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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 classification: E13, E16, D31

Key words: economic stagnation, wage polarization, wealth inequality

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1 Introduction

Japan finds itself in the midst of a protracted episode of economic stagnation. Per capita GDP growth between 1994 and 2014 has averaged 0.73% per year. 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 2007.

Economic stagnation has occurred against a background of higher earnings risk and wage polarization in a number of advanced economies. Kamborouv and Manovskii (2008) were the first to document a secular decline in occupation stability and a concurrent increase in earnings inequality in U.S. data when comparing data from the 1970s with data from the 1990s. In subsequent work Autor, Katz and Kearney (2006, 2008) document 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 in equality in the left tail of the distribution is not. They go on to provide evidence that these results are driven by a decline in the demand for medium-skilled workers in routine

occupations. Jaimovich and Siu (2012) find that employment losses in routine occupations are concentrated in recessions in the U.S.

Similar patterns can be found in Japan. Lise et al. (2012) find that household earnings inequality increases by 3.8 log points between 1991 and 2008. Wage inequality is also increasing among higher wage male and female workers. However, in Japan wage inequality among lower paid workers actually falls between 1991 and 2008. But varies by gender. Wage inequality among lower wage male workers is increasing inequality among lower wage women is falling. Kambayashi, Kawaguchi, and Yamada (2012) find that the decline in wage inequality among lower wage female workers can be attributed to a concentration of women in minimum wage jobs and a steady increase in the minimum wage between 1991-2008.

Japan is also 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) find that this reallocation is concentrated in recession periods and that job losses in routine occupations are responsible for jobless recoveries. In Japan, 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 has risen sharply and argues in favor of taxes on capital. Wealth inequality is also rising in Japan. Ohtake et al. (2013) find

that wealth inequality increased between 1984 and 1989, decreased between 1989 and 1994 but then has been increasing again between 1994 and 2004. Lise et al. (2013) using the same survey (National Survey on Family Income and Expenditure) find a small but steady decline in the share of wealth held by the bottom 10% from about zero in between 1984 to -1 percent in 2004. The share of wealth held by the top 10%, in contrast, rises from 40 to 45 percent over the same period.

Our paper has two objectives. First, we argue that economic stagnation, increasing wealth inequality and wage polarization are related. The research described above suggests that earnings inequality is concentrated in medium-skilled routine occupations. To capture this observation we construct a model where households are endowed with unskilled labor and skilled labor. The later form of labor is special because it can be augmented via investment but investing in human capital is risky. Households are risk averse and when faced with an increase in the risk of investing in human capital choose to invest more of their savings in physical capital and less in human capital. This results in a misallocation of investment and aggregate output and consumption both fall. In our model an increase in uninsured earnings risk increases wealth inequality. The reason for this result is that households choose to save a fixed proportion of their earnings at all income levels. An increase in the risk of investing in human capital produces higher earnings inequality and thus wealth inequality also rises.

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 start by comparing policies that stimulate output with policies that provide more insurance social insurance to the poor. Reducing tax rates acts to stimulate economic activity, but if other forms of government spending are held fixed, government transfers to the poor must fall. Another way to proceed is for the government to help poor households cope with higher earnings risk by increasing transfers to those who have low earnings and low levels of assets. Higher transfers, however, require additional tax revenue and raising tax rates acts to 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 less social insurance.

The fact, that households prefer lower capital taxes is noteworthy. Carey and Tchilinguirian (2000) who 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 in capital among advanced economies.[1] Based largely on concerns from businesses, the Abe administration recently legislated reductions in the overall tax rate on capital by reducing corporate profits taxes. Corporate profits taxes are gradually being reduced from 37% in 2013 to 29.74% in 2018. Reducing the tax rate on capital, improves the incentives for firms to undertake investment, however, this policy runs counter to the

[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.

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, which is currently about 63%, to a level as low as 45% increases welfare and reduces wealth inequality.

Reductions in the tax rate on capital increases the ability of agents to self-insure against low earnings because the after tax return on their savings increases. The combination of lower government transfers to the poor and a higher after tax interest rate induces the poor to save more and this acts to reduce wealth inequality.

The nature of the tradeoff between equity and efficiency depends on the specific instrument. For instance, if the consumption tax is reduced instead wealth inequality increases. Overall, we find that reductions in labor taxes and/or taxes on capital are the most effective way to detail with an increase in earnings risk. Both policies stimulate economic activity, reduce wealth inequality and increase welfare.[2]

The model used to make these points builds on previous research by Krebs (2003), Angeletos and Panousi (2009), Toda (2014), and Gottardi, Kajii, and Nakajima (2015). In order to capture job polarization we assume that households are endowed with

[2] Very 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.

two types of labor: skilled and unskilled. Skilled labor is not risky but earns a low wage rate. Skilled labor can be enhanced over time by investing in human capital but 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 capital and increasing their investment in physical capital and this has a depressing effect on output and consumption. In order 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 contains our concluding remarks.

2 The model economy

Households

There is a continuum of households of measure one. Each household dies with a constant probability and, as in 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 each 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: risk-free (financial) asset, b, and human capital, h. A new born skilled household is endowed with $h_0 > 0$ units of human capital but no financial asset. Consider a skilled household that is born at time s (call it household (i,s)). Her lifetime expected utility is given by

$$\text{(1)} \qquad \mathrm{E}_s \int_s^\infty e^{-(\rho+p)(t-s)} \ln c(i,s,t)\, dt,$$

where $\rho > 0$ is the time discount rate; $p > 0$ is the death rate; $c(i,s,t)$ 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. Each household is subject to different forms of taxes.

Let $\tau_c(t)$ be the rate of consumption tax at time t; $\tau_r(t)$ be the tax rate on interest income; and $\tau_w(t)$ be the tax rate on labor income (common across skilled and unskilled labor). There are also lump sum transfers $\tau(t)$, which are identical across (living) households.

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

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

Then the flow budget constraint at time t is expressed as

(3)

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

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

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

so that

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

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

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

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 $\hat{r}(t)$ 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

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

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

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

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

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

Firms

There are perfectly competitive firms with constant-returns-to-scale technology:

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

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

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

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

(14)
$$\begin{aligned} r(t) &= \alpha z K(t)^{\alpha-1} H(t)^{\beta} L^{1-\alpha-\beta} - \delta_k, \\ w_h(t) &= \beta z K(t)^{\alpha} H(t)^{\beta-1} L^{1-\alpha-\beta}, \\ w_l(t) &= (1-\alpha-\beta) z K(t)^{\alpha} H(t)^{\beta} L^{-\alpha-\beta}. \end{aligned}$$

Government

The government issues debt $D(t)$, consumes goods $G(t)$, makes lump sum 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

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

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

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

where

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

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

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

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

Distribution of Wealth

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

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

where

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

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

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

where

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

Its mean and variance are given as follows:

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

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 more

routine occupations are falling while wages in higher-skilled non-routine occupations are increasing. Low-skilled jobs show no evidence of divergence. Polarization of wages has been accompanied with a secular increase in wealth inequality. There are a variety of economic mechanisms that can account for these phenomena in isolation but we believe that we are the first to provide a comprehensive theory 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

Our model has a rich set of implications. But, this comes at a cost. We are not able 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 we thus set ρ the preference discount rate to 0.03. This value is close to values used in the real business cycle literature. Hayashi and Prescott (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 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 about 0.4. Our value of 0.3 lies in the middle of this interval. The human capital share β is set to 0.4. Thus, the overall labor share in the production function is 0.7. The depreciation rate on physical and human capital is set to 0.085. This value is close to the value of 0.089 that Hayashi and Prescott (2002) report. 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 is set to 0.63. This tax rate is the sum of two components. Braun and Joines (2015) estimate that firms paid an overall tax rate on physical capital of 0.43 using the Hayashi-Prescott (2002) methodology over the period 1990-2006 and households face a statutory tax rate of 0.20 on interest income since 2012. The overall labor tax rate including SS and medical contributions is set to 0.32. This is the OECD estimate of the overall labor wedge in Japan for the year 2014. The consumption tax is set to its 2015 statutory value of 0.08. The government purchase share of output is set to 0.21. This is its value in the calendar year of 2014. Finally we set the debt-GDP ratio to 1.5. This value is an estimate of Japan's net debt-GDP ratio for 2012 constructed by Braun and Joines (2015).

Simulation Results

We start by analyzing the effects of an increase in uninsured earnings on output,, transfers, utility and wealth inequality. The scenario we consider is based on results reported in Lise et al. (2014) who 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 forward it implies a standard deviation of log-earnings of 0.30 in 2015.

Table 2 reports the effects of increasing earnings inequality from 0.246 to 0.3 in our model. An increase in earnings inequality of this magnitude depresses output by 2.5%. 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 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. Government 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 falls. Households are now exposed to more risk and have less government provided insurance.

Finally observe that wealth inequality increases. In our model households save a fixed proportion of their earnings and with higher earnings inequality, wealth inequality also rises.

Higher earnings inequality creates a potential conundrum for policy makers. Should the policy maker take actions to boost output, or alternatively increase transfers to the poor? Unfortunately, there is a tradeoff, as we will see. Boosting output requires tax reductions but lowering taxes in our setup is likely to result in even lower government transfers. Increasing 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 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 show 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. This can be discerned by comparing the value of $\Delta\sigma_a$ in this table with its value in Table 2. The combination of lower after tax interest rates and lower government transfers induces households to save a higher fraction of their income and this acts to reduce wealth

inequality. By 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 government transfers. 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 output gains could be even larger than what we have documented here.

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 very a small reduction in the labor tax rate of 1.4 percentage points is needed to boost output by 2.5%. This fiscal policy also reduces wealth inequality and increases utility. Finally, note that the decline in utility in the second row of Table 3 is lower than in the first row. Households prefer a lower tax rate on labor as compared to a lower tax rate on capital.

The third and final tax policy we consider is reducing the consumption tax. Observe in row 3 of Table 3 that boosting output by 2.5% requires reducing the consumption tax to 3%. In other words, this means the fiscal authority would have to undo all of the increases in the consumption tax that have been implemented since 1997! Interestingly, this policy increases wealth inequality. Using the household budget constraint one can show that the consumption tax reduces the expected present value

of lifetime income or in other words wealth. Lowering this tax-rate thus acts to increase the incentive for households to acquire wealth and this increases wealth inequality. In spite of the fact that government transfers are lowest here and wealth inequality is highest, households prefer a lower consumption tax as compared to the previous two policies. The reason for this result is that the poorest households have a particularly urgent need to consume (their marginal utility of consumption is very high) and taxing the consumption good they need to subsist is particularly painful.

The lower panel of Table 3 considers the alternative strategy of increasing 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 requires higher tax rates and that this acts to depress output and lower utility. Note that the output losses are highest when the increase in transfers is financed by a higher capital tax. Output declines by 5%. The output losses are also large if the labor tax is increased (4.3%).

Interestingly, increasing the consumption tax has the smallest negative effect on output. 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 10%. Increasing the consumption tax is the most effective way to fund 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 and it is consequently meaningful to ask what fiscal policies

deliver the same utility to them in the specification with high earnings risk as they previous 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. Perhaps the most noteworthy result is that 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 in the baseline specification. In fact, when $\tau_r < 0.12$ welfare is also lower than 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 appear to be surprising. Previous research has found it hard 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 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 also obtains in our economy, which has been calibrated to reproduce key features of Japan's current fiscal situation. From this we see that households do value social insurance for the poor. They just prefer a much lower tax rate on capital and much smaller levels of social insurance.[4]

[4] Transfers fall by 23% when τ_k is reduced from 0.63 to 0.45.

Observe next that 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. Such a policy has other benefits. It stimulates economic activity-- output is 1% above the baseline level in this scenario -- and wealth inequality declines. Wealth inequality is 0.178 log points lower than the baseline when the labor tax rate is set at this level. At this level of the labor tax rate, the benefits of higher after-tax wages continue to be stronger than the cost of lower levels of transfers.

A second way to restore utility to its baseline level is to reduce the consumption tax to 1.1%. This policy raises output by about the same amount as a labor tax reduction, but acts to increase wealth inequality. A lower consumption tax makes poverty less painful, households respond by saving a smaller fraction of their income and this acts to significantly increase wealth inequality.

The recent work of Piketty (2014) has brought the issue of wealth inequality back into the public eye. Piketty has asserted that higher taxes on capital are an 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 bring wealth inequality back down to its baseline (1991) level. In our model the appropriate way to reduce wealth inequality is to *lower* the tax rate on capital. For the capital tax rate there is no tradeoff between welfare and equity. Lowering the tax rate to the level of 0.435 increases welfare (compare with Table 2) and lowers wealth inequality. The labor tax rate works in the same way. Of the two options though individuals prefer a lower labor tax

rate. The labor tax rate taxes human capital and even though this tax rate is lower than the capital tax rate, the capital tax rate only applies to the net of depreciation return on capital whereas the labor tax applies to the gross return on human capital.

For the consumption tax rate, in contrast, there is a tradeoff between welfare and inequality. Lowering inequality back to its baseline level requires increasing the consumption tax rate to 12.9%. However, a higher consumption tax rate lowers welfare due to the negative effect it has on those who experience low wealth and earnings. For these reasons lowering either the tax rate on capital or the tax rate on wages is a better way to proceed. Both of these policies act to reduce inequality, stimulate economic activity and improve welfare.

Up to this point we have limited attention to tax reforms and held public debt fixed. In our model government debt can enhance welfare in the long-run so it makes sense to consider the fiscal effects of varying its level. Table 4 indicates that a debt/GDP ratio of 1.5 is too large and that lowering the debt-GDP ratio increases welfare. In particular, a reduction in the debt/GDP ratio to 0.115 is required to restore welfare to its baseline level. This policy increases output but lowers public transfers. However, there is also a tradeoff between welfare and equity considerations here. The final row of Table 4 shows that if the objective is to reduce wealth inequality instead that this would require a much higher debt-GDP ratio. A higher debt-GDP ratio is associated with higher interest payments by the government, which reduces

the amount of resources available for public transfers. This is 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 have used 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 reduces economic activity.

We have also investigated 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 are most attractive. These policies stimulate output, increase welfare and lower wealth inequality. Lower consumption taxes and government debt reductions also increase welfare but at the same time act to increase wealth inequality.

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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	

Table 2

Effects of an Increase in Uninsured Earnings Risk on Output, 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	0.255

*All values are relative to their baseline value and ln refers to the natural logarithm. Thus, a negative value indicates that the value of the variable is lower in its baseline level in the High Earnings Risk scenario with $\sigma = 0.30$.

Table 3

Comparison of Fiscal Policies that Increase Output with Policies that Increase 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	0.171
Lower τ_w	0.306	0.32	0	-0.113	-0.1792	0.167
Lower τ_c	0.03	0.08	0	-0.473	-0.0639	0.540
Lower Debt/GDP	0.2	1.5	0	0.0863		0.5115
Fiscal Policies That Increase Transfers by 2% Above the Baseline Level						
Higher τ_r	0.669	0.63	-0.05	0.020	-0.2719	0.335
Higher τ_w	0.329	0.32	-0.043	0.020	-0.2843	0.3148
Higher τ_c	0.0872	0.08	-0.0288	0.020	-0.2659	0.2158

*All values are relative to their baseline value. Thus, a negative value indicates that the value of the variable is lower in its baseline level in the scenario begin considered.

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	-0.178
Lower τ_c	0.0108	0.08	0.0103	-0.710	0	0.6473
Lower Debt/GDP	0.115	1.5	0.0017	0.0938	0	0.5288
Fiscal Policies That Restore Wealth Inequality to its Baseline Level						
Lower τ_r	0.4354	0.63	0.0543	-0.250	-0.1955	0
Lower τ_w	0.277	0.32	0.050	-0.3267	-0.0786	0
Higher τ_c	0.129	0.08	-0.0484	0.2712	-0.4219	0
Higher Debt/GDP	2.87	1.5	-0.0511	-0.1889	-0.4820	0

*All values are relative to their baseline value. Thus, a negative value indicates that the value of the variable is lower in its baseline level in the scenario begin considered.