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A Comparison of the Japanese and U.S. Business Cycles

R. Anton Braun
University of Tokyo
Julen Esteban-Pretel
University of Tokyo
Toshihiro Okada
Kwansei Gakuin University
Nao Sudou
Bank of Japan and Boston University

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Abstract

This paper constructs a consistent set of quarterly Japanese data for the 1960-2002 sample period and compares properties of the Japanese and U.S. business cycles. We document some important differences in the adjustment of labor input between the two countries. In Japan most of the adjustment is in hours per worker of males and females and also in employment of females. In the U.S. most of the adjustment is in employment of both males and females. We formulate, estimate and analyze a model that makes the distinction between the intensive and extensive margin and allows for gender differerences in labor supply. A weak empirical correlation between hours per worker and employment in Japanese data is a puzzle for our theory.

1 Introduction

This paper has three objectives. The first objective is to construct a set of quarterly macroeconomic indicators that are consistently measured and suitable for the analysis of the Japanese business cycle using dynamic general equilibrium models. The second objective is to compare and contrast the Japanese business cycle with the U.S. business cycle using this data set. The third objective is to investigate and document the sources of what we find to be significant differences in the labor markets in the two countries.

Our strategy in constructing quarterly data is to follow to the extent possible the same methodology used previous by Hayashi and Prescott (2002) to construct annual data for Japan. They integrate data from the 1968 System of National Accounts (SNA) with data from the 1993 SNA. There are several obstacles in constructing quarterly measures. One issue that we face is the measurement of the capital stock. Hayashi and Prescott (2002) assume time-varying depreciation rates for capital. The capital stock measured in this way using quarterly data implies that the capital stock is more volatile than output. We construct an alternative measure of the capital stock assuming fixed depreciation that reduces the measured relative variability of capital stock by about one-half. Another issue is that coverage of the income side of the National Income and Product Accounts (NIPA) is only reported for the total economy and not for primary sectors in Japanese quarterly data.

A comparison of the Japanese business cycle with the U.S. business cycle using our quarterly data finds substantial similarities across the two countries. Using data from 1960 through 2002 we find that the magnitude of business cycle variations is about the same and both economies deliver about the same amount of consumption smoothing over the business cycle. On the other hand, variables related to the labor market are different in the two countries. Aggregate labor input in Japan is less volatile over the business cycle than in the U.S. Furthermore, the principal source of labor input variation differs across the two countries. In the U.S. it is well known that variability in employment accounts for most of the variation in aggregate labor input over the business cycle. The variability of hours per worker is small. In Japan the opposite is true. Most of the variation in aggregate labor input is due to variations in hours per worker whereas variations in employment are much smaller.

We also report facts on a gender basis for Japan. Labor input for Japanese females is 60 percent more variable over the business cycle than for males. Underlying the large variations in female labor input are large variations in both hours per worker and employment. These large gender based differences in labor supply suggest that labor supply elasticities are very different for Japanese males and females.

We then formulate a model that makes the distinction between the intensive and extensive margin and estimate the preference parameters that govern labor supply using aggregate data. Our strategy follows the example of Heckman et al. (1998) who estimate labor supply parameters by formulating and solving a real business cycle model. A novel feature of our specification is that it makes a distinction between the length of the workweek and the number of days worked in a year for both males and females.

Our model draws on two strands of the literature. First it is related to work by Cho and Cooley (1994) and Cho and Rogerson (1987). The former paper proposes a preference specification which produces variation in hours and employment. The latter paper models the distinction between male and female labor supply. Second, our model is related to research by Braun (1994) and McGrattan (1994), which studies the effects of distortionary taxes on economic activity. We find that modeling fluctuations in income taxes is essential for the model to reproduce the high volatilities of employment in the U.S. on the one hand and hours per worker in Japan on the other hand. However, variations in income taxes are not sufficient to account for the fact that labor input variation in the U.S. operates primarily through the extensive margin and through the intensive margin in Japan. In order to reproduce this we find it is necessary to appeal to differences in attitudes towards risk on the intensive and extensive margins.

The remainder of the paper is organized as follows. Section 2 describes the construction of the data set. In Section 3 we compare Japanese business cycle facts with U.S. business cycles facts. Section 4 describes the model, Section 5 discusses the estimation strategy and results, Section 5 reports simulation results and in Section 6 we conclude.

2 Data Construction

Our source for Japanese NIPA (National Income and Product Accounts) variables is the Economic and Social Research Institute (ESRI), Cabinet Office. We use data from both the 1968 and 1993 SNA (System of National Accounts) to produce time-series that extend from 1960 to 2002. Data from both SNA's are available from the ESRI. Our labor market data for Japan is based on two different surveys: the Labor Force Survey (LFS), which is a household survey, and the Monthly Labor Survey (MLFS), which is an establishment survey. We obtained our labor variables from the

Ministry of Health, Labor and Welfare (MHLW) and the International Labor Organization (ILO).

The primary data source of the U.S. NIPA data set is the Bureau of Economic Analysis, Department of Commerce. U.S. data on labor variables is from the Current Population Survey (CPS).

The data, in principal, start in the first quarter of 1960 and end in the fourth quarter of 2002 for both countries. The exceptions are the Japanese gender based labor series reported in Table 3 which start in the first quarter of 1976 and the Japanese household survey weekly hours data which starts in the first quarter of 1986.

We faced two difficulties in constructing a Japanese quarterly data-set. The first is that only broad categories of the data are provided in Japanese quarterly data. For example, the annual income data is available for the following major sectors:

- non-financial corporations
- financial corporations
- general government
- households
- private non-profit institutions serving households.

Quarterly income data, however, is only reported for the total economy. To obtain quarterly time-series for these major sectors, we allocate total economy income to each sector, using ratios calculated from the annual data. These ratios are updated on an annual basis.

In an effort to make the data consistent with variables used in standard dynamic general equilibrium (DGE) theory, we adjust the raw data. Our adjustments follow the methodology described in Hayashi and Prescott (2002). There are, however, two main differences between our data set and the data set used by Hayashi and Prescott (2002). First, the frequency of our data set is quarterly and it runs through the end of 2002. A second and more important difference relates to the way that the capital stock is calculated. Hayashi and Prescott (2002) assume variable depreciation of capital. The capital stock calculated in this manner has a relative volatility to output in excess of 1.08. We construct an alternative measure of the capital stock assuming a fixed rate of capital depreciation, at the quarterly rate of 2.5 percent. The relative volatility of this measure of the capital stock is 0.57.

There are four important points about the construction of the quarterly series. First, all variables are expressed in real terms and converted from their nominal counterparts using the GNP deflator with 2000 as the base year. The U.S. data uses a chain-weighted deflator. However, the Japanese data uses a constant 1990 yen deflator. Chain-weighted price indices have been released in Japan since 2004. However, they currently only extend back to 1994.[1] Second, all Japanese data are seasonally adjusted using Tramo/Seats. Third, the 1993 SNA data is integrated with the 1968 SNA data by extending the latter by the quarterly change in the corresponding 1993 SNA series. Fourth, the Japanese data is updated to 2002 using the 2002 National Accounts Report from ESRI. More specific details about the construction of the data are available in the data appendix.

[1]Another difficulty is that the chain weighted indices are only available for the product side of the Japanese NIPA accounts.

3 Comparison of Japanese and U.S. Business Cycles

Now that we have described the construction of the data we turn to compare the properties of business cycles in Japan and the United States. Table 1 reports second moments for HP filtered U.S. data and Table 2 reports second moments for HP filtered Japanese data. The sample period extends from the first quarter of 1960 to the fourth quarter of 2002. The main similarities and differences in the U.S. and Japanese business cycles are summarized by the following five facts.

Fact 1: Japanese and U.S. business cycles have similar magnitudes but U.S. business cycles are more persistent.

One might think that U.S. business cycles and Japanese business cycles are quite different. On the one hand, the U.S. experienced 10 distinct episodes of negative GDP growth between 1945 and 1990 while Japan experienced zero (see e.g. Ito (1991)). However, inspection of the first row of Table 1 and Table 2 indicates otherwise. Japanese business cycles during our sample period have been of about the same magnitude as business cycles in the U.S. The variability of output in the U.S. is 1.61 and in Japan it is 1.55. The auto-correlations show that business cycles in the U.S. are somewhat more persistent than in Japan. The first order autocorrelation of output is 0.86 in the U.S. and 0.80 in Japan. Higher ordered autocorrelations are about the same in the two countries. These two pieces of evidence lead us to conclude that U.S. and Japanese business cycles have similar magnitudes but that U.S. business cycles are more persistent.

Fact 2: Variations in productivity are larger and more correlated with output in Japan.

Even though output variability is about the same in the U.S. and Japan, productivity is more volatile in latter country. A comparison of volatilities for labor productivity and total factor productivity in Tables 1 and 2 indicates that the relative volatility of each of these variables is higher in Japan than the United States. Labor productivity's relative volatility is 0.55 in the U.S. and 0.78 in Japan and TFP's relative volatility is 1.01 in the U.S. and 1.20 in Japan. Cross-correlations of either measure of productivity with output are higher in Japan than in the U.S. For instance, the contemporaneous cross-correlation of labor productivity with output is 0.61 in the U.S. versus 0.76 in Japan.

Fact 3: Consumption smoothing is high in both countries but higher in Japan.

One of the principal features of the business cycle is that consumption is less variable than output and investment is more variable than output. We find this pattern in both the United States and Japan. The similarities are particularly striking for consumption.[2] The relative variability of consumption to output is 0.75 in the U.S. and 0.73 in Japan. Cross-correlations with output suggest that the Japanese economy , if anything, delivers more consumption smoothing over the business cycle than the U.S. economy. In the U.S., the contemporaneous cross-correlation of consumption with output is 0.89 whereas the same correlation is 0.65 in Japan. It is striking that, even though Japan experiences larger variations in productivity and productivity is more correlated with output, consumption is less correlated with output. These facts suggest that the Japanese economy is very effective at insuring business cycle risks.

Additional evidence about the extent of consumption smoothing in the two countries can be seen by inspecting investment patterns. Interestingly, the relative variability of investment is quite

[2]The data for consumption reported in both tables is total consumption expenditures. Sub-categories of consumption are not available in Japan on a quarterly basis prior to1980.

a bit higher in the U.S. than Japan. Two possible reasons for this are differences in the relative volatility in government purchases and differences in the persistence of business cycles in the two countries. Government purchases are much more volatile in Japan (1.53) than in the U.S. (1.04). In addition, as we noted above, business cycles are somewhat more persistent in the U.S. so that investment may have to respond more to achieve a given level of consumption smoothing.

Fact 4: Labor adjustments are very different in the two countries.

We have already observed that output variability is similar in the two countries but that labor productivity is higher in Japan. If one abstracts from differences in the covariance terms one might expect that aggregate labor input is less volatile in Japan. As we can see in Table 1 and Table 2 this is indeed the case. In the U.S. the relative variability of labor input is 0.80 and in Japan it is 0.65. Moreover, the cross-correlations of labor input with output are also lower in Japan. The cross-correlation of labor input with output is 0.84 in the U.S. and 0.63 in Japan. This evidence suggests that the Japanese economy is also very effective at smoothing labor input over the business cycle.

We noted above in Section 2 that the measures of labor input in the two countries are slightly different. In the U.S. both hours per worker and employment are based on household survey data whereas in Japan employment is from the household survey but hours is from the establishment survey. We made this choice because household survey hours is not available before 1986. However, we think that this distinction is not central to our result. In particular if we calculate the volatility of hours per worker for the 1986 -2002 subsample it is about the same using either survey. The variability of hours per worker from the household survey is 0.54 and it is 0.56 from the establishment survey.

The mechanisms of adjustment of labor input are also different in the two economies. In the U.S. most of the variation in aggregate labor input is due to variations in employment and much less is due to variations in hours per worker. The relative variability of employment as reported in Table 1 is 0.61 and hours is 0.25. In Japan the magnitudes are the opposite. The relative variability of employment is 0.30 and the relative variability of hours is 0.51.

Note finally the cross-correlations of hours and employment with output. As emphasized in Burnside, Eichenbaum and Rebelo (1993) employment lags output in the U.S. by one quarter while hours per worker are coincident with output. In Japan this pattern is even more pronounced. Hours lead output by two quarters and employment lags output by one quarter.

Fact 5: The variability of female labor input is large in Japan.

It is well known that some Japanese employees have implicit life-time employment guarantees. Ono (2005) estimates that about 20 percent of the Japanese labor force is covered by life-time employment guarantees. He also finds big gender based differences. The probability of a male staying with the same company for 30 years is 0.34. For women the same probability is 0.07. Given these differences it is interesting to document the labor market facts by gender. This is done in Table 3. Data availability limits the sample period to 1976:1 to 2002:4. Note however, that limiting attention to this sample does not alter the basic fact that employment relative variability is low and hours variability is high in Japan. In Table 3 the relative variability of labor input is 0.64 as compared to 0.65 for the whole sample period. Employment relative variability is now 0.34 as compared to 0.3 and the relative variability of hours worked is now 0.54 as compared to 0.51

in Table 2. Observe that female labor input volatility is 60 percent higher than male labor input volatility in Japan. This suggests most of the adjustments in labor input over the business cycle in Japan are born by females. For purposes of comparison Gomme et al. (2004) report that female labor input volatility is 19 percent lower than that of males in U.S. data.

What is the source of the large variability in Japanese female labor input? Is it due primarily to variations in employment or variations in hours per worker? The results in Table 3 show that variations in employment are particularly large for Japanese females. The relative variability of female employment to output is 0.65 and for males it is only 0.31. Hours per worker variability, in contrast, is similar for males on females. For females the relative variability of hours per worker is 0.59 and for males it is 0.54.

Overall, these patterns suggest that the dynamics of the adjustment of labor input are very different in the two countries. In the U.S. male and female labor input variations are similar. Where as in Japan female labor input adjustments are much larger than male adjustments. Moreover, in Japan there are significant adjustments in hours per worker of both males and females. Finally, female employment adjustments are also large.

4 The Model

The facts presented above suggest that it is important to model both the intensive and extensive margins of labor supply. In Japan there are important variations in the length of the workweek for both males and females. Thus, specifications with indivisibilities of the form considered in Rogerson (1984) and Hansen (1985) are not suitable, since it implies that the length of the work week is constant. We want a specification in which there is substitution along both the intensive and extensive margins as in Cho and Cooley (1994). We analyze gender differences in labor supply by generalizing their preference structure to allow for two worker households.

The period utility function for a household is given by:

$$2u(c_t) - e_{1t}v(h_{1t}) - e_{2t}v(h_{2t}) - e_{1t}m_1(e_{1t}) - e_{2t}m_2(e_{2t}) \tag{1}$$

where c_t is consumption, e_{it} and h_{it} are respectively the number of days worked and the number of hours worked per day in period t by worker $i \in \{1, 2\}$. It is important to emphasize that allowing for curvature in $m_i(\cdot)$ for both workers is essential for inducing variation along both margins. If for instance $m_i(\ \cdot)$ is a constant for the first worker as in Cho and Rogerson (1992), the equilibrium length of the workweek is a constant for the first worker. When solving the model we assume the following functional forms for the household utility function:

$$\begin{aligned} u(c) &= \ln(c) \\ v_i(h) &= \alpha_{h_i}\frac{h^{1+\gamma_{h_i}}}{1+\gamma_{h_i}},\ a_{h_i} > 0, \gamma_{h_i} > 0 \\ m_i(e) &= \alpha_{e_i}\frac{e^{1+\gamma_{e_i}}}{1+\gamma_{e_i}},\ a_{e_i} > 0, \gamma_{e_i} > -1 \end{aligned} \tag{2}$$

where the restriction on γ_{e_i} reflects the fact that $m_i(\cdot)$ is multiplied by e_i.

The remainder of the economy is specified as follows. Household present value expected utility is given by:

$$E_0\Sigma_{t=1}^{\infty}\beta^t\left[2u(c_t) - e_{1t}v(h_{1t}) - e_{2t}v(h_{2t}) - e_{1t}m_1(e_{1t}) - e_{2t}m_2(e_{2t})\right]. \tag{3}$$

Labor is combined with capital, k_t, to produce goods using the following production technology:

$$y_t = \lambda_{1t}k_t^{\theta}H_t^{1-\theta} \tag{4}$$

where λ_{1t} is a productivity shock. Labor input H_t is expressed in efficiency units

$$H_t = e_{1t}h_{1t} + \lambda_2 e_{2t}h_{2t} \tag{5}$$

where λ_2 is the relative efficiency of the second worker. Goods are produced by perfectly competitive firms which implies that each input is paid its marginal product.

The single good is used for consumption by households, the government, g_t, or investment i_t:

$$y_t = 2c_t + i_t + g_t. \tag{6}$$

Capital is linked to investment in the following way:

$$k_{t+1} = (1-\delta)k_t + i_t \tag{7}$$

where δ is the depreciation rate on capital. The government budget constraint is given by:

$$g_t + TR_t = \tau_t(w_{1t}e_{1t}h_{1t} + w_{2t}e_{2t}h_{2t} + (r_t - \delta)k_t) \tag{8}$$

where TR_t are lump-sum transfers, τ_t is a tax on household income, w_i is the wage rate for worker i and r_t is the rental rate on capital. Finally, technology and the income tax rate are assumed to follow a first order Markov process:

$$\begin{bmatrix} \ln \lambda_{1t+1} \\ \ln(\tau_{t+1}/\overline{\tau}) \end{bmatrix} = \Lambda \begin{bmatrix} \ln \lambda_{1t} \\ \ln(\tau_t/\overline{\tau}) \end{bmatrix} + \boldsymbol{\varepsilon}_t \tag{9}$$

where $\overline{\tau}$ is the mean of the tax rate and $\boldsymbol{\varepsilon}_t$ is a $(2x1)$ vector of i.i.d. normal random variables with variance-covariance matrix Σ . Government purchases are assumed to follow: $g_t = \eta y_t$.

Given this structure a typical household chooses $\{c_t, y_t, i_t, k_{t+1}, h_{1t}, h_{2t}, e_{1t}, e_{2t}\}_{t=1}^{\infty}$.

to solve:

$$\max E_0 \Sigma_{t=1}^{\infty} \beta^t \left[2u(c_t) - e_{1t}v(h_{1t}) - e_{2t}v(h_{2t}) - e_{1t}m_1(e_{1t}) - e_{2t}m_2(e_{2t})\right] \tag{10}$$

subject to

$$2c_t + k_{t+1} = k_t + (1 - \tau_t)\left(w_{1t}e_{1t}h_{1t} + w_{2t}e_{2t}h_{2t}\right) + (1 - \tau_t)\left(r_t - \delta\right)k_t + TR_t \tag{11}$$

The first order conditions for the household's problem are given by:

c_t :

$$u'(c_t) = E_t \beta u'(c_{t+1}) \left\{ (1 - \tau_{t+1}) \lambda_{1t+1} r_{t+1} + (1 - \delta) \right\} \tag{12}$$

h_{1t} :

$$u'(c_t)(1 - \tau_t) w_{1t} = v_1'(h_{1t}) \tag{13}$$

h_{2t} :

$$u'(c_t)(1 - \tau_t) w_{2t} = v_2'(h_{2t}) \tag{14}$$

e_{1t} :

$$u'(c_t)(1 - \tau_t) w_{1t} h_{1t} = v_1(h_{1t}) + m_1(e_{1t}) + e_{1t} m'(e_{1t}) \tag{15}$$

e_{2t} :

$$u'(c_t)(1 - \tau_t) w_{1t} h_{2t} = v_2(h_{2t}) + m_2(e_{2t}) + e_{2t} m'(e_{2t}) \tag{16}$$

This economy can be supported as a recursive competitive equilibrium using the methods described in Hansen and Prescott (1995). In practice we solve for the equilibrium decision rules by first linearizing the economy around its perfect foresight steady state and then by solving the resulting set of linear expectational difference equations using the method of Blanchard and Kahn (1980).

5 Estimation Results

In this section we report estimation results for the model. The objective of this section is to produce estimates of model preference parameters that are consistent with the labor market facts we described in Section 3 for the U.S. and Japan. We do this in the following way. We solve the model, produce model simulated data, calculate summary moments for the simulated data and then compare these moments with analogue moments in Japanese data. We then search over the model preference parameters using Generalized Method of Moments (GMM) to minimize the difference between a set of model and data moments. This type of estimation strategy is also considered by Ingram and Lee (1998), and is applied to analyze real business cycle models in Christiano and Eichenbaum(1992) and Braun (1994). The general strategy of estimating labor supply parameters by solving and simulating a dynamic general equilibrium model is also used in Heckman et al. (1998).

5.1 Estimation Method

The model parameters fall into two categories. A subset of the parameters are fixed on a priori grounds and a second set of parameters are estimated using quarterly U.S. and Japanese data from 1976-2002. Parameters that are fixed include the capital share parameter which is set to a value of 0.36. This is the value used in Hayashi and Prescott (2002) using data from the 1980s. Braun, Okada and Sudou (2005) calibrate this same parameter using a longer sample period and report the same value. The depreciation rate is set to 0.025. This is the same value used when constructing our capital stock measure. The preference discount rate is set to 0.99 and implies that the annualized rate of time preference is 4 percent. We fix the auto-regressive parameter for the technology shock at 0.95. This is the same value used in e.g. Cho and Cooley (1994).

The share of government purchases to output, η, is calibrated to its sample average over the 1976-2002 sample period. For the U.S. the resulting value is 0.18 and in Japan it is 0.15. We assume that innovations to the tax rate are uncorrelated with innovations to technology. Mendoza, Razin and Tesar (1994) report annual time-series on effective labor tax rates for Japan and the U.S. We assume that this value of the tax rate applies to both personal labor and capital income. The mean of the tax rate is set to the average value of the effective labor tax rate reported in Mendoza, Razin and Tesar (1994) for each country. This results in a value of the tax rate of 0.29 in the U.S. and 0.24 in Japan. Their data on labor tax rates exhibits trends. This in conjunction with the fact that their data is annual lead us to calibrate the income tax process in the following way. First, we regress the tax data for each country on its own first lag, a constant and a deterministic trend. Next we derive the quarterly representation for the tax rate under the assumption that the quarterly model has an AR(1) law of motion and that the annual data is point sampled. We then perform a Monte-Carlo analysis using the implied quarterly representation to ascertain what setting of the HP smoothing parameter for the annual sampled data recovers the same variability of the tax rate as the quarterly sampled data. We find that the appropriate setting of the smoothing parameter is 9.2 for annual data in samples of the length of our data set. We then condition on a quarterly autoregressive coefficient of 0.95[3] and calibrate the quarterly standard deviation of the tax rate shock to reproduce the standard deviation of the annual HP filtered tax rate data for each country.

[3]The implied quarterly estimate of the autoregressive coefficient on the tax rate is 0.94 in Japan and 0.92 in the U.S. Since AR(1) estimates have a downward bias we set the value of the autogressive coefficient to 0.95 in each country.

The remaining parameters of the model are estimated. We estimate two basic specifications of the model described in Section 4 above: a heterogeneous agent version that models gender differences and a homogeneous version that abstracts from gender differences. The gender-based specification has nine remaining free parameters: $\Pi_g = \{a_{h_1}, a_{h_2}, a_{e_1}, a_{e_2}, \gamma_{h_1}, \gamma_{h_2}, \gamma_{e_1}, \gamma_{e_2}, \sigma_{\varepsilon_{\lambda_1}}\}$, where $\sigma_{\varepsilon_{\lambda_1}}$ is the standard deviation of the shock to technology. These parameters are estimated by GMM using the following nine moment conditions:

$$
\begin{aligned}
E\left[h_{1t}^d - h_{1t}^m\right] &= 0 \\
E\left[h_{2t}^d - h_{2t}^m\right] &= 0 \\
E\left[e_{1t}^d - e_{1t}^m\right] &= 0 \\
E\left[e_{2t}^d - e_{2t}^m\right] &= 0
\end{aligned}
\tag{17}
$$

$$
\begin{aligned}
E[(h_{1t}^d - \overline{h}_1^d)^2 - (\sigma_{h_1}^m)^2] &= 0 \\
E[(h_{2t}^d - \overline{h}_2^d)^2 - (\sigma_{h_2}^m)^2] &= 0 \\
E[(e_{1t}^d - \overline{e}_1^d)^2 - (\sigma_{e_1}^m)^2] &= 0 \\
E[(e_{2t}^d - \overline{e}_2^d)^2 - (\sigma_{e_2}^m)^2] &= 0 \\
E[(y_t^d - \overline{y}^d)^2 - (\sigma_y^m)^2] &= 0
\end{aligned}
\tag{18}
$$

where, d denotes actual data, m denotes model and an overbar denotes sample average. Moments for the model are calculated by solving and simulating the model for two hundred periods and then averaging over twenty replications.

Note that the number of moment conditions is the same as the number of parameters to be estimated so that the system is just-identified. Parameters estimated in this way have the property that the model exactly reproduces the following data facts: average weekly hours for males and females, average employment to population ratios for males and females, the variability of weekly hours for males and females, the variability of employment for males and females and the variability of output.

The free parameters for the homogeneous agent specification are $\Pi_h = \{a_h, a_e, \gamma_h, \gamma_e, \sigma_{\varepsilon_{\lambda_1}}\}$. These parameters are estimated in the same way as the gender-based specification but we use hours and employment data that are aggregated over males and females.

Estimation results are reported in Table 4. We report estimates for three different specifications. Column 1 and 2 report results for the homogenous agent specification using respectively U.S. and Japanese data. Column 3 reports gender based estimates for Japan. The gender based results assume that λ_2, the relative productivity of female workers is 0.61. This is the sample average of the ratio of female to male wages in the non-agricultural sector for our sample period. For the two homogeneous specifications we set this parameter to one.

Consider first the results for the U.S. Our homogeneous agent specification generalizes the model of Cho and Cooley (1994) by introducing shocks to the income tax rate. It is interesting to compare our estimates with their calibration. Our estimates of the risk aversion coefficients for hours per worker and employment are $\gamma_h = 0.58$ and $\gamma_e = -0.40$. They report values of $\gamma_h = 1$ and $\gamma_e = -0.38$ when they calibrate their model to macroeconomic data. Note first that the values of γ_e are almost identical. Our estimated value of γ_h is somewhat lower than their value of this parameter.

Next we turn to discuss the results for the Japanese homogeneous agent specification reported in column 2. These estimates indicate that Japanese households are less averse to variations in hours per worker and more averse to variations in the number of days worked. It is clear from these estimates that modeling differences in the processes for technology, and taxes in Japan and the U.S. is not sufficient to bridge the gap between the labor market facts in these two countries. The model needs to adjust the risk aversion coefficients on hours and employment in order to account for the increased relative variability in hours and the lower relative variability in employment that we see in Japanese data. However, allowing for fluctuations in taxes is essential to reproduce the levels of the volatility of hours per worker and employment in Japan. Without variations in the tax rate there is no setting of preference parameters that produces enough variability in hours per worker.

Column 3 reports results for the gender-based specification. We find that all of the male specific parameters are similar to those in the homogeneous specification. For females the biggest difference relative to the homogeneous specification is γ_{e_2}, which is much lower than for males. This reflects the fact that employment variability in the data is much larger for women than for men.

6 Simulation Results

Next we turn to report simulation results. We are interested in evaluating the performance of the model for other variables and moments that were not used when estimating the parameters. We also assess the role of the two shocks in accounting for movements in the different variables. Finally, we report pseudo labor supply elasticities that reflect the general equilibrium effects of technology and tax shocks on wages and hours.

Table 5 reports second moments for the data and the homogeneous U.S. and Japanese specifications. The sample period is 1976 to 2002 and the standard errors on the data moments are calculated using GMM with a Newey-West autocovariance estimator with four lags. Consider first the upper panel for the U.S. The model successfully reproduces the relative volatility of aggregate labor input, aggregate labor productivity, investment and capital. The model also successfully reproduces the pattern of correlations of output with investment, employment, hours and productivity. One gap between the model and U.S. data relates to consumption volatility.[4] The model produces considerably more consumption smoothing than we see in U.S. data. Consumption's relative volatility is 0.27 in the model and 0.58 in U.S. data.

It is interesting to compare these results with those obtained by Cho and Cooley (1994). Their model understates the variability of both hours per worker and employment in U.S. data. Our model, which has similar settings of the preference parameters, is able not only to match the variability of hours per worker and employment but to also reproduce other features of the U.S. business cycle. As noted in Braun (1994) and McGrattan (1994) fluctuations in taxes play a key role in generating additional volatility in labor market hours and employment. One way of assessing the plausibility of our tax specification is to compare the variability of tax revenues in the model with tax revenues in the data. Mendoza, Razin and Teser (1994) report that the relative variability of HP filtered labor tax revenue in the U.S. is 1.8. In our model simulations the relative volatility of labor tax revenue is 1.6.

[4]The U.S. data statistics for consumption reported here are based on consumption of non-durables and services.

The homogeneous specification for Japan is reported in the lower panel of Table 5 and the gender-based specification is reported in Table 6. Both specifications have similar second moment properties for many variables. Observe first that the volatility of investment in Japanese data is within one standard deviation of the model moments in both specifications. For, most other variables the models' predicted volatilities lie outside of standard deviation confidence intervals around Japanese data. The two models do better in matching the cross-correlations with output. The model predictions are within two standard deviations of the relevant data statistic for all variables except hours worked and employment. For these two variables the model values lie just outside of this confidence interval.

A distinction between the two Japanese specifications is that the gender-based specification is estimated to match gender specific data on hours per worker and employment. From Table 6 we see that this is not sufficient to insure that the model matches aggregate hours and aggregate employment. The reason for this is that both shocks have a symmetric effect on male and female hours per worker and employment. This, in turn, implies that hours per worker and employment are perfectly correlated for men and women. Japanese data, however, exhibits substantial independent variation in these variables. The correlation of hours per worker and employment for males is -0.06 and for females it is 0.17 and neither statistic is significantly different from zero using two standard deviation confidence bands.

It is also useful to compare the simulation results in the upper and lower panels of Table 5 which correspond respectively to the U.S. and Japanese homogeneous agent specifications. With the exception of the labor market volatility facts, both specifications are very similar. For instance, consistent with Fact 3, both models produce about the same amount of consumption smoothing. Note also that the low relative volatility of labor input and the high relative volatility of labor productivity in Japanese data are particularly puzzling from the perspective of our model. To understand why this is the case observe that in U.S. data aggregate labor input volatility is almost equal to the sum of hours and employment volatility. This is because hours and employment are highly positively correlated. The contemporaneous correlation between these two variables is 0.70 and the model which predicts a perfect correlation between these two variables performs well. However, in Japanese data there are important independent movements in these two variables that reduce the volatility of aggregate labor input. The contemporaneous cross-correlation of hours per worker and employment is 0.02 in Japan. It is clear that there is an important source of independent variation in these two variables in Japan that is absent from the model .

Next we turn to discuss the role of each of the two shocks in producing our results. Table 7 reports variance decompositions for the three specifications. The results are qualitatively similar in all three cases. Variations in technology are the main source of fluctuations in output, consumption, investment and capital. Over 65 percent of the variance in these variables is due to technology shocks. In the U.S. technology shocks account for 70 percent of the variance in output and 50 percent of the variance in labor productivity whereas in Japan variations in technology account for 81 percent of the variance in output and 66 percent of the variance in productivity. This finding is consistent with data Fact 2 which states that productivity is more correlated with output in Japan. More generally, in Japan technology accounts for a higher fraction of movements in all the variables we report.

Note next that the income tax is the key source of variation in labor market variables. In the U.S. 72 percent of the variation in each of these variables is due to fluctuations in the income tax and in Japan the income tax accounts for 60 percent of the variation in these variables. The reason why variation in the tax rate is so important for these variables is that it is directly affecting what Chari, McGrattan and Kehoe (2004) refer to as the labor wedge, which is defined to be the marginal rate of substitution between leisure and consumption divided by the marginal product of labor. Evidence in Braun, Okada and Sudou (2005) and Kobayashi and Inaba (2005) suggests that this wedge is very important in Japan. Braun, Okada and Sudou (2005) find that variations in TFP account for much of the variation in output, consumption, and investment in Japanese data but that variations in TFP do not account for the magnitude of movements in labor input nor the comovements with other macroeconomic variables. Kobayashi and Inaba (2005) find that there have been large variations in the labor wedge in Japan during the 1980s and 1990s. Our results indicate that variation in the tax rate on labor income may be a principal source of variation in the tax wedge in Japanese data.

Table 8 reports pseudo labor supply elasticities for hours per worker and employment for the three specifications. These elasticities summarize the general equilibrium responses of after-tax wages and hours or employment to each shock. The elasticity for hours per worker, for instance, is calculated as the ratio of the impact responses of hours per worker and the after-tax wage rate to each shock. The elasticity for employment is calculated in an analogous fashion. Consider first the elasticities for labor input in the two homogeneous agent specifications. We see that while the aggregate labor input elasticity for technology shocks is the same in Japan and the U.S., the employment elasticity is 1.9 times as large in the U.S. as in Japan whereas the hours per worker elasticity is 2.3 times as large in Japan. These numbers imply that an equivalent technology shock induced movement in the real wage produces the same change in labor input in Japan and the U.S. But that the mechanisms underlying these changes are dramatically different in the two countries. In the U.S. households are about 1.3 times as willing to adjust the extensive relative to the intensive margin. In Japan households are about 3.3 times as willing to move the intensive margin. For our preferences impulses to the tax rate produce the same magnitude of relative responses.

Now consider the gender-based elasticities for Japan. Observe first that female labor input is more elastic than male labor input. Underlying this fact are big differences in female attitudes towards hours and employment. Even though females are less risk averse to fluctuations in both hours and employment than males (γ_{h_1} is bigger than γ_{h_2}, and γ_{e_1} is bigger than γ_{e_2}), females are only more responsive than males in their employment decisions. Hours worked by females are less elastic than hours worked by males.

7 Conclusions

We have documented big differences in the Japanese and U.S. labor market. Both economies produce about the same volatility of labor input but hours and employment variability are very different in the two countries. We have also produced a theory that explains the source and magnitude of these differences. According to our theory the representative Japanese worker is twice as willing to adjust along the intensive margin of labor supply as compared to the extensive margin. On the other hand, the extensive margin is twice as responsive as the intensive margin for the representative U.S. worker. Finally, our model implies that Japanese females are on the margin more willing to adjust employment than Japanese males but less willing than males to adjust hours.

Our theory accounts for the differences in the aggregate variability in hours and employment across countries and gender. However, it does not produce independent variation in hours or employment. The two variables are perfectly correlated in the model. This gap between theory and data is particularly large in Japan where the empirical correlation between hours per worker and employment is about zero. A theory that draws a distinction on the technology side between hours per worker and employment might help resolve this issue. Search frictions in the labor market or precommitments to the employment level as in Burnside, Eichenbaum and Rebelo (1993) create this type of distinction.

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9 Data Appendix

We now explain in detail the construction of the variables reported in the tables.

Output

The output variable corresponds to Real Gross National Product (GNP) . The GNP series is constructed as the sum of “Personal Consumption Expenditures,” “Investment (defined below)” and “Government consumption expenditures and gross investment” less “Capital consumption of fixed capital by government." We subtract the last term since government purchases of investment goods are expensed in the DGE theory.

Consumption

Consumption corresponds to "Private consumption" series from NIPA.

Investment

Investment is constructed as the sum of "Gross private domestic investment," "Net exports of goods and services" and "Income payments to the rest of the world," less "Income payments from the rest of the word." All these variables are from the NIPA..

Government Purchases

Government purchases is constructed as "Government consumption expenditures and gross investment" less "Consumption of fixed capital by Government".

Capital Stock

In order to compute the capital stock we need to estimate the stock of inventories. This is done using the following formula: Inventory stock(t)= inventory investment(t)+residuals*0.25 where the residual is the difference of inventory ingredient between those estimated from inventory investment and the released data. We report two different measures of the capital stock. The first measure assumes variable depreciation. It is constructed from published data of the

investment and depreciation. This is the method used by Hayashi and Prescott (2002). However, we found that this measure has lots of volatility and that the source of this volatility is in the depreciation data. For this reason we also constructed an alternative measure of the capital stock that assumes constant geometric depreciation rate:

$$K_{t+1} = I(t) + (1 - \delta)K_t \tag{19}$$

where K_t is the value of the capital stock at the beginning of each period. We assumed that 1956 is the initial period and chose the depreciation rate so that the level of the capital stock in 2003 constructed from the method above does not differ from actual data by more than 0.0001$\dot{\text{W}}$e apply this procedure to private sector and government sector respectively and thus allow for a difference in δ between the two sectors.

Employment

The employment series represents the ratio between the total number of persons at work and the population aged 15 to 64. For Japan, the series "Persons at work" is drawn from the Labor Force Survey. The source for the U.S. series is the CPS. The population series is obtained from the Japanese Population Census and the U.S. Department of Labor, Bureau of Labor Statistics.

Weekly Hours

This variable has two sources for the Japanese tables. The variable in Table 1 corresponds to "Average weekly hours worked by a person at work" from the LFS, as reported by the MHLW. The variable in Table 3 corresponds to the variable "Hours actually worked" from the LFS, as reported by the ILO. The reason to have these two different sources is the lack of gender disaggregated data in the data reported by the MHLW.

Table 3 also reports weekly hours from the household survey. This variable corresponds to the series "Hours actually worked" of the LFS as reported by the ILO.

For the U.S. the weekly hours variable corresponds to the series "Average hours worked per week by a person at work" from the CPS.

Aggregate Hours

This series is constructed as the product of the series "employment" and "weekly hours", which are explained above. The employment series for both Japan and the U.S. and the weekly hours series for the U.S. are based on household survey data. However, the weekly hours series for Japan is based on establishment data. The reason for using establishment survey hours data is due to the limited number of years of the household survey weekly hours data.

Labor Productivity

The labor productivity series is constructed as the ratio of the "output" to "aggregate hours" series explained above.

Total Factor Productivity (TFP)

This series is constructed by using the "output" (Y), "capital" (K) and "aggregate hours" (H) series in the following way

$$TFP = \left(\frac{Y}{K^{0.36} H^{1-0.36}} \right)^{\frac{1}{1-0.36}}. \tag{20}$$

Table 1: Volatility and Cross-Correlations with Output. United States.

	Volatility		Cross Correlation of Variable X With Output										
Variable	% Std. Dev	Relative to Output	X(t−5)	X(t−4)	X(t−3)	X(t−2)	X(t−1)	X(t)	X(t+1)	X(t+2)	X(t+3)	X(t+4)	X(t+5)
Output	1.61	1.00	0.020	0.21	0.42	0.67	0.86	1.00	0.86	0.67	0.42	0.21	0.020
Consumption	1.21	0.75	0.17	0.36	0.52	0.71	0.85	0.89	0.76	0.57	0.35	0.15	−0.015
Investment	5.93	3.67	−0.064	0.10	0.30	0.53	0.72	0.88	0.74	0.56	0.33	0.13	−0.069
Government Purchases	1.69	1.04	−0.10	−0.09	−0.09	−0.01	0.06	0.16	0.18	0.20	0.24	0.32	0.35
Capital	0.37	0.23	−0.56	−0.56	−0.51	−0.40	−0.21	0.02	0.26	0.44	0.58	0.65	0.66
Labor Input	1.29	0.80	0.035	0.17	0.34	0.53	0.73	0.84	0.84	0.76	0.59	0.38	0.15
Employment	0.98	0.61	0.00033	0.12	0.28	0.46	0.66	0.78	0.81	0.75	0.61	0.41	0.19
Weekly Hours	0.41	0.25	0.11	0.24	0.41	0.57	0.71	0.77	0.71	0.59	0.40	0.23	0.024
Labor Productivity	0.89	0.55	−0.015	0.14	0.27	0.44	0.51	0.61	0.34	0.10	−0.11	−0.19	−0.21
TFP	1.63	1.01	0.073	0.26	0.44	0.66	0.78	0.88	0.64	0.37	0.10	−0.066	−0.19

Sample period: 1960.q1−2002.q4

Table 2: Volatility and Cross-Correlations with Output. Japan.

	Volatility		Cross Correlation of Variable X With Output										
Variable	% Std. Dev	Relative to Output	X(t−5)	X(t−4)	X(t−3)	X(t−2)	X(t−1)	X(t)	X(t+1)	X(t+2)	X(t+3)	X(t+4)	X(t+5)
Output	1.55	1.00	0.0016	0.23	0.43	0.62	0.80	1.00	0.80	0.62	0.43	0.23	0.0016
Consumption	1.13	0.73	0.10	0.29	0.45	0.53	0.59	0.65	0.45	0.27	0.13	−0.05	−0.15
Investment	4.30	2.78	−0.08	0.09	0.23	0.44	0.63	0.85	0.75	0.65	0.48	0.32	0.07
Government Purchases	2.36	1.53	0.08	0.13	0.18	0.14	0.14	0.14	0.01	−0.084	−0.08	−0.03	0.05
Capital	0.89	0.57	−0.33	−0.33	−0.28	−0.16	−0.013	0.14	0.32	0.47	0.58	0.64	0.65
Labor Input	1.00	0.65	0.16	0.28	0.39	0.51	0.56	0.63	0.51	0.43	0.24	0.07	−0.19
Employment	0.47	0.30	−0.17	−0.13	0.02	0.18	0.33	0.48	0.53	0.53	0.47	0.37	0.18
Weekly Hours	0.78	0.51	0.30	0.43	0.50	0.55	0.53	0.52	0.33	0.24	0.023	−0.13	−0.34
Labor Productivity	1.20	0.78	−0.13	0.063	0.22	0.37	0.56	0.76	0.61	0.44	0.35	0.24	0.16
TFP	1.86	1.20	0.01	0.24	0.42	0.58	0.74	0.93	0.69	0.45	0.28	0.10	−0.063

Sample period: 1960.q1−2002.q4

Table 3: Volatility and Cross-Correlations with Output by Gender. Japan.

		Volatility		Cross Correlation of Variable X With Output										
Variable	Gender	% Std. Dev	Relative to Output	X(t−5)	X(t−4)	X(t−3)	X(t−2)	X(t−1)	X(t)	X(t+1)	X(t+2)	X(t+3)	X(t+4)	X(t+5)
Labor Input	Total	0.78	0.64	0.18	0.34	0.45	0.59	0.65	0.67	0.69	0.60	0.46	0.29	0.075
	Male	0.72	0.60	0.20	0.35	0.43	0.58	0.67	0.70	0.66	0.55	0.37	0.20	0.0035
	Female	1.14	0.95	0.10	0.26	0.36	0.46	0.51	0.52	0.56	0.53	0.46	0.29	0.12
Employment	Total	0.41	0.34	−0.32	−0.18	−0.016	0.19	0.34	0.48	0.63	0.66	0.66	0.59	0.46
(Household Survey)	Male	0.37	0.31	−0.44	−0.32	−0.16	0.07	0.27	0.45	0.57	0.60	0.60	0.55	0.46
	Female	0.78	0.65	−0.12	−0.009	0.10	0.22	0.31	0.36	0.47	0.51	0.52	0.43	0.31
Weekly hours worked	Total	0.65	0.54	0.40	0.50	0.54	0.58	0.56	0.50	0.43	0.31	0.13	−0.03	−0.20
(Establishment Survey)	Male	0.64	0.54	0.46	0.56	0.57	0.62	0.60	0.53	0.41	0.28	0.076	−0.084	−0.25
	Female	0.71	0.59	0.29	0.42	0.48	0.50	0.48	0.44	0.39	0.30	0.16	−0.01	−0.15
Weekly hours worked	Total	0.71	0.59	0.71	0.73	0.66	0.53	0.40	0.19	−0.062	−0.25	−0.42	−0.53	−0.60
(Household Survey)	Male	0.81	0.67	0.78	0.81	0.75	0.64	0.50	0.29	0.055	−0.16	−0.34	−0.47	−0.58
	Female	0.60	0.50	0.62	0.64	0.50	0.35	0.23	0.00	−0.20	−0.36	−0.54	−0.59	−0.61

Sample period: 1976.q1−2002.q4

Table 4: Estimation Results.

	U.S.	Japan		
Parameter	Homogeneous Agent	Homogeneous Agent		Gender Based
a_h	5.73 (1.12)	4.42 (0.64)	a_{h1}	4.71 (0.58)
			a_{h2}	2.89 (0.36)
a_e	0.19 (0.06)	0.34 (0.12)	a_{e1}	0.23 (0.10)
			a_{e2}	0.12 (0.06)
γ_h	0.58 (0.19)	0.31 (0.14)	γ_{h1}	0.23 (0.12)
			γ_{h2}	0.21 (0.11)
γ_e	−0.40 (0.09)	1.06 (0.25)	γ_{e1}	1.15 (0.25)
			γ_{e2}	0.10 (0.25)
$\sigma_{\varepsilon\lambda 1}$	0.0054 (0.0010)	0.0048 (0.00086)		0.0045 (0.000088)

Table 5: Volatility and Cross-Correlations with Output. Data and Simulations - Homogeneous Agent Model.

Variable	Volatility: Data % Std. Dev	Volatility: Data Relative to Output	Volatility: Simulation % Std. Dev	Volatility: Simulation Relative to Output	Conteporaneous Correlations with output: Data	Conteporaneous Correlations with output: Simulation
U.S.						
Output	1.47 (0.25)	1.00	1.47	1.00	1.00 (0.00)	1.00
Consumption	0.85 (0.13)	0.58	0.40	0.27	0.79 (0.28)	0.86
Investment	5.55 (0.67)	3.78	4.42	3.00	0.85 (0.27)	0.99
Capital	0.34 (0.035)	0.23	0.39	0.27	−0.035 (0.19)	0.35
Labor input	1.38 (0.20)	0.94	1.47	1.00	0.92 (0.31)	0.88
Employment	1.07 (0.14)	0.72	1.07	0.72	0.88 (0.28)	0.88
Weekly hours worked	0.41 (0.061)	0.28	0.41	0.28	0.82 (0.32)	0.88
Labor productivity	0.56 (0.058)	0.38	0.65	0.44	0.34 (0.19)	0.35
After tax wage			0.56	0.38		0.96
Real return on capital			1.50	1.02		0.97
Technology shock (λ_t)			0.71	0.48		0.94
Income tax (τ)			1.84	1.25		−0.65
Japan						
Output	1.20 (0.17)	1.00	1.20	1.00	1.00 (0.00)	1.00
Consumption			0.34	0.28		0.87
Investment	3.33 (0.44)	2.77	3.61	3.00	0.80 (0.26)	0.99
Capital	0.46 (0.05)	0.38	0.32	0.26	0.14 (0.17)	0.47
Labor input	0.78 (0.11)	0.64	1.06	0.88	0.66 (0.21)	0.90
Employment	0.41 (0.046)	0.34	0.41	0.34	0.47 (0.21)	0.90
Weekly hours worked	0.65 (0.10)	0.54	0.65	0.54	0.49 (0.18)	0.90
Labor productivity	0.90 (0.10)	0.75	0.52	0.43	0.76 (0.23)	0.47
After tax wage			0.48	0.40		0.96
Real return on capital			1.23	1.02		0.97
Technology shock (λ_t)			0.63	0.52		0.90
Income tax (τ)			1.63	1.35		−0.44

Sample period: 1976.q1–2002.q4

Table 6: Volatility and Cross-Correlations with Output. Data and Simulations - Gender Based. Japan.

Variable		Volatility				Conteporaneous Correlations with output	
		Data		Simulation		Data	Simulation
		% Std. Dev	Relative to Output	% Std. Dev	Relative to Output		
Output		1.20 (0.17)	1.00	1.20	1.00	1.00 (0.00)	1.00
Consumption				0.33	0.27		0.87
Investment		3.33 (0.44)	2.77	3.63	3.01	0.80 (0.26)	0.99
Capital		0.46 (0.05)	0.38	0.32	0.27	0.14 (0.17)	0.34
Labor input	Total	0.78 (0.11)	0.64	1.14	0.94	0.66 (0.21)	0.91
	Male	0.72 (0.10)	0.60	1.01	0.84	0.67 (0.21)	0.91
	Female	1.14 (0.15)	0.95	1.48	1.23	0.51 (0.19)	0.91
Employment	Total	0.41 (0.046)	0.34	0.53	0.44	0.47 (0.21)	0.91
Weekly hours worked	Total	0.65 (0.10)	0.54	0.67	0.56	0.49 (0.18)	0.91
Labor productivity	Total	0.90 (0.10)	0.75	0.50	0.42	0.76 (0.23)	0.34
After tax wage	Male			0.41	0.34		0.94
	Female			0.41	0.34		0.94
Real return on capital				1.23	1.02		
Technology shock (λ_t)				0.59	0.49		0.87
Income tax (τ)				1.63	1.35		−0.49

Sample period: 1976.q1–2002.q4

Table 7: Variance Decompositions

Variable	U.S. Homogeneous Agent Tech.	U.S. Homogeneous Agent Tax	Japan Homogeneous Agent Tech.	Japan Homogeneous Agent Tax		Japan Gender Based Tech.	Japan Gender Based Tax
Output	70.06	29.94	80.69	19.31		76.84	23.16
Consumption	81.86	18.14	89.00	11.00		85.94	14.06
Investment	66.11	33.89	77.59	22.41		73.63	26.37
Capital	66.11	33.89	77.59	22.41		73.63	26.37
Labor input	28.45	71.55	40.34	59.66	Total	37.54	62.46
					Male	37.54	62.46
					Female	37.54	62.46
Employment	28.45	71.55	40.34	59.66	Total	37.54	62.46
					Male	37.54	62.46
					Female	37.54	62.46
Weekly hours worked	28.45	71.55	40.34	59.66	Total	37.54	62.46
					Male	37.54	62.46
					Female	37.54	62.46
Labor productivity	50.37	49.63	66.26	33.74	Total	56.73	43.27
					Male	56.73	43.27
					Female	56.73	43.27
After tax wage	65.66	34.34	75.38	24.62	Total	75.10	24.90
					Male	75.10	24.90
					Female	75.10	24.90
Real return on capital	69.89	30.11	80.56	19.44		76.70	23.30
Technology shock (λ_t)	100	0	100	0		100	0
Income tax (τ)	0	100	0	100		0	100

Table 8: Elasticities

	U.S.		Japan				
	Homogeneous Agent		Homogeneous Agent			Gender Based	
Variable	Tech.	Tax	Tech.	Tax		Tech.	Tax
Labor input	11.54	25.42	11.50	24.45	Male	9.54	21.60
					Female	14.69	33.28
Employment	2.93	6.45	1.54	3.27	Male	1.25	2.82
					Female	2.43	5.50
Weekly hours worked	2.22	4.89	5.08	10.81	Male	5.29	11.98
					Female	4.03	9.12