**Declined Effectiveness of Fiscal and Monetary Policies Faced with Aging Population and Pension Asset Management**[1]

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**Abstract**

This paper studies how an aging population affects economic performance and the effectiveness of fiscal and monetary policies. We develop a New Keynesian dynamic stochastic general equilibrium model with heterogeneous households, workers, and retirees. We demonstrate that an increase in the proportion of working population increases aggregate output, consumption, and investment by increasing total labor supply in the long run. It also increases wages and reduces social security burden of the government. This paper also finds that effectiveness of fiscal and monetary policies is weakened when the proportion of retirees becomes larger. This is the reason why recent monetary policies cannot recover the Japanese economy from the prolonged stagnation.

The Pension asset management is another important issue in face with aging population. Fee and commission structure is important to make asset management company, sales agents and pension funds. The same thing can be applied to investment trust asset management. The paper proposes the desired fee structure of pension asset management.

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## 1. Introduction

Japan's economy has suffered from the long-term stagnation after the burst of the bubble of 1990. Fiscal and monetary policies have been implemented to recover the Japanese economy. Specifically, zero interest rate policy and quantitative and qualitative monetary policy were pursued, and large expansionary fiscal packages were implemented. However, a number of studies show that the effectiveness of monetary and fiscal policies has been diminished (Nakahigashi and Yoshino 2016; Yoshino et al. 2016). Moreover, it has been pointed out that the deep cause of the Japanese recession relies on aging population and lack of new startups (Yoshino and Farhad Taghizadeh-Hesary 2014).

This paper studies how population aging affects an economic performance. Japan is undergoing a sustained process of population aging. As seen in Figure 1, the working population is diminishing drastically, and the elderly population is growing rapidly. We will show the necessary policy to cope with an aging population is to keep the old people continuing to work by paying marginal product of labor, which reduces the government's social security burden.

This study also assesses the effect of population aging on the effectiveness of fiscal and monetary policies. Recently, some economists are proposing fiscal stimulus to boost the Japanese economy. However, the economic effect of infrastructure investment in Japan had been drastically diminished (Nakahigashi and Yoshino 2016).[2] Furthermore, a huge increase of social security due to population aging made Japan's budget deficits skyrocket (Figures 2 and 3), making difficult to expand government spending. This paper addresses the suitable fiscal policy in face with aging population. The paper also addresses the declining effect of monetary policy due to diminished marginal productivity of capital faced with an aging population (Yoshino and Farhad Taghizadeh-Hesary 2016).

In order to study the effects of population aging on economic performance and the effectiveness of fiscal and monetary policies, we develop a dynamic stochastic general equilibrium (DSGE) model with heterogeneous consumers, young and old people. We assume that young people provide labor services and earn wages while old people do not provide any labor services but obtain the social security benefits from the government. Thus, in our model, young people are workers and old people are retirees. It is assumed that retirees spend all income for consumption in each period of time, while workers maximize their lifetime utility function subject to a budget constraint. In the model, the proportion of retirees is exogenously determined and by changing the proportion parameter, we can examine the effects of a gradual

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[2] Nakahigashi and Yoshino (2016) demonstrate that the effect of public investment in Japan has been diminished by using a translog production function.

population aging on the economy.

We demonstrate that a decline in the proportion of working population, i.e., population aging, reduces output and aggregate consumption in the long run. This is because of higher social security costs. In the economy, pension benefits to retirees are financed by taxes imposed on workers and issues of government bonds. Given a fixed amount of pension benefits per retiree, a decline in the proportion of workers increases the tax paid by each worker. Thus, population aging reduces consumption of a worker due to a negative wealth effect. Due to the negative wealth effect, each worker provides more labor supply. However, a decline in working population pushes down total labor supply, decreasing output. Our model also shows that the decline in working population also reduces aggregate investment.

The striking finding is that population aging weakens the effectiveness of fiscal and monetary policies. By comparing the dynamic responses to fiscal and monetary policy shocks in a model with a small working population (aging economy) with those in a model with a large working population, we find that qualitatively the effects of macroeconomic policy shocks are the same between two economies. However, we find that quantitatively, the effects are mitigated as the proportion of working population decreases. This is mainly because of lower total labor supply.

Our results suggest that a necessary policy to cope with aging population is to keep the old people working by paying wages at the level of marginal productivity of labor. In the long run, making old people continue to work will bring higher output, which brings a higher level of consumption. If old people keep on working, they do not rely so much on social welfare, which brings a lower level of tax, and thus the tax burden of the younger generation declines. Disposable income of the young generation rises and their consumption will rise. By the survey conducted by the Bank of Japan, only 22% of the people want to retire immediately. About 67% of the people want to work longer after 60 years old. Some want to work even after 80 years old.

A number of studies are related to this paper. Fujiwara and Teranishi (2008) examine how demographic changes affect the dynamic response of an economy to a monetary policy shock by using a dynamic New Keynesian life cycle model. Wang (2016) assesses the effects of demographic changes on the transmission of a monetary policy to consumption by using a life cycle model. While these papers focuses on the effect of demographic changes on the effectiveness of monetary policy, we study not only the effects of demographic changes on the transmission of the monetary policy but also that on the fiscal policy. Furthermore, we develop a tractable DSGE model which enables us to analyze effects of demographic changes on the economy without assuming life cycle of agents. This is the novelty of the current paper.

Iman (2015) demonstrates that the effectiveness of a monetary policy becomes weak as society is graying by analyzing the panel data of advanced countries. Although his focus is on the effects of monetary policy on unemployment and inflation, which is not our focus, our view that population aging weakens the effectiveness of a monetary policy is consistent with his findings.

The reminder of the paper is organized as follows. In section 2, we extend the standard New Keynesian model by allowing the presence of retired workers. Section 3 calibrates the model. Section 4 examines how the demographic structure affects the performance of the economy and the effects of macroeconomic policies. Section 5 addresses the issue of pension asset management. The desired fee structure to provide incentive mechanism to asset managers will be proposed.

## 2. The Model

The economy consists of two types of households, a continuum of firms producing differentiated intermediate goods, a perfectly competitive final good firm, and a government in charge of monetary and fiscal policies. Except for the presence of heterogeneous households, our model structure is similar to a standard DSGE model with staggered price setting à la Calvo (1983).

### 2.1 Household's Problem

There are two types of infinitely lived households. A fraction $\varphi$ of households provides labor services and earns wages. We refer to them as workers. Besides providing their labor services, workers buy and sell physical capital and government bonds. The remaining fraction of $1-\varphi$ of households do not provide any labor services but obtain the social security benefits from the government. We refer them as retirees. We assume that workers maximize their intertemporal utility function subject to a lifetime budget constraint, while retirees consume all resources in each period of time.

#### 2.1.1 Worker's problem

We begin by seeing the worker's problem. Following Linnemann and Schaubert (2003) and Brückner and Pappa (2012), we assume that the consumer's utility depends on government consumption. This is because the government typically does not produce only waste, but supplies goods that are of value to the household such as schools, roads, local public utilities, and so on. Furthermore they are more or less substitutable with private consumption goods.

The expected lifetime utility function of a worker is given by

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{1}{1-\sigma} \left[ \left\{ \omega c_{w,t}^{\frac{\zeta-1}{\zeta}} + (1-\omega)\, g_t^{\frac{\zeta-1}{\zeta}} \right\}^{\frac{\zeta}{\zeta-1}} \right]^{1-\sigma} + \frac{m_{w,t}^{1-\gamma}}{1-\gamma} - \frac{h_{w,t}^{1+\mu}}{1+\mu} \right\}, \tag{1}$$

where $\beta \in (0,1)$ is an individual's subjective discount factor, $c_{w,t}$ is a worker's consumption, g_{t} is government consumption, $m_{w,t}$ is real money balances, and $h_{w,t}$ is hours of work. The parameter $\gamma$ determines the elasticity of money demand, $\mu$ is the inverse of the Frisch elasticity of labor supply, and $1/\sigma$ is intertemporal elasticity of substitution. The parameter $\zeta$ is the elasticity of substitution between private and government consumption and the share parameter $\omega$ determines how much government consumption affects utility.

The worker chooses consumption $c_{w,t}$, physical capital $k_{w,t}$, real money balances $m_{w,t}$, and government bonds $b_{w,t}$ to maximize the above expected lifetime utility function subject to the budget constraint:

$$c_{w,t} + k_{w,t} + m_{w,t} + b_{w,t} = w_t h_{w,t} + r_{k,t} k_{w,t-1} + (1-\delta) k_{w,t-1} + R_{t-1} \frac{b_{w,t-1}}{\pi_t} + \frac{m_{w,t-1}}{\pi_t} + d_{w,t} - \tau_{w,t}, \tag{2}$$

where $w_t$ is real wages, $r_{k,t}$ is the real rental rate of capital, $R_t$ is the nominal interest rate, $d_{w,t}$ is the dividend that the worker receives from the firm sector, $\tau_{w,t}$ is the lump-sum tax, $P_t$ is the nominal price level, and $\pi_t \equiv P_t / P_{t-1}$ is the gross inflation rate.

The evolution of physical capital stock is given by

$$k_{w,t} = (1-\delta) k_{w,t-1} + i_{w,t}, \tag{3}$$

where $\delta$ is the depreciation rate and $i_{w,t}$ is investment.

The worker's optimization problem yields the following first-order conditions:

$$\left( \omega c_{w,t}^{\frac{\zeta-1}{\zeta}} + (1-\omega)\, g_t^{\frac{\zeta-1}{\zeta}} \right)^{\frac{1-\sigma\zeta}{\zeta-1}} \omega c_{w,t}^{\frac{-1}{\zeta}} = \lambda_t, \tag{4}$$

$$m_{w,t}^{-\gamma} + \beta \mathbb{E}_t \lambda_{t+1} \frac{1}{\pi_{t+1}} = \lambda_t, \tag{5}$$

$$h_{w,t}^{\mu} = \lambda_t w_t, \tag{6}$$

$$\beta \mathbb{E}_t \lambda_{t+1} \left[ r_{k,t+1} + 1 - \delta \right] = \lambda_t, \tag{7}$$

$$\beta \mathbb{E}_t \frac{\lambda_{t+1} R_t}{\pi_{t+1}} = \lambda_t, \tag{8}$$

where $\lambda_t$ is the Lagrange multiplier on the budget constraint.

### 2.1.2 Retiree's problem

The remaining measure of 1–φ consumers is retired. The lifetime utility function of a retiree is given by

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{1}{1-\sigma} \left[ \left\{ \omega c_{r,t}^{\frac{\zeta-1}{\zeta}} + (1-\omega) g_t^{\frac{\zeta-1}{\zeta}} \right\}^{\frac{\zeta}{\zeta-1}} \right]^{1-\sigma}, \tag{9}$$

where $c_{r,t}$ is a retiree's consumption.

It is assumed that retirees do not maximize consumption intertemporally and simply consume their income each period.[3] Thus, the consumption of a retiree $c_{r,t}$ is

$$c_{r,t} = s \tag{10}$$

where s is the social security benefit in the real term.

### 2.2 Firm's Problem

As we explained earlier, there are two types of firms: a perfectly competitive final good firm and monopolistically competitive intermediate goods firms indexed by j∈[0,1].

#### 2.2.1 The final good producer

The final good $Y_t$ is produced by combining a continuum of differentiated intermediate goods $y_{j,t}$ produced by the firm j. The production function of the final good producer is given by

$$Y_t = \left( \int_0^1 y_{j,t}^{\frac{\epsilon-1}{\epsilon}} dj \right)^{\frac{\epsilon}{\epsilon-1}}, \tag{11}$$

where ε governs the degree of substitution between different inputs.

The final good producer is perfectly competitive and maximizes real profits subject to (11), taking as given input prices $P_{j,t}$ and the final good price $P_t$. Thus, the problem of the final good producer is

$$\max_{y_{j,t}} P_t Y_t - \int_0^1 P_{j,t} y_{j,t} dj. \tag{12}$$

This yields the demand for intermediate goods:

$$y_{j,t} = \left( \frac{P_{j,t}}{P_t} \right)^{-\epsilon} Y_t. \tag{13}$$

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[3] Instead of assuming that retirees only consume social security benefits each period, we may assume that they have initial wealth and have decisions of saving. However, this does not change our main results.

Substituting (13) into (11), we have the following relationship between the aggregate price level and the prices of intermediate goods:

$$P_t^{1-\epsilon} = \int_0^1 \left(P_{j,t}\right)^{1-\epsilon} dj. \tag{14}$$

**2.2.2 Intermediate goods firms' problem**

The production function of intermediate goods firm j is given by

$$y_{j,t} = \left(k_{j,t}^d\right)^{\alpha} \left(h_{j,t}^d\right)^{1-\alpha} k_{g,t}^{\alpha_g}, 0 < \alpha < 1, \alpha_g > 0, \tag{15}$$

where $k_{j,t}^d$ and $h_{j,t}^d$ represent capital and labor services hired by firm j, and $k_{g,t}$ is aggregate public capital.

Cost minimization implies

$$\frac{k_{j,t}^d}{h_{j,t}^d} = \frac{\alpha w_t}{(1-\alpha) r_{k,t}}. \tag{16}$$

This equation implies that the capital–labor ratio is equalized across intermediate goods producers. Then, the marginal costs of firms are given by

$$mc_t = \frac{w_t}{(1-\alpha) k_{g,t}^{\alpha_g}} \left[\frac{(1-\alpha) r_{k,t}}{\alpha w_t}\right]^{\alpha}. \tag{17}$$

We assume that intermediate goods firms are subject to price setting frictions à la Calvo (1983). Thus, an intermediate goods firm can set its price optimally with probability 1–ξ, and with probability ξ it must keep its price unchanged relative to what it was in the previous period:

$$P_{j,t} = P_{j,t-1}. \tag{18}$$

A firm optimizing its price maximizes

$$\max_{P_t^*} \mathbb{E}_t \sum_{i=0}^{\infty} (\beta\xi)^i \lambda_{t+i} \left\{P_t^* - P_{t+i} mc_{t+i}\right\} y_{t+i} \tag{19}$$

subject to the demand function

$$y_{t+i} = \left(\frac{P_t^*}{P_{t+l}}\right)^{-\epsilon} Y_{t+l}, \tag{20}$$

and where $P_t^*$ is the optimal nominal price.

The profit maximization problem yields

$$P_{j,t}^* = \frac{\epsilon}{\epsilon - 1} \frac{\mathbb{E}_t \sum_{i=0}^{\infty} (\beta\xi)^i \lambda_{t+i} mc_{t+i} y_{t+i}}{\mathbb{E}_t \sum_{i=0}^{\infty} (\beta\xi)^i \lambda_{t+i} \frac{y_{t+i}}{P_{t+i}}}. \tag{21}$$

Finally, the law of motion for the aggregate price level is given by

$$P_t = \left[\xi P_{t-1}^{1-\epsilon} + (1-\xi) P_{j,t}^{*1-\epsilon}\right]^{\frac{1}{1-\epsilon}}. \tag{22}$$

**2.3 Aggregation**

The aggregate level of any consumer-specific variables $x_{i,t}$ where $i \in [w, r]$ is given by $x_t = \int_0^1 x_{i,t} di = \phi x_{w,t} + (1-\phi) x_{r,t}$, as consumers in each of the two groups are identical. Hence, aggregate consumption $c_t$ is given by

$$c_t = \phi c_{w,t} + (1-\phi) c_{r,t}. \tag{23}$$

Since only workers provide labor services and accumulate physical capital, aggregate hours of worker $h_t$, aggregate capital stock $k_{t-1}$, and aggregate investment $i_t$ are given by

$$h_t = \phi h_{w,t}, \tag{24}$$
$$k_{t-1} = \phi k_{w,t-1}, \tag{25}$$
$$i_t = \phi i_{w,t}. \tag{26}$$

Similarly, only workers hold real money and financial assets

$$m_t = \phi m_{w,t}, \tag{27}$$
$$b_t = \phi b_{w,t}, \tag{28}$$

and only workers receive dividends from firms and pay the lump-sum tax

$$d_t = \phi d_{w,t}, \tag{29}$$
$$\tau_t = \phi \tau_{w,t}. \tag{30}$$

**2.4 Fiscal and Monetary Authorities**

The government purchases goods for consumption $g_t$ and investment purpose $i_{g,t}$ and pays social security benefits $s(1-\phi)$. It finances them by levying the lump-sum tax and issuing government bonds. Hence, the government budget constraint in real terms is given by

$$b_t + \tau_t + \left(m_t - \frac{m_{t-1}}{\pi_t}\right) = g_t + i_{g,t} + R_{t-1}\frac{b_{t-1}}{\pi_t} + s(1-\phi). \tag{31}$$

The law of motion for public capital is

$$k_{g,t} = (1-\delta_g) k_{g,t-1} + i_{g,t}, \tag{32}$$

where $\delta_g$ is the depreciation rate for public capital.

Government spending $g_t$ follows a stochastic process:

$$\log(g_t) = (1-\rho_g)\log(g) + \rho_g \log(g_{t-1}) + \varepsilon_{g,t},\ \varepsilon_{g,t} \sim N(0, \sigma_g^2). \tag{33}$$

Similarly, the government investment takes the following form:

$$\log(i_{g,t}) = (1-\rho_i)\log(i_g) + \rho_i \log(i_{g,t-1}) + \varepsilon_{i,t},\ \varepsilon_{i,t} \sim N(0, \sigma_i^2). \tag{34}$$

We allow for debt financing, but assume that there exists a tax rule to keep the level of real debt constant in the long run. Thus, the tax rule is

$$\frac{\tau_t}{\tau} = \left(\frac{b_{t-1}}{b_t}\right)^{\psi}, \tag{35}$$

where ψ is the feedback parameter from debt to taxes which insures determinacy.

Monetary policy follows a Taylor rule,

$$\frac{R_t}{R} = \left(\frac{\pi_t}{\pi}\right)^{\varphi_\pi} \left(\frac{Y_t}{Y}\right)^{\varphi_Y} \exp(\nu_t), \tag{36}$$

where any variable without time subscript denotes the corresponding steady-state value of the variable, $\varphi_\pi$ indicates how strongly the monetary authority respond to deviations of inflation from target, $\varphi_Y$ is the response to the output gap, and $\upsilon_t$ follows a stochastic process:

$$\nu_t = \rho_\nu \nu_{t-1} + \varepsilon_{\nu,t}, \varepsilon_{\nu,t} \sim N(0, \sigma_\nu^2). \tag{37}$$

### 2.5 Market Clearing Conditions

The labor market is in equilibrium when the labor demand by the intermediate goods firms $h_t^d \equiv \int_0^1 h_{j,t}^d dj$ is equal to the labor services supplied by workers. Similarly, the capital rental market is in equilibrium when the demand for capital by the intermediate goods firms $k_t^d \equiv \int_0^1 k_{j,t}^d dj$ equals to the capital supply by consumers. The interest rate is determined by the monetary policy rule. In order to maintain money market equilibrium, the money supply adjusts endogenously to meet the money demand at those interest rates. The final good market is in equilibrium when the supply by the final good firms (equation (15)) equals the demand by consumers and government:

$$Y_t = c_t + i_t + g_t + i_{g,t}. \tag{38}$$

## 3. Calibration

In this section, we calibrate the model to match several dimensions of the Japanese data. Calibrated parameter values are summarized in Table 1. We choose the model period to be one quarter and set the subjective discount factor $\beta$=0.99, implying a steady-state real interest rate of 4% per year.

We calibrate the parameters related to the consumer's utility function based on existing studies. The risk aversion parameter $\sigma$ is set to 1. We choose $\mu$=2.0 or the Frisch elasticity is 1/$\mu$=0.5, which is consistent with the micro evidence that Frisch elasticity is less than one. Our parameter value is also consistent with the evidence that the Frisch elasticity for males in Japan is in the range of 0.2–0.7 (Kuroda and Yamamoto 2008). The inverse of the interest elasticity of money demand gamma is set to $\gamma$=1.5 based on Kuo and Miyamoto (2016). Based on Hamori and Asako (1999) and Bruckner and Pappa (2012), we set the share parameter $\omega$=0.6 and the elasticity of substitution between private and government consumption $\zeta$=0.4.

In the production function, we set $\alpha$=1/3 to target the capital share. We normalize the technology level to A=1 without loss of generality. Based on Yoshino and Nakajima (1999), we set the elasticity of output with respect to public capital $\alpha_g = 0.129$. Following Esteban-Pretel et al. (2010), we set the deprecation rate to be $\delta$=0.028. We assume that the depreciation rates are the same between private and public sectors. Thus, $\delta_g = \delta$.

We also calibrate the parameters related to nominal rigidities based on existing studies. Specifically, the elasticity of demand is set to $\varepsilon$=11, which implies a steady-state markup of 10%. This is the conventional value in the literature. Estimates of the Calvo parameter for price in Japan are in range of 0.72–0.88 (Iiboshi et al. 2006; Sugo and Ueda 2008; Ichiue et al. 2013; Kuo and Miyamoto 2016). Given this, we set the Calvo parameter to $\xi$=0.8, which implies that the average contract duration of price setting is about 5 quarters.

We choose the value of the fraction of workers $\phi$ based on the ratio for the population aged 20–64 to the population aged 20 or older. According to the National Institute of Population and Social Security Research, over the period of 1970–2000, the mean value of the ratio is about 0.85. Thus, for the benchmark case, we set $\phi = 0.85$.

We now turn to the policy parameters. For the Taylor rule, in order to maintain comparability with existing studies (Clarida et al. 1998; Fukuda and Terayama 2004; Fujiwara et al. 2007; Fujiwara et al. 2008), we set $\varphi_\pi = 1.5$ and $\varphi_Y = 0.1$. For the feedback parameter from debt to taxes in the tax rule, we set $\psi$=0.1. This value is also used by Mayer et al. (2010).

We pin down the value of social security benefits s by targeting the ratio of the average social benefits to the average wages. Based on surveys, Explanation of the Statistical Survey of Actual Status for Salary in the Private Sector conducted by the National Tax Agency, and the annual report on the public pension system conducted by the Ministry of Health, Labour and Welfare, the ratio of the average monthly pension benefits to the average monthly salary is about 0.4. So, we calibrate s by targeting this.

Based on the data, we set the steady-state value for government spending to output ratio g/Y=0.16, the steady-state value for government investment expenditure to output ratio $i_g/Y$=0.06, and the steady-state value for debt to output ratio b/Y=1.7. Following Kato and Miyamoto (2013), we also set the value for the government spending autoregressive parameters $\rho_g = \rho_i = 0.9$. Finally, following Gali (2008), we consider a moderately persistent monetary shock and we set $\rho_v = 0.5$.

Table 1: Parameter values

| Parameter | Description | Value | Source/Target |
|---|---|---|---|
| $\beta$ | Discount factor | 0.99 | Data |
| $\sigma$ | Relative risk aversion parameter | 1.0 | See text |
| $\mu$ | The inverse of Frisch elasticity | 2.0 | Kuroda and Yamamoto (2008) |
| $\gamma$ | The inverse of the interest elasticity of money demand | 1.5 | Kuo and Miyamoto (2016) |
| $\omega$ | share parameter | 0.6 | See text |
| $\zeta$ | Elasticity of utility function | 0.4 | See text |
| $\alpha$ | Capital share | 1/3 | Data |
| $\alpha_g$ | Elasticity of output with respect to public capital | 0.129 | Yoshino and Nakajima (1999) |
| $A$ | Aggregate productivity | 1.0 | Normalization |
| $\delta$ | Depreciation rate | 0.028 | Esteban-Pretel et al. (2010) |
| $\delta_g$ | Depreciation rate | 0.028 | $\delta = \delta_g$ |
| $\epsilon$ | Elasticity of demand | 11 | See text |
| $\xi$ | Calvo parameter | 0.8 | See text |
| $\phi$ | Fraction of workers | 0.85 | Data |
| $\varphi_\pi$ | Taylor-rule coefficient for inflation | 1.5 | See text |
| $\varphi_Y$ | Taylor-rule coefficient for output | 0.1 | See text |
| $\psi$ | Feedback parameter in the tax rule | 0.1 | See text |
| $s$ | Social security benefits | 0.900 | See text |
| $\rho_g$ | Persistency of the gov. consumption shock | 0.9 | Data |
| $\rho_i$ | Persistency of the gov. investment shock | 0.9 | Data |
| $\rho_v$ | Persistency of the monetary policy shock | 0.5 | See text |

## 4. Quantitative Analysis

This section examines how a demographic change influences the economy. We first examine the long-run effects of a change in the proportion of working population on the aggregate economy. We then investigate how a change of demographic structure alters the effectiveness of fiscal and monetary policies in the short run.[4]

[4] We solve the model by approximating the equilibrium conditions around a non-stochastic steady state. We then examine the dynamic responses of the economy to macroeconomic policy shocks.

### 4.1 The Long-Run Effect of Aging

We first examine the long-run effects of a demographic structure change on the economy by calculating the steady-state response to an increase in the proportion of workers. The results are shown in Figure 4.

An increase in labor participation increases output, aggregate consumption, aggregate investment, and total labor input. The effect of the change in the proportion of workers on the economy can be understood by examining the response of taxes paid by workers. In the economy, pension benefits to retirees are financed by imposing taxes on workers. In other words, the pension benefits are transfers from tax payments by workers. Since the amount of pension benefits per retiree is fixed, an increase in the proportion of working population reduces the tax paid by each worker. Since a retired person receives a fixed amount of pension benefits and consumes all of it in each period, consumption of those who are retired do not change. In contrast, consumption of a worker increases due to the reduction of tax. This leads to a higher aggregate consumption.

The positive wealth effect of decreased taxes also reduces the labor supply of each worker. However, an increase in working population pushes up total labor supply, leading to higher output. The decrease in the proportion of retirees reduces the amount of investment of each worker. However, aggregate investment increases because of the increase in working population.

Interestingly, wages rise as labor participation increases. This is because the increase in working population increases the capital–labor ratio. Since an increase in working population increases workers' consumption, welfare increases as labor participation increases.[5]

### 4.2 Dynamics

We now study the dynamic responses of the economy to various macroeconomic policy shocks. In particular, we are interested in examining how the demographic structure affects the dynamic responses of the economy to shocks.

#### 4.2.1 Government consumption shock

We first examine the effects of a government consumption shock on the economy. We are

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[5] We define the welfare function as $W=\varphi W_{w}+(1-\varphi)W_{r}$, where $W_{w}$ and $W_{r}$ are the utility of workers and retirees, respectively.

interested in (i) the transmission mechanism of the government spending shock and (ii) how the demographic structure affects the effects of the government spending shock on the economy.

The solid lines in Figure 5 display the impulse responses of relevant variables to a one-standard-deviation government consumption shock in the benchmark case. A positive government spending shock increases workers' consumption and labor supply. In a standard DSGE model, an increase in government consumption is more likely to reduce private consumption due to a negative wealth effect.[6] In contrast, our model generates a positive response of private consumption to the positive government spending shock. This is due to a low substitutability between private and government consumption. When the elasticity of substitution is low, increased government spending, such as for public parking areas and public transportation services, raises the marginal utility of private consumption, allowing consumption to rise as a result of the increase of government services.

An increase in government consumption compared with an increase in total output leads to a decline in private investment (i.e., private capital), which reduces private wealth. Therefore, workers increase their labor supply. This leads to a higher output and a lower wage. In this model, reduction of the wage rate will reduce the marginal cost of production, which reduces the price of output and the inflation rate. Lower inflation raises the real rate of interest.

In order to examine how the demographic structure affects the effects of the government spending shock on the economy, we compute the impulse responses to the government spending shock in the economy with a lower proportion of workers (aging economy). Specifically, we consider the case of $\varphi$=0.55. The dashed lines in Figure 5 show the impulse responses to the government spending shock in the economy with a lower proportion of workers. Qualitatively, the effects of the government spending shock are the same for the benchmark case and the aging economy.

Quantitatively, however, the effect of the government spending shock in the economy with a higher proportion of workers is magnified in the economy with a higher proportion of workers. This is due to a larger labor supply. Compared with the economy with a lower proportion of workers, aggregate income (aggregate output) is higher in the economy with higher labor participation due to higher total labor supply. When more people start to work, the government does not need to collect so much tax revenue to support retired people. Total tax revenue is diminished, which increases disposable income to workers. Thus, aggregate consumption of the economy rises. An increase in total labor supply by inducing old workers to keep their jobs will reduce wage rates in the beginning. This reduces price of output and the rate of inflation, leading to a higher real rate of interest.

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6 See, for example, Gali et al. (2007).

### 4.2.2 Government investment shock

We now turn to examine the effects of an increase in government investment expenditure. Figure 6 shows the impulse responses to a positive government investment shock. Similar to the case of the government consumption shock, we compare the responses of the model with a larger proportion of workers to those of the model with a lower labor participation. In each figure, the solid lines are responses of the model with $\varphi$=0.85 and the dashed lines are those of the model with $\varphi$=0.55.

The transmission mechanism of the government investment shock is explained as follows. An increase in government infrastructure will push up total output. After the shock, private consumption initially falls but rises in a later period. In the short run, due to a negative wealth effect, the positive government investment shock crowds out private consumption. The negative wealth effect also increases labor supply in the short run, which further boosts output. An increase in labor supply reduces the wage rate, which lowers marginal cost of production and thus the rate of inflation declines. However, a crowding in of consumption takes place in the later period due to increased public capital. Tax revenue will rise, but it is not big enough to increase government investment. Thus, the government has to increase bond supply.

Similar to the case of the government spending shock, the size of the government investment shock's effects is larger in the economy with a higher proportion of workers due to a larger supply of total labor.

### 4.2.3 Monetary policy shock

Finally, we examine the effect of an expansionary monetary policy shock on the economy. Figure 7 shows the results. The expansionary monetary policy shock dealt with in this paper is lowering the rate of interest on government bonds. The expansionary monetary policy shock increases inflation. In turn, the resulting decrease in the real interest rate boosts consumption and investment. Increased demand puts upward pressure on the process of production factors, leading to higher wages and increased hours of work.

Figure 7 also illustrates the dynamic effects of an expansionary monetary policy shock in the economy with a lower proportion of workers. Similar to the case of the government spending shock, the demographic structure does not affect the qualitative responses of the economy to the monetary policy shock. However, it affects the quantitative responses of endogenous variables to the shock.

The quantitative responses in the economy with higher labor participation are larger than those in the economy with less workers. This is because in the economy with more workers, the monetary policy boosts demand more than in the economy with less workers. Higher labor participation will increase total labor supply, which raises total output and total income. An increase in total income leads to higher consumption of the economy. Decline in interest rate will raise the real interest rate. An increased aggregate demand due to higher consumption raises wage rate, which increases rate of inflation.

## 5, Fee Structure of Asset Management and desirable structure

### 5-1, Current fee structure

Asset management companies should invest in global financial markets, including Asia, which has much higher growth than Japan. A professional asset management business is expected to invest more in overseas markets when the Japanese economy is sluggish and less when it is upbeat.

Investment trust distributors such as banks, post banks, and post offices earn sales charges (or loads), which are the pillar of their earnings. In securities companies, investment trust sales load supplement revenue from stock commissions. The sales loads of investment trusts are completely liberalized. However, sales loads on investment trust can be set at ceiling rates as prescribed in the prospective a legal disclosure document prepared by asset managers. As for banks and post banks, they are the base of off-balance service revenue. However, if incentives are not aligned between individual investors and distributors (such as banks and securities companies), individual investors might not benefit as much as they could.

We estimate whether investors in investment trusts receive a positive return or not, based on the following equations:

$$A_T = A_0 + R - \tau - \varepsilon \qquad \varepsilon = \varepsilon_1 + \varepsilon_2 + \varepsilon_3 \ (\varepsilon_1)=47\% \ (\varepsilon_2)=6\% \ (\varepsilon_3)=47\% \qquad \ldots\ldots\ldots (1)$$

The initial investment amount is denoted by $A_0$ (=the trust assets of the funds). R represents the net return on investment trusts. The fee( $\tau$ )is the sales loads received by banks, securities companies, and post offices. $\varepsilon$ is the trust fees (called “trust remuneration” in Japan), which consists of (i) trust fee for the management fee( $\varepsilon_1$), (ii) trust fee for the trust fee( $\varepsilon_2$), and (iii) agent fee( $\varepsilon_3$).

By rewriting equation (1), we obtain equation (2) as follows:

$$R=(A_T-A_0)+\tau+\varepsilon \quad \ldots\ldots\ldots\ldots\ldots(2)$$

R is the gross return from investment, which is composed of

(i) $(A_T-A_0)$: the net return of individual investors,

(ii) $(\tau)$: sales load,

(iii) $(\varepsilon)$: trust fee.

Therefore, the net return to investors after deducting the sales load and trust fee is expressed as follows:

$$NR=(A_T-A_0)=R-\tau-\varepsilon \quad \ldots\ldots\ldots\ldots\ldots(3)$$

If 100 is invested at the end of 1999, the average monthly return of public-offered open-ended investment trusts, excluding exchange traded funds, is $(R-\varepsilon)$ in the period from 1999 to 2014. We estimate the average holding period of investment trusts as follows:

$$\text{average holding period} = \frac{\text{average amount of investment trust } (A_T)}{\text{sum of termination + redemption amount } (\Delta A_{OUT})} \quad \ldots\ldots(4)$$

Equation (4) can be obtained by the following equations:

$$A_T=R+A_0+\Delta A_{IN}-\Delta A_{OUT}-\tau-\varepsilon \quad \ldots\ldots\ldots(5)$$

$A_T$ is the terminal value of an investment trust

$\Delta A_{IN}$ denotes net inflow of funds into an investment trust in entire period

$(\Delta A_{IN}=\Delta A_{IN\,(1)}+\Delta A_{IN\,(2)}+\Delta A_{IN\,(3)}\ldots\ldots+\Delta A_{IN(t)}+\ldots\ldots+\Delta A_{IN(T-1)}$

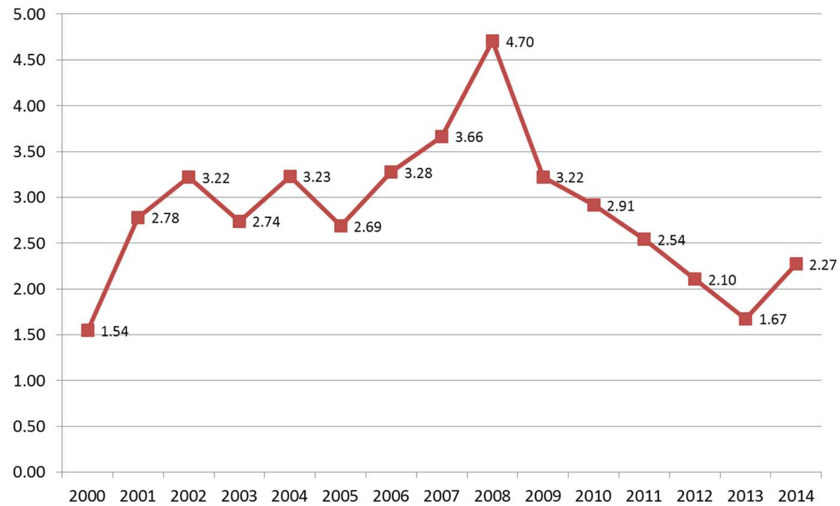
$\Delta A_{OUT}$ denotes net outflow of funds from an investment trust (=redemption + termination) in entire period

$(\Delta A_{out}=\Delta A_{out\,(1)}+\Delta A_{out\,(2)}+\Delta A_{out\,(3)}\ldots\ldots+\Delta A_{out(t)}+\ldots\ldots+\Delta A_{out(T-1)}$

Equation (3) is the case where net inflow of funds $\Delta A_{IN}$ and $\Delta A_{out}$ are set to zero.

The average amount of investment trusts in Japan is ¥568.20 trillion, but the sum of redemption + the sum of termination is ¥214.40 trillion. Therefore, the average holding period is about 2.60 years. Figure 4 shows the fluctuations of average holding periods of investment trusts: the lowest was 1.54 in 2000 and the longest 4.7 in 2008. When the gross rate of return is high, investors tend to hold investment trusts much longer. The low gross rate of return such as in 2008 saw investors holding investment trusts for short periods and shifting to other funds.

**Figure 4: Estimated average holding period of public-offered investment trusts by year**




Source: Changes in Assets of Publicly Offered Investment Trusts (Market Value). The Investment Trusts Association, Japan.

According to the gross return formula($R=(A_T-A_0)+\tau+\varepsilon$), if investors switch funds every 2.8 years, then the net return of individual investors($NR=A_T-A_0$) is 14.65, sales load ( $\tau$ ) are 12.13, and trust fees（$\varepsilon$） 16.53 for an initial investment of 100 (Figure 5).

When there was no switching between 1999 and 2014 (holding the same investment trust for the entire period), the net return of individual investors was 24.34, sales load 2.45, and trust fees 17.48 for an initial investment of 100 (Figure 5).

In the case of a 2-year turnover (used to calculate the monitoring report of the Japanese Financial Service Agency [FSA]), the net return of individual investors was 10.47, sales load 16.32, and trust fees 16.20 for an initial investment of 100 (Figure 5).

**Figure 5: Net return of individual investors under current fee structure**

| | | Gross return on investment | | Net return of individual investors | | Sales load | | Trust fee |
|---|---|---|---|---|---|---|---|---|
| | | R | | At−Ao | | $\tau$ | | $\varepsilon$ |
| No switching for 15 years 2000.1～2014.12 | Ao=100 | 44.27 | = | 24.34 | + | 2.45 | + | 17.48 |
| | | | | Sharp ratio 0.0268 | | | | |
| Switching funds every 2.8 years | Ao=100 | 43.31 | = | 14.65 | + | 12.13 | + | 16.53 |
| | | | | Sharp ratio 0.0149 | | | | |
| Switching funds every 2.0 years | Ao=100 | 42.99 | = | 10.47 | + | 16.32 | + | 16.20 |
| | | | | Sharp ratio 0.0094 | | | | |

Sharp ratio: (net return of individual investors – interest rate on fixed deposit) / monthly deviation of monthly return of investment trust.

As a result, the net return of individual investors and sales load move in opposite directions. Trust fees, however, are stable compared with the fluctuating net return on individual investors.

**5-2,The conflicts of interest in fee structure**

We can indicate as follows the structure of the sales load and the trust fee on the investment trust cost:

Sales load( $\tau$ )= $A_0 \times \rho$ ……………. (6)

( $\rho$ = ratio of sales load)

Trust fee( $\varepsilon$ )=( $A_0 - \tau$ +R)× $\theta$ ……………. (7)

( $\theta$ = ratio of trust fee)

The individual investors maximize the terms ( $A_T - A_0$ ), the distributor ( $\tau$ ) and ( $\varepsilon_3$ ), the asset management company ( $\varepsilon_1$), and the trust bank ( $\varepsilon_2$). The sales load does not depend on individual investors in the case of this fee structure.

Sales charges are only paid at the beginning of the purchase of a new investment trust. For the distributors, therefore, sales charges increase if investors switch much more frequently from one kind of investment trust to another. Japanese investors tend to hold investment trusts for short periods and switch from one to another very frequently.

Sales load in Japan are presently set to about 2.5% on average. The degree of competition in sales loadsince 1998 has not been clear.

The trust fee ( $\varepsilon$ ) is a positive value, even if ($A_T - A_0$) is a negative value, as long as ($A_0 - \tau + R$) is a positive value. Even when the investor cannot get a positive return, the asset management company, the distributor, and the trust bank can regularly receive positive trust fees.

The level of the sales load has been pointed out as a deterrent for the growth of mutual funds for many years. Therefore, the number of wrap accounts is increasing. A wrap account is a type of discretionary account service that entrusts distributors to invest in financial products.

In a wrap account's fee structure, ( $\tau$ ) is removed from( $\varepsilon$ )=($A_0 - \tau + R$)$\times \theta$ , and the account management fee is added to ( $\varepsilon$ )=($A_0$+R)$\times$( $\theta$ ). If the wrap account's fee is set to ( $\lambda$ ), then the total fee charged to the wrap account is ($A_0$+R)$\times$( $\lambda$ ). Therefore, the fee structure in a wrap account is similar to a trust fee.

**5-3, Room for improvement on comparison of fees**

One solution to get higher returns for investors is a more competitive environment. The prospectus discloses trust fees but only describes upper limit to sales load, leaning it to the decision by distributors.

The investment trust is a highly transparent financial product. However, transparency is meaningful only by disclosing sales load and trust fees because investors can compare one investment trust with other financial products such as deposits. Some investors in investment trusts can compare one product to another by checking sales load fees charged by different distributors. Individual investors, however, are not always conscious of comparing costs. While the investment trusts association website lists the sales charge ratio on the same fund, and some websites compare the sales load ratios of internet securities companies, ordinary investors do not always have ways compare costs in an easy way. Much more disclosure on cost will be needed to increase investors' awareness.

$$NR=(A_T-A_0)= R-\tau-\varepsilon \qquad \text{……………(8)}$$

Desirable disclosure for individual investors will be "net rate of return on investment trust," which can be written as follows:

$$\frac{NR}{nA_0}=\frac{(A_T-A_0)}{nA_0}=\frac{R-\tau-\varepsilon}{nA_0} \qquad \text{………… (9)}$$

The numerator of NR has been disclosed in Japan as "net return." The NR is reported to investors by distributors is called "total return." However, it is the amount of net return from an investment trust and cannot be compared with the rate of return on deposits or other financial products. It is recommended to disclose equation (9), which is the "net return ratio." Equation (9) can easily be compared with the rate of return on other financial products such as deposits.

**5-4,Regulation of fee improvements in the United States and the United Kingdom**

In the United States (US), where investment trusts account for about half the world's total, investment companies ordinarily disclose all costs of the funds. However, the SEC requires a description of possible conflicts of interest in the summary prospectus if the fund or the asset management company pays a fee to the broker or the distributors. Investors are looking for higher net return. On the other hand, distributors seek higher sales charges and agent fees. There is a conflict of interest between investors and distributors, as shown in Figure 5.

In the United Kingdom (UK), payment of commissions to independent financial advisers for fund sales is prohibited by the Retail Distribution Review. Advisers may not recommend funds to investors that will result in higher fees for themselves.

**5-5, Variable fee that reflects investors' return in the US and the UK**

Conflicts of interest between investors and distributors are common not only in Japan but also in other countries such as the US and the UK. In the current cost system, distributors have no incentive to maximize investors' returns. Instead, sales load and trust fees are maximized by distributors and asset management companies.

The sales load is collected at the initial sale of the investment trust, and it does not depend on investment performance. Although the trust fees depend on investment performance, it is also collected at the initial investment and investment performance. Investment performance is borne only by investors rather than distributors and asset managers.

For example, the fee structure of Fidelity Magellan Fund's management fee is adjusted up and down 20 basis points every month based on fund performance and the S&P 500 index. Management fees often change. The March 2015 prospectus said that it was 0.52%, and most recently it was 0.68% in May 2016.

Japan has two types of funds: (i) high-watermark funds; and (ii) Japanese stock funds, where performance fees are added to or subtracted from trust fees for the asset management companies, depending on the percentage in price of NIKKEI225 or TOPIX. However, a cost system should be considered where investors' net return and earnings of distributors serve the same objective: to make the investment trust as popular as households' self-help efforts and to cultivate an investment mind-set among individuals.

**5-6, The fee structure on investment trusts based on customers' needs**

If a fee structure materializes combining a fixed fee that reflects the costs of each fund—such as for systems, infrastructure, and labor—and a variable fee that depends on investors' net return, investment trusts may produce and sell products that give priority to investors' returns.

Household financial assets of Japan are about ¥1,700 trillion. Providing a high return only when the Japanese stock market is performing well is not truly professional management. Developed countries are faced with an aging population and it is quite important to obtain higher rates of return to household assets. Retired people rely on the return from their accumulated financial assets without receiving wages and salaries. In the periods of 1999 to

2014, the revenue from investment trusts was lower than the interest earnings from deposits in Japan. What people seek in investment trusts is a higher rate of return. Both asset management companies and distributors have to manage their assets in order to achieve high net return for investors.

We showed in this paper that distributors may behave to maximize sales load and trust fees. Asset management business is expected to earn a higher rate of return than the deposit interest rate. We showed in this paper that sales load and trust fees are as follows.

$(A_0) \times \rho = \tau$

$(A_0 - \tau + R) \times \theta = \varepsilon$

The fee structure on investment trusts based on customers' needs can be summarized as follows:

<Case1, Hold the investment trust until maturity>

| | |
|---|---|
| $C+(R \times \rho)$ | sales load |
| $C+(R \times \theta)$ | trust fees |

C is an initial fixed fee (=the necessary fee to produce each investment trust such as wages, computer costs etc.). R is the return on the entire period. $\rho$ is the rate of sales charge and $\theta$ is the rate on trust fees.

It is necessary for people to be able to compare the net return of other financial products and investment trusts, and to reform the structure of investment trusts so that asset management companies and distributors maximize investors' net return.

<Case 2, Sell the investment trust before maturity>

Case 2 denotes where sales load are replaced by advisory fees to the distributors and trust fees are received by sales companies and asset management companies in each period based on the rate of return on investment trusts where negative rate of return could be possible. When the rate of return on investment trusts becomes negative, the losses are shared by advisories, asset management companies, and investors. Of course the positive rate of return (Rt) is also shared by all the members.

$C+(R_1\times\rho)+(R_2\times\rho)+(R_3\times\rho)+(R_N\times\rho)$ advisory fees

$C+(R_1\times\theta)+(R_2\times\theta)+(R_3\times\theta)+(R_N\times\theta)$ trust fees

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**Figure 1: Population Aging of Japan**

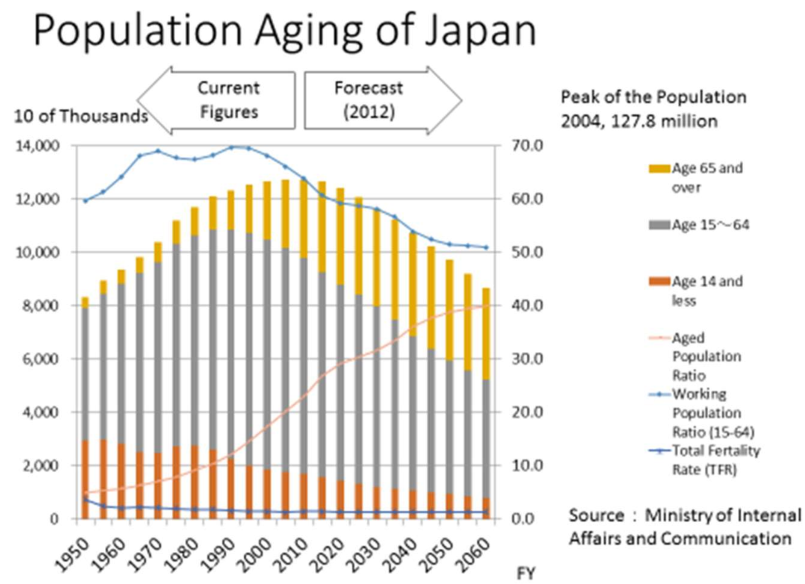



**Figure 2: Japan's Government Expenditures and Tax Revenues**

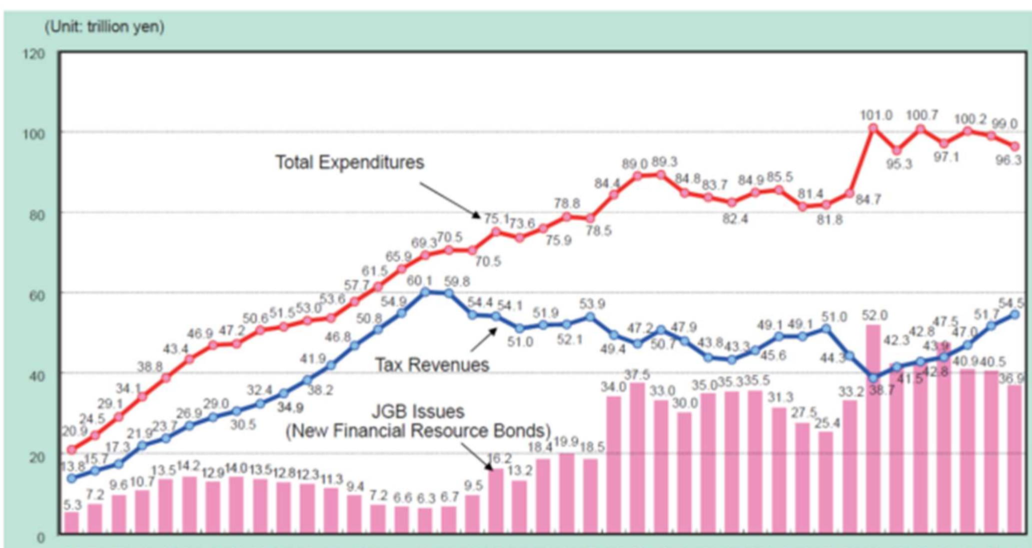



**Figure 3: General account Budget—Breakdown of Expenditure**

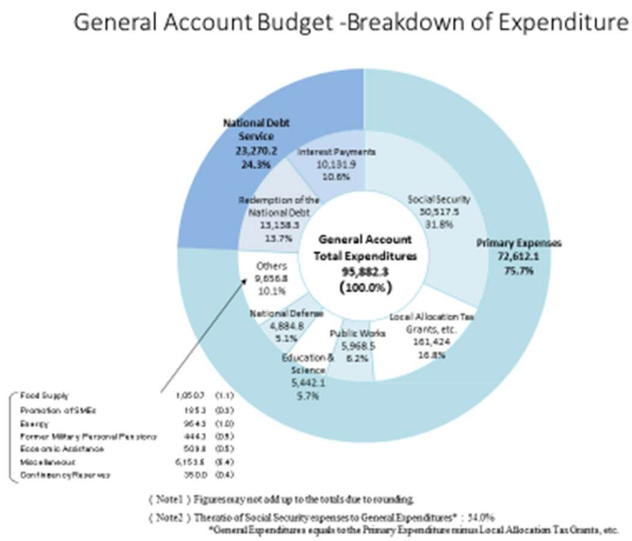
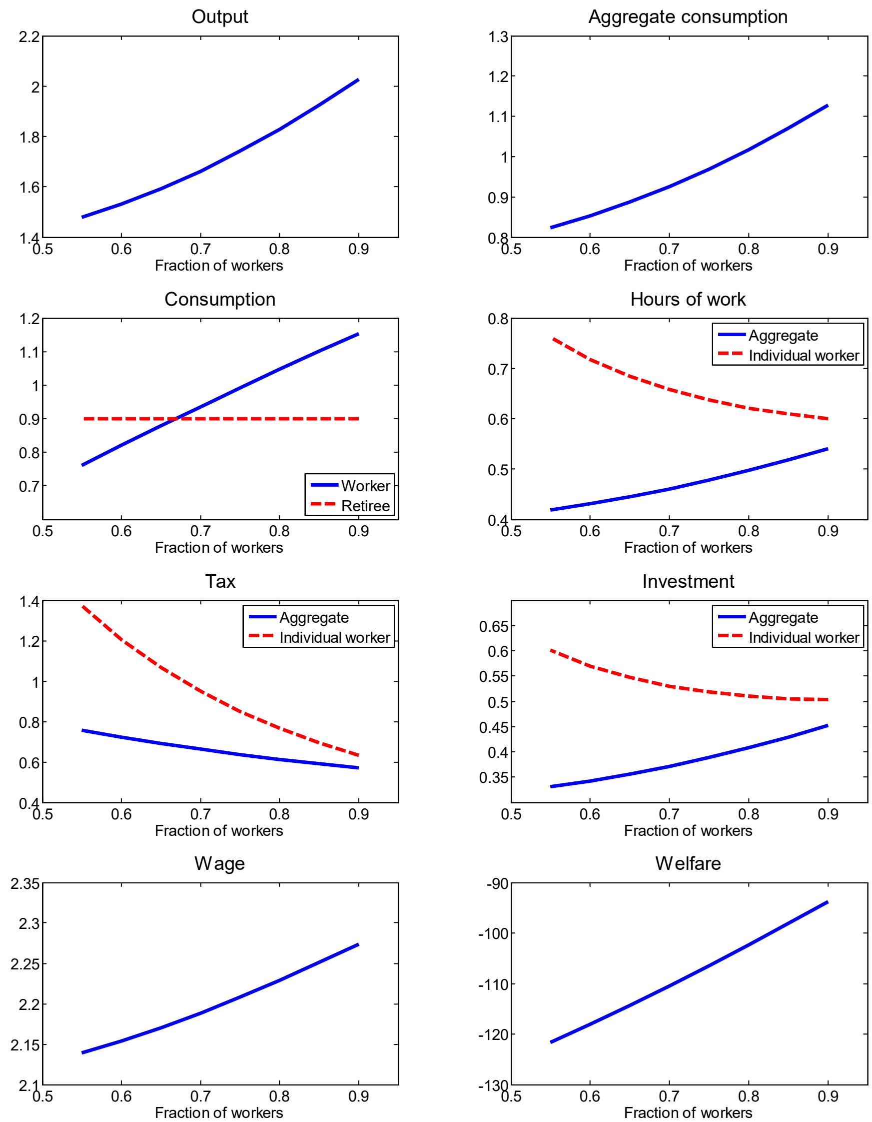
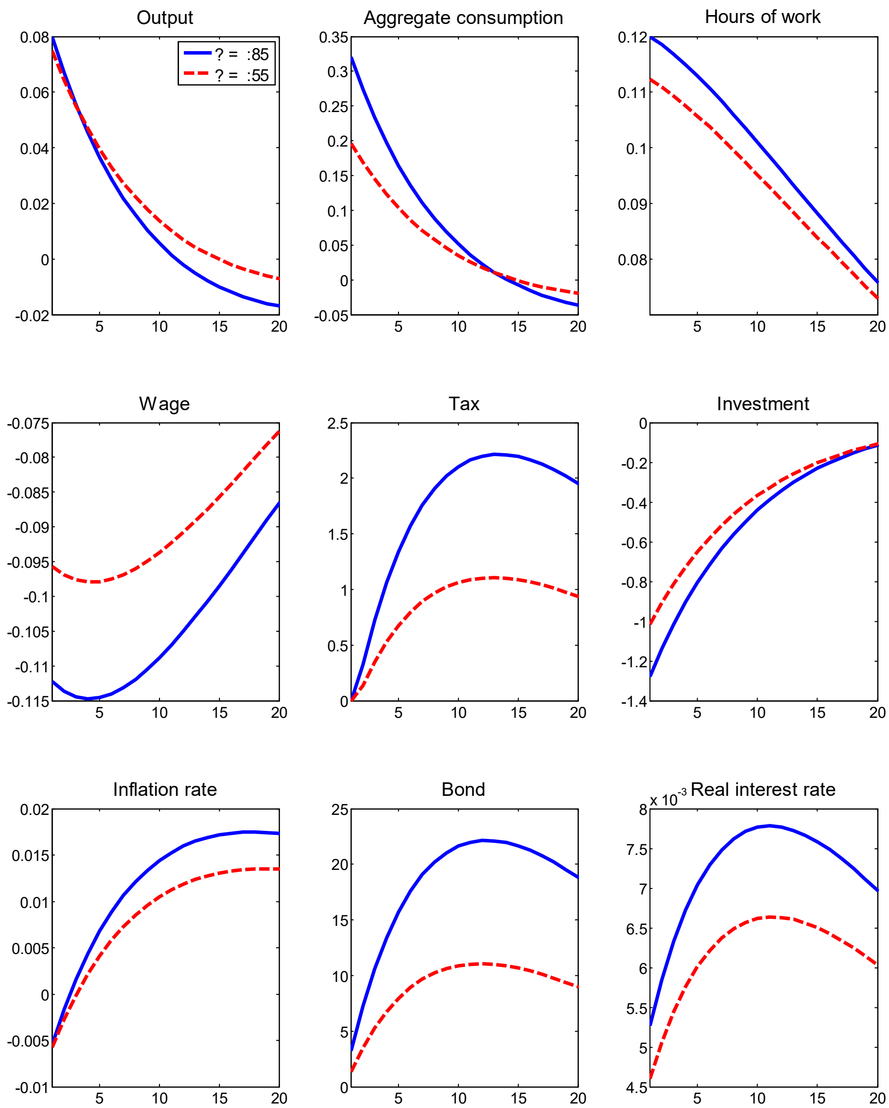



**Figure 4: The Long-Run Effects of a Change in Labor Participation**



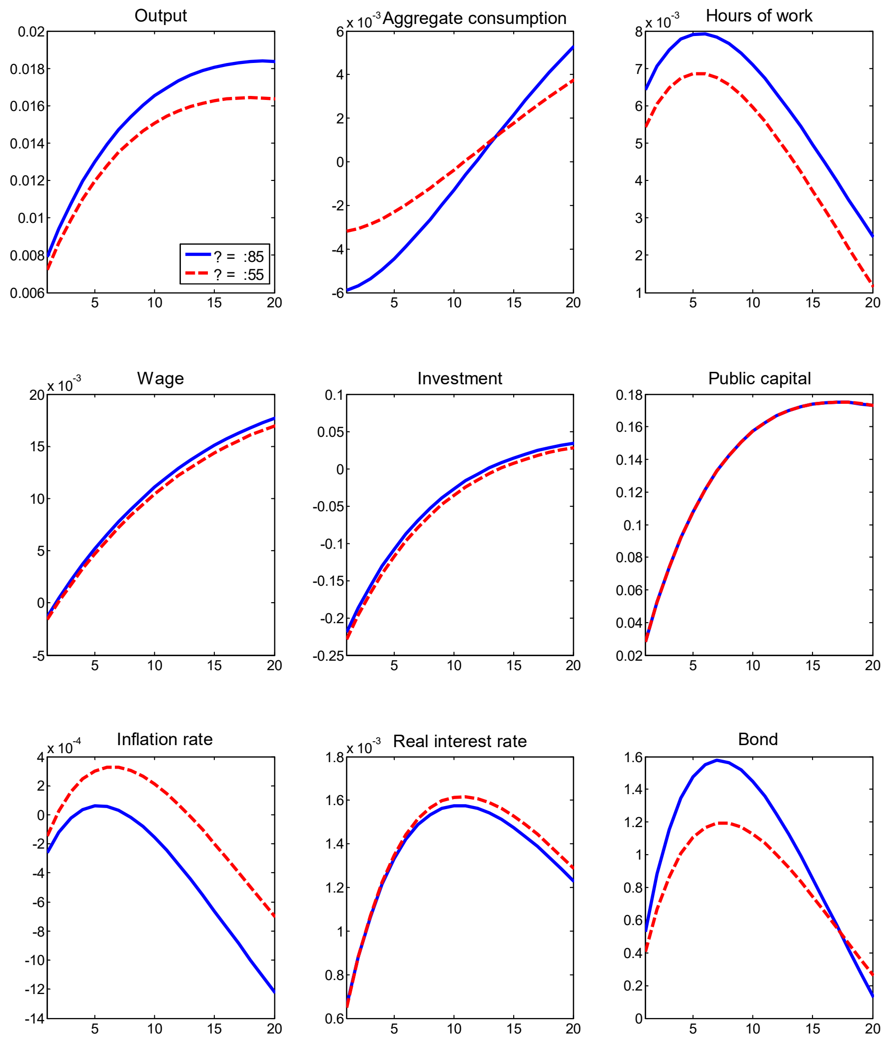
Output
Fraction of workers
Aggregate consumption
Fraction of workers
Consumption
Worker
Retiree
Fraction of workers
Hours of work
Aggregate
Individual worker
Fraction of workers
Tax
Aggregate
Individual worker
Fraction of workers
Investment
Aggregate
Individual worker
Fraction of workers
Wage
Fraction of workers
Welfare
Fraction of workers

**Figure 5: Effects of a Positive Government Spending Shock**



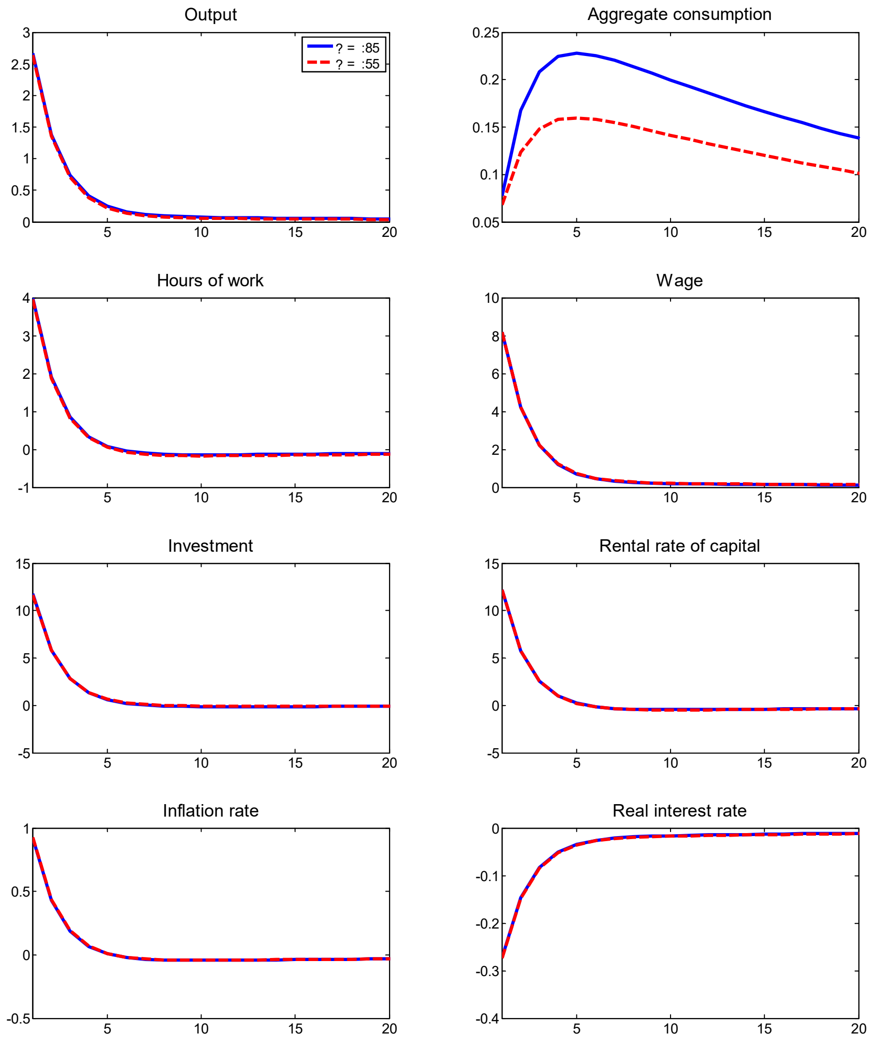

Note: The solid line labeled "$\phi$=.85" plot the impulse responses obtained in the model with higher labor participation. The dashed lines labeled "$\phi$=.55" plot the impulse responses obtained in the model with lower labor participation. The horizontal axis represents quarters after the shock. The vertical axis represents percentage deviations from the steady-state value.

**Figure 6: Effects of a Positive Government Investment Shock**




Note: The solid line labeled "$\phi$=.85" plot the impulse responses obtained in the model with higher labor participation. The dashed lines labeled "$\phi$=.55" plot the impulse responses obtained in the model with lower labor participation. The horizontal axis represents quarters after the shock. The vertical axis represents percentage deviations from the steady-state value.

**Figure 7: The Effects of an Expansionary Monetary Shock**




Note: The solid line labeled "$\phi$=.85" plot the impulse responses obtained in the model with higher labor participation. The dashed lines labeled "$\phi$=.55" plot the impulse responses obtained in the model with lower labor participation. The horizontal axis represents quarters after the shock. The vertical axis represents percentage deviations from the steady-state value.