each model parameter. The specific values of the parameters we use are reported in Table 1. We briefly summarize the rationale for our choices. The model period is one year, and thus, we thus set ρ the preference discount rate to ρ at 0.03 per year. This value is close to values used in the real business cycle literature. Hayashi and Prescott

Table 1: Model Parameter Values

A. Parameters that Govern Preferences and Technology

Parameter	ρ	p	α	β	δ, δ_h	σ
Value	0.03	0.01195	0.3	0.45	0.085	0.246

B. Fiscal Policy Parameters

Parameter	G/GDP	Debt/GDP	τ_r	τ_w	τ_c
Value	0.21	1.5	0.63	0.32	0.08

(2002), for instance, use a value of 0.036 per year. Our choice is also close to values used in the New Keynesian literature. Christiano, Eichenbaum, and Evans (2005), for instance, also assume a value of 0.03 per year.

The World Health Organization reports that life expectancy in Japan was 83.7 years in 2013. This implies that $p=0.01195$. Estimates of α, the capital share parameter in the production function, range from 0.25 to approximately 0.4. Our value of 0.3 lies in the middle of this interval. The human capital share β is set at 0.45. Thus, the overall labor share in the production function is 0.7. The depreciation rate for physical and human capital is set at 0.085. This value is close to the value of 0.089 that is reported by Hayashi and Prescott (2002). We assume that the relative endowments of initial human capital and unskilled labor are four to one and the initial amount of uninsured earnings risk in human capital accumulation σ is 0.246, which is the 1991 value of household earnings dispersion in Japan reported by Lise *et al.* (2014).

The fiscal policy parameters are chosen in the following way. The overall tax rate on capital τ_r, is set at 0.63. This value lies between the value of 0.836 estimated by Caray and Tchilinguirian (2000) and the value of 0.544 estimated by Braun and Joines (2015). The overall labor tax rate τ_w including SS and medical contributions is set at 0.32. This is the OECD estimate of the overall labor wedge in Japan for the year 2014. The consumption tax rate τ_c, is set at its 2015 statutory value of 0.08. The government purchase share of output is set at 0.21. This is its value in the calendar year of 2014. Finally we set the debt-to-GDP ratio to 1.5. This value is an estimate of Japan's net debt-to-GDP ratio for 2012 constructed by Braun and Joines (2015).

Simulation Results

We now analyze the effects of an increase in uninsured earnings on output, public transfers, utility and wealth inequality. The scenario we consider is based on results reported by Lise *et al.* (2014). They find that the standard deviation of log earnings

among Japanese households gradually increased from 0.246 in 1991 to 0.284 in 2008. If we project this trend, it implies a standard deviation of log earnings of 0.30 in 2015 or a total increase in earnings inequality of 5.4 log points.

Table 2 reports the effects of increasing the standard deviation of earnings from 0.246 to 0.3 in our model. An increase in earnings inequality of this magnitude depresses output by 2.52 percent[4]. This decline in output is due to a change in household savings plans. Accumulating human capital is now riskier, and households allocate a larger fraction of their savings to physical capital. This savings response allows the model to reproduce the increase in capital intensity that has been documented in research by Hayashi and Prescott (2002). The physical capital-output ratio in the model increases from 2.61 to 2.65.

Lower output reduces government tax revenue. Under our assumption, the resulting gap in the government budget constraint is remedied by reducing government transfers. Public transfers are a particularly valuable form of insurance to households who have low earnings and low wealth. It is thus not surprising to see that utility declines. Households are now exposed to more risk and have less government provided insurance.

Finally, notice that financial wealth inequality increases by 5 log points. The capital-output ratio has risen. In our model, all households save the same proportion of their earnings. Thus higher earnings inequality translates into higher wealth inequality.

Higher earnings inequality creates a potential conundrum for policy makers. Should the policy maker take actions to boost output, or alternatively increase public transfers

Table 2: Effects of an Increase in Uninsured Earnings Risk on Output, Public Transfers, Utility, and Wealth Inequality

	$\Delta \ln Y$	$\Delta \ln \tau$	ΔU	$\Delta \sigma_a$
High Earnings Risk Scenario	-0.0252	-0.0333	-0.2398	0.0501

* All values are relative to their baseline value and "ln" refers to the natural logarithm.
A negative value indicates that the magnitude of the variable is smaller in the baseline scenario as compared with the high earnings risk-scenario with $\sigma=0.30$.

[4] The response of output to a change in earnings inequality is sensitive to the share of human capital β. Note that our calibration implies that the average skill premium is $(F_H H)/(F_L L)=1.8$, which is modest, for instance, compared with the estimate given by Hara, Katayama, and Kato (2014).

to the poor? Unfortunately, there is a tradeoff, as we will see. Boosting output requires tax reductions; however, lowering taxes in our setup is likely to result in even lower government transfers. Increasing public transfers, in contrast, requires higher taxes.

We now turn to consider each of these policies in turn. The upper panel of Table 3 shows alternative fiscal measures that restore output to its baseline level. In all cases, we assume that public transfers are adjusted to insure that the government satisfies its budget constraint. We start by considering reductions in the tax rate on capital. At the behest of Japanese companies, Japan has recently started to phase in reductions in corporate profits taxes. Corporate tax rates are scheduled to decline by a total of 7.26 percentage points between 2014 and 2018. Results reported in the first row of Table 3 indicate that this type of policy boosts output in our model. In fact, if the objective is to restore output to its baseline level, a reduction of 4.9 percentage points would be sufficient. Reducing the tax rate on capital also reduces wealth inequality[5]. The combination of higher after-tax interest rates and lower government transfers induces households to save a higher fraction of their income, thereby reducing wealth inequality. Comparing the change in utility in Table 3 with its value in Table 2, we can see that households would prefer to be born into the economy with a lower capital tax rate, higher output, and lower public transfers.

Table 3: Comparison of Fiscal Policies that Increase Output with Policies that Increase Public Transfers

	New Magnitude	Baseline Value	$\Delta \ln Y$	$\Delta \ln \tau$	ΔU	$\Delta \sigma_a$
Fiscal Policies that Restore Output to its Baseline Level						
Lower τ_r	0.581	0.63	0	−0.0945	−0.2149	0.0362
Lower τ_w	0.3058	0.32	0	−0.113	−0.1792	0.038
Lower τ_c	0.03	0.08	0	−0.473	−0.0639	0.1176
Lower Debt/GDP	0.2	1.5	0	0.0863	−0.0146	0.1046
Fiscal Policies That increase Public Transfers by 2 percent above the Baseline Level						
Higher τ_r	0.669	0.63	−0.05	0.020	−0.2719	0.0632
Higher τ_w	0.329	0.32	−0.043	0.020	−0.2843	0.0582
Higher τ_c	0.0872	0.08	−0.0288	0.020	−0.2659	0.0406

* All values are relative to their baseline value. Thus, a negative value indicates that the magnitude of the variable is smaller in the baseline scenario as compared with the scenario being considered in this table.

[5] This can be ascertained by comparing the value of $\Delta\sigma_a$ in Table 3 with its value in Table 2.

We wish to emphasize that our model is a closed economy and it thus abstracts from international tax differences. Japan has particularly, high tax rates on capital by international standards, and it is likely that the gains in output, welfare, and inequality from lowering capital taxes would be even larger.

A second way to restore output to its baseline level is to reduce the labor tax rate. Lowering this tax rate in response to an increase in earnings risk is particularly effective because it induces households to invest more in human capital. The results in the second row of Table 3 indicate that only a small reduction in the labor tax rate of 1.4 percentage points is needed to boost output by 2.5 percent. This fiscal policy also reduces wealth inequality and increases utility. Finally, households prefer the lower labor tax rate scenario to the lower capital tax rate scenario. The decline in utility in the second row of Table 3 is smaller than that in the first row.

The third and final tax policy tool we consider is reducing the consumption tax rate. The results in row 3 of Table 3 indicate that boosting output by 2.5 percent requires reducing the consumption tax rate to 3 percent. This means that the fiscal authority would have to undo all of the increases in the consumption tax rate that have been implemented since 1997 if it wishes to reverse the negative effects of higher earnings inequality on output!

Interestingly, lowering the consumption tax rate *increases* wealth inequality. Using the household budget constraint, one can show that the consumption tax is a tax on the expected present value of lifetime income or, in other words, wealth. Lowering this tax rate reduces lumpsum transfers and lowers the return on assets or human capital accumulation, which exposes the old to a higher risk of impoverishment. Despite the fact that government transfers are lowest here and wealth inequality is highest, households prefer the lower consumption tax policy best.

The lower panel of Table 3 considers the alternative strategy of increasing public transfers by 2 percent above their baseline level. Given the results from the upper panel of Table 3, it is not surprising to see that higher transfers require higher tax rates and that this acts to depresses output and lower utility. Note that the output losses are highest when the increase in public transfers is financed by a higher capital tax rate. Output declines by 5 percent. The output losses are also large if the labor tax rate is increased (4.3 percent).

The higher consumption tax rate scenario has the smallest negative effect on output of the three tax higher public transfer scenarios. Moreover, the size of the increase in

this tax rate is close in magnitude to Japan's plan to increase this tax rate from 8 to 10percent. Our results suggest that increasing the consumption tax rate is the most effective way to increase funding for government programs that provide social insurance to the poor.

We have seen that none of the policies considered so far restore welfare to its baseline level. Agents in our model use their utility function to compare alternative consumption plans; hence, it is consequently meaningful to ask what fiscal policies deliver the same utility to them in the specification with high earnings risk as they previously enjoyed in the baseline. We now turn to consider fiscal policies that achieve this objective.

Results are reported in the upper panel of Table 4. Notably, it is not possible to adjust the tax rate on capital to restore utility to its baseline level. Welfare increases monotonically as the capital tax rate is reduced from 0.63 to 0.45 but then falls if it is reduced beyond this level. At $\tau_r=0.45$, households' utility is lower than that in the baseline specification. In fact, when $\tau_r<0.12$, welfare is lower than that in the high earnings risk economy with $\tau_r<0.63$. The fact that there is a role for a positive tax rate on capital might be surprising. Previous research has found it difficult to justify a role for capital tax rates that are of this magnitude. Our finding echoes a result by Gottardi *et al.* (2015). They show that the optimal tax rate on capital is positive when

Table 4: Tradeoffs Between Welfare and Equity

	New Magnitude	Baseline Value	$\Delta \ln Y$	$\Delta \ln \tau$	ΔU	$\Delta \sigma_a$
Fiscal Policies that Restore Utility to its Baseline Level						
τ_r	Not Possible					
Lower τ_w	0.243	0.32	0.107	−0.726	0	−0.0005
Lower τ_c	0.0108	0.08	0.0103	−0.710	0	0.1451
Lower Debt/GDP	0.115	1.5	0.0017	0.0938	0	0.1083
Fiscal Policies that Restore Wealth Inequality to its Baseline Level						
Lower τ_r	0.3726	0.63	0.0713	−0.3154	−0.1997	0
Lower τ_w	0.2516	0.32	0.0927	−0.5993	−0.0158	0
Higher τ_c	0.1197	0.08	−0.0439	0.2199	−0.3864	0
Higher Debt/GDP	2.734	1.5	−0.0484	−0.1693	−0.4577	0

* All values are relative to their baseline value. Thus, a negative value indicates that the magnitude of the variable is smaller in the baseline scenario as compared with the scenario being considered in this table.

human capital investment is subject to idiosyncratic uninsured risk, government purchases are positive but sufficiently small, and government debt is positive. Our results indicate that this theoretical possibility is empirically relevant. Households in our economy, which has been calibrated to reproduce key features of Japan's current fiscal situation, value social insurance for the poor. However, they just prefer a much lower tax rate on capital and much smaller levels of social insurance as compared with their current levels[6].

It is possible to deliver households the same level of utility that they enjoy in the baseline specification if the labor tax rate is reduced from 0.32 to 0.243. This policy has other benefits. It stimulates economic activity — output is 1 percent above the baseline level in this scenario — and wealth inequality declines significantly. Wealth inequality in this scenario is actually 0.5 log points *lower* than the baseline. The only negative aspect of this policy is that public transfers decline.

A second way to restore utility to its baseline level is to reduce the consumption tax rate to 1.1 percent. This policy raises output by about the same amount as a labor tax rate reduction, but wealth inequality increases.

Recent research by Piketty (2014) highlights the issue of wealth inequality. Piketty (2014) asserts that higher tax rates on capital are the appropriate way to reduce wealth inequality. Using our model, we can assess this claim. The lower panel of Table 4 reports results from scenarios that reduce wealth inequality to its baseline (1991) level. In our model, the appropriate way to reduce wealth inequality is to *lower* the tax rate on capital from its current level. Lowering the tax rate on capital increases the return on assets, and this makes it easier for households to insure against life-expectancy risk. Our calibrated version of the model has the property that a long life is painful. As individuals age, wealth gradually declines (μ_a is negative). Reducing the tax rate on capital increases μ_a and this reduces the fraction of old and poor individuals in the economy[7]. Therefore, wealth inequality declines. Finally, observe that lowering the capital tax rate to the level of 0.373 also increases welfare (compare with Table 2).

A second policy for reducing wealth inequality is to lower the tax rate on labor.

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[6] Public transfers decline by 23 percent when τ_k is reduced from 0.63 to 0.45.

[7] Note from equation 20 that μ_a directly depends on the after-tax real interest rate and the after-tax wage rate for skilled labor. Lowering the capital tax rate increases both terms. The fact that wages are now higher also increases η, the share of wealth allocated to human capital.

Lowering the labor tax rate results in a higher after-tax wage rate for skilled workers and a higher after-tax interest rate. The increase in the after-tax wage rate is larger, and η increases. Thus, μ_a increases, and wealth inequality falls. Individuals prefer the lower labor tax rate scenario to the lower capital tax scenario because the labor tax induces a bigger distortion. Although the level of the labor tax rate is lower than the capital tax rate, the labor tax rate applies to the gross return on skill accumulation while the capital tax rate only applies to the net of depreciation return on capital.

Welfare declines when the consumption tax rate is used to reduce wealth inequality. This is because the consumption tax rate must *increased* from 8 to 12 percent to reduce wealth inequality to its baseline level. Increasing the consumption tax rate, in contrast, lowers average wealth and reduces both physical capital and human capital. This increases the interest rate and the wage rate for skilled labor, and μ_a increases. The old are now less impoverished, and overall inequality falls. Increasing the consumption tax rate, however, lowers welfare due to its negative incentive effects. Consequently, the lower capital tax rate and the lower labor tax rate scenarios are better public policies. Both these policies reduce inequality, stimulate economic activity, and improve welfare.

Thus far, we have limited attention to tax reforms that hold public debt fixed. In our model, government debt can enhance welfare in the long-run; thus, it makes sense to consider the fiscal effects of varying its level. Table 4 indicates that a debt-to-GDP ratio of 1.5 is too large and that lowering the debt-to-GDP ratio increases welfare. In particular, a reduction in the deb-to-GDP ratio to 0.115 is required to restore welfare to its baseline level. This policy increases output but lowers public transfers. However, a tradeoff between welfare and equity considerations exist here. The final row of Table 4 shows that reducing wealth inequality to its baseline value requires a big increase in the debt-to-GDP ratio from 1.5 to 2.7. A higher long-term debt-to-GDP ratio requires higher interest payments by the government. These expenditures reduce the amount of resources available to the government for public transfers. This explains why public transfers are so low in this scenario.

4. Conclusion

Japan has experienced a protracted period of economic stagnation. Stagnation has been accompanied by wage and earnings polarization and rising wealth inequality. In

this paper, we use a model to show that these patterns are related. We find that an increase in the extent of uninsured earnings risk faced by households increases wealth inequality and causes stagnation in output.

Furthermore, we investigate the efficacy of alternative fiscal policies in helping households to cope with higher earnings risk. Interestingly, households prefer lower taxes and lower levels of social insurance. Not all taxes are the same. Reducing either the capital tax rate or the labor tax rate stimulates output, increases welfare, and lowers wealth inequality. Lower consumption taxes and government debt reductions also increase welfare, but wealth inequality increases.

We hope that our results will foster more research on this topic. It would be interesting to consider these same policies in a model with a richer microeconomic structure along the lines of research by Braun, Kopecky and Koreshkova (2016). We have analyzed the long-run or steady state effects of these fiscal policies on output, inequality, and welfare. Another extension of our analysis would be to examine the short-run effects of introducing these fiscal policies. On the one hand, lower capital and/or labor tax rates are likely to provide an immediate boost to economic activity. On the other hand, government revenue will also decline. The question arises as to whether it is better to reduce public transfers immediately or gradually over time.

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