Effects of Fiscal Stimulus on the Labor Market

Ryuta Ray Kato
Professor, Graduate School of International Relations, International University of Japan

Hiroaki Miyamoto
Project Associate Professor, Graduate School of Public Policy, University of Tokyo

Abstract

In recent years, the effects of fiscal stimuli on the labor market have been studied mainly in the United States and European countries. The purpose of this paper is twofold: to review existing studies that examine the effects of fiscal expansion on the labor market and to study how fiscal stimulus affects the labor market in Japan. We first examine the effect of a change in government spending on the real economy using a structural VAR model. Our empirical analysis finds that fiscal expansion increases output, private consumption and private investment and reduces unemployment. We also find that an increase in government spending increases the job finding rate and reduces the separation rate. We then develop a dynamic stochastic general equilibrium model with labor market friction and examine whether the theoretical model can explain what we observe in the data. While our model fails to predict the exact size of the impact of a government spending shock on the Japanese labor market variables, it can consistently capture the empirical pattern of responses of labor market variables to such a shock. By using our model, we also analyze the effect of fiscal stimulus in the form of a job creation subsidy. We demonstrate that the qualitative effect of the job creation subsidy is similar to that of the traditional government spending, but quantitatively the job creation subsidy is more effective in reducing unemployment than government spending.

I. Introduction

An important objective of fiscal policies is to boost output and reduce unemployment in recessions. Following the financial crisis of 2007-2008, various national governments around the globe have implemented large expansionary fiscal packages to counteract labor market sclerosis. A key question is how effective fiscal expansion is in increasing employment and reducing unemployment.

While there is an active debate on the effects of fiscal stimulus policies on the labor market among policy makers, the debate on fiscal policies among economists has rather focused on the size of the output and consumption multipliers of government spending. Recently, a number of studies examine the effect of fiscal stimuli on the labor market
(Monacelli et al. 2010; Brückner and Pappa, 2012; Faia et al. 2013). However, these studies mainly focused on the U.S. and European countries, and less is known about the effects of fiscal stimuli on the labor market in Japan. Given the fact that Japan’s budget deficits and public debt have grown through the series of expansionary fiscal packages and also that Japan is the most indebted nation among OECD countries, it is crucial to examine the effectiveness of fiscal policies in the Japanese economy.¹

The purpose of this paper is to examine the effects of fiscal stimulus on the labor market in Japan both empirically and theoretically. In the first part of our analysis, we examine the effects of fiscal expansion on both macroeconomic variables, such as output, private consumption and investment, and labor market variables by using a structural vector autoregressive (VAR) model.²

Our empirical analysis demonstrates that an increase in government spending increases output, private consumption and private investment. It also increases employment and vacancies posted and reduces unemployment. Furthermore, our analysis shows that in the post-2000s, fiscal stimuli are more effective in reducing unemployment than in the pre-2000s.

In the second part of our analysis, we develop a dynamic stochastic general equilibrium (DSGE) model with search friction in the labor market and study the effect of fiscal expansion on unemployment. Analyzing the effect of fiscal expansion on unemployment in standard DSGE models is not possible since standard models only allow for movements in hours of work and/or employment and thus there is no unemployment. Therefore, in order to analyze the effect of fiscal expansion on unemployment, we incorporate search and matching friction à la Mortensen and Pissarides (1994) into a standard real business cycle model. Furthermore, instead of assuming all government spending is wasteful, we assume that a government supplies goods that are valuable to households. The parameters in the model are calibrated to match certain facts of the Japanese economy.

Our model can generate a similar pattern of responses of labor market variables to a government spending shock to that of the structural VAR model. In our calibrated model, a positive government spending shock increases employment and vacancies and reduces unemployment significantly. Furthermore, in our model, the positive government spending shock increases private consumption. Thus, our model succeeds in capturing an empirical response of private consumption to the government spending shock, which is in contrast to standard DSGE models.³ This is because a negative wealth effect of fiscal expansion is

¹ Through a combination of fiscal stimulus spending and increasing social security payouts, gross public debt has exceeded 227% of GDP as of 2013 in Japan. A number of studies have examined the sources and consequences of the fiscal deficit in Japan. See, for example, Asako et al. (1991), Ihori et al. (2003) and Fukuda and Yamada (2011).

² A number of studies investigate the effect of fiscal policy on macroeconomic variables such as output, private consumption, and private investment in Japan by using VAR models. See for example, Ramaswamy and Rendu (2000), Kuttner and Posen (2001), Ihori et al. (2003) and Miyazaki (2010).

³ The standard dynamic general equilibrium model fails to trace the empirical response of private consumption to government spending shocks. See for example Baxter and King (1993).
mitigated by the assumption that the government supplies goods that are of value to households.

By using our theoretical model, we also examine the effects of fiscal stimuli in the form of a hiring subsidy on the labor market. Following the 2007-2008 crisis, large expansionary fiscal packages have been implemented around the globe. Since a significant portion of these stimulus policies took the form of labor market subsidies, it is important to examine the effectiveness of fiscal stimuli in the form of labor market subsidies.\(^4\) We consider a subsidy for costs of posting vacancies. Our analysis shows that the qualitative effects of an increase in the subsidy on the labor market are similar to those of an increase in government spending. However, the quantitative effects of these two policy instruments are different, and the hiring subsidy policy is more effective in creating jobs and lowering unemployment than traditional government spending policy.

The remainder of the paper is organized as follows. In Section II, we review the recent literature that studies the effects of fiscal policies on the labor market. Section III presents the empirical results from the structural VAR model. In Section IV, we develop a DSGE model with search frictions in the labor market. We then analyze the effects of fiscal stimuli in the form of both government spending and hiring subsidies on the economy. Section V concludes.

II. Literature review: fiscal stimulus and the labor market

The effects of fiscal expansion on the labor market have become a hot topic since the 2007-2008 financial crisis and the subsequent Euro Area crisis. Both theoretical and empirical studies that examine the effects of fiscal stimuli on the labor market are growing. This section provides a literature review on the effects of fiscal stimulus on the labor market.

Most recent studies that examine the effects of fiscal policies on the labor market consist of both empirical and theoretical analysis. Empirical analysis estimates the output and unemployment multipliers, focusing on the transmission of a fiscal policy on the labor market. Specifically, most studies employ structural VAR models and examine the effects of a government spending shock on relevant macroeconomic and labor market variables. In order to interpret the empirical results, they employ dynamic stochastic general equilibrium models. Analyzing the effects of fiscal expansion on unemployment in standard RBC and New Keynesian models is not possible since standard versions of these models only allow for movements in hours of work and employment, and there is no unemployment. Therefore, in order to study the effects of the government spending shock on unemployment, usually the Mortensen-Pissarides search and matching model is incorporated into the standard framework.\(^5\)

---

\(^4\) These subsidy expenditures indeed account for 50 to 80% of the total fiscal stimuli depending on countries. An important example is the HIRE Act and the American Job Act which focused almost entirely on introducing hiring subsidies.

\(^5\) Andolfatto (1996) and Merz (1995) consider a stochastic real business cycle model with search and matching frictions.
Yuan and Li (2000) analyze the dynamic behavior of employment and hours of work per employee in response to a government spending shock in the U.S. They first investigate empirical facts about the impact of a government spending shock on employment, hours per worker, and output by estimating a structural VAR model. Then, they develop an RBC model with labor market friction that can generate similar responses of hours worked per worker and employment to those of VAR models.

Monacelli et al. (2010) compute both the output and unemployment multipliers of government spending in the U.S. by estimating structural VAR models. They show that an increase in government spending of 1 percent of GDP generates output and unemployment multipliers of about 1.2 percent and 0.6 percentage points, respectively. They find that a standard RBC model with labor market friction fails in reproducing the size of the output multiplier whereas it can produce a realistic unemployment multiplier but only under a special parameterization. They also demonstrate that incorporating New Keynesian features into the model only marginally magnifies the size of the multipliers.

In general, it is argued that expansionary fiscal policy stimulates employment and lowers unemployment. Indeed, Yuan and Li (2000) and Monacelli et al. (2010) demonstrate that an increase in government spending increases employment and reduces unemployment in the U.S. In contrast, Brückner and Pappa (2012) show that for many OECD countries, increases in government spending actually can increase both employment and unemployment simultaneously by inducing increases in labor force participation. They demonstrate that the empirical regularities can be reproduced by incorporating a labor force participation choice and workers’ heterogeneity into a standard DSGE model.

Mayer et al. (2010) develop a DSGE model with search friction on the labor market and liquidity constrained consumers. They demonstrate that the labor market implications of a government spending shock alter substantially with respect to the degree of persistence of the shock and the share of liquidity constrained consumers. Specifically, they show that (i) a persistent positive government spending shock is more likely to be effective in reducing unemployment (ii) a positive government spending shock is likely to reduce aggregate unemployment when the share of liquidity constrained consumers is small.

While the above-mentioned studies focus on the effect of a change in government spending on the labor market, Campolmi et al. (2011) examine the effectiveness of fiscal stimuli in the form of labor market subsidies in a DSGE model with labor market frictions. In particular, they analyze the relative effectiveness of traditional increases in government spending versus increases in hiring subsidies. They find that hiring subsidies are more effective in fostering job creation and lowering unemployment than the government spending policy. This is because hiring subsidies are more targeted to foster job creation than general public expenses. Faia et al. (2013) also examine the effect of fiscal stimuli directed toward the labor market, such as income tax cuts, hiring subsidies and short-time work, on the labor market. They find that demand stimuli yield small multipliers, as they have little impact on hiring and firing decisions. By contrast, hiring subsidies and short-time work deliver large multipliers since they stimulate job creation and employment.
One of the common features of the above-mentioned studies is exogenous job separation. In the existing studies, while a worker’s transition rate from unemployment to employment is endogenously determined through a matching market, employed workers lose their jobs due to exogenous separation shocks and thus a transition rate from employment to unemployment is exogenous. However, recent empirical studies demonstrate that unemployment dynamics are determined by both inflow and outflow rates of unemployment, and find large variations in both inflow and outflow rates over business cycles. This suggests that taking into account both hiring and firing margins is important in studying the effects of fiscal policies on unemployment. Kuo and Miyamoto (2014) develop a DSGE model with labor market friction in which job separation is endogenously determined and examine the effects of fiscal stimuli in the form of government spending and a hiring subsidy on the labor market.

The literature that examines the effect of fiscal stimuli on the labor market mainly focuses on the U.S. and European countries, and less is known about the Japanese case. Kato and Miyamoto (2013) provide details on the transmission of fiscal expansion to the labor market. By estimating structural VAR models, they show that an increase in government spending reduces unemployment by increasing the job finding rate and reducing the separation rate. They also develop a RBC model with labor market frictions and demonstrate that their model can reproduce the empirical pattern of labor market variables’ responses to a government spending shock.

III. Empirical analysis

This section empirically examines the effects of a government spending shock on the Japanese labor market by using a structural vector autoregressive (SVAR) model. Following Blanchard and Perotti (2002), we identify the government spending shock by assuming that government spending is not contemporaneously affected by all variables in the model. This identification scheme is implemented by ordering government spending first in a SVAR model and using a Choleski decomposition.

We consider a SVAR model consisting of thirteen variables: government spending, gross domestic product (GDP), private consumption, private investment, real wages, the real long-term interest rate, tax revenues, hours of work per employee, employment, vacancies, the unemployment rate, the job finding rate, and the separation rate.

---

6 See, for example, Elsby et al. (2009), Fujita and Ramey (2009), and Petrongolo and Pissarides (2008).

7 Monacelli et al. (2010) and Brückner and Pappa (2012) use this identification approach to investigate the effect of government spending on the labor market. Gali et al. (2007) and Perotti (2007) also use the restriction that government spending does not contemporaneously react to changes in macroeconomic variables to identify fiscal shocks.
**Data**

Government spending, GDP, private consumption, private investment, and tax revenues are in real per capita terms. We obtain quarterly data on them from the Cabinet Office. The real long-term interest rate is computed as the difference between the 10-year government bond yield and year-over-year percent change in the GDP deflator. The 10-year government bond yield is obtained from the Bank of Japan Statistics and real wages are taken from Monthly Labour Survey (MLS) conducted by the Ministry of Health, Labour and Welfare (MHLW).

Hours of work per employee are obtained from the MLS. We obtain employment and the unemployment rate from the Labour Force Survey (LFS) conducted by the Statistics Bureau and the Director-General for Policy Planning. The measure of job vacancies is obtained from the monthly Report on Employment Service (Shokugyo Antei Gyomu Tokei) conducted by the MHLW. Job vacancies are defined as the difference between the number of active job openings (yuko-kyuujin-suu) and the number of job placements (shushoku-ken-suu). Following Miyamoto (2011) and Lin and Miyamoto (2012), we construct the job finding and separation rates from the LFS.

All variables are seasonally adjusted by using the X12-filter. The sample covers 1980Q1–2010Q1. The lag length of the SVAR model is based on information criteria and set equal to one. In addition to a constant term, the SVAR model includes a deterministic time trend up to the second order.

**Estimation result**

Figures 1 and 2 show the impulse responses of the selected variables to a one standard error shock to government spending with 95% confidence bands constructed by Monte Carlo simulations. We show the impulse response functions for a horizon of 20 quarters.

A positive government spending shock increases GDP, private consumption, and private investment. Following the government spending shock, GDP rises and reaches its peak after one-and-a-half years. The shock crowds in private consumption, and the response of private consumption is statistically significant at the peak.

We now turn to see the effects of the government spending shock on labor market variables. While the positive government spending shock increases employment and vacancies, it reduces hours of work per employee and the unemployment rate. Note that the effects of the positive government spending shock on the unemployment rate and vacancies are asymmetric. While vacancies immediately increase following the government spending shock, the unemployment rate starts to fall after one quarter.

Since unemployment dynamics are determined by the underlying flows in and outs of unemployment, we now study the responses of the job finding rate and the separation rate to the government spending shock. The positive government spending shock increases the job finding rate and reduces the separation rate significantly. The responses of the job finding and separation rates are consistent with the response of the unemployment rate to the government spending shock.

We next investigate the sensitivity of our results to changes in the sample period. Kato
Figure 1. Impulse responses to a government spending shock

Note: Dashed-lines indicate the 95% confidence bands constructed by Monte Carlo simulations.

and Miyamoto (2013) point out that there was a structural change in the Japanese labor market at the end of the 1990s. The structural change may affect our empirical results. Furthermore, in the literature, it is known that the effect of a government spending shock on the economy changes when different sample periods are used for the estimation (see, for example, Perotti, 2005). Therefore, we examine the robustness of our results by estimating SVAR models with different sample periods. Following Kato and Miyamoto (2013), we divide our sample period into two subsamples based on the result of Andrews’ (1993) Sup $F$ test.

Recent empirical studies demonstrate that both unemployment inflow and outflow rates significantly contribute to the unemployment dynamics in Japan. Miyamoto (2011) and Lin and Miyamoto (2012) examine the relative importance of inflow and outflow rates for fluctuations in unemployment, and find approximately a 50:50 inflow/outflow split to unemployment variation in Japan. Esteban-Pretel and Fujimoto (2012) also suggest that the Japanese labor market has been experiencing considerable structural changes over the recent decades.
Figure 2. Impulse responses to a government spending shock

Figure 2: Impulse responses to a government spending shock

Note: Dashed-lines indicate the 95% confidence bands constructed by Monte Carlo simulations.

Specifically, we consider the pre-2000s (the 1981–1997 period) and the post-2000s (the 1998–2010 period) samples.

Figure 3 shows impulse responses of selected labor market variables for these two sample periods. The main result is that while unemployment significantly decreases for both subsamples, employment and vacancies increase significantly. Thus, the patterns of responses of these labor market variables to fiscal shocks are similar to those in the benchmark case. Figure 3 also shows that the impact of fiscal shocks on the labor market is larger in the post-2000s sample.

10 The test result indicates that a structural change occurred at 1998Q1.
Figure 3. Impulse responses to a government spending shock for the pre-2000s and the post-2000s.
Multipliers  In order to examine the quantitative effect of fiscal expansion on the economy, we compute output and unemployment multipliers. Table 1 reports the results. The first two columns display the actual responses, or the multipliers relative to the initial government spending shock, which is normalized to 1 percentage point of GDP.\textsuperscript{11} The next two columns display the cumulative multipliers.

The output responses and the output cumulative multipliers are similar. While both impact and cumulative output multipliers are below one after one year, they exceed one after one-and-a-half years. The unemployment rate responses and cumulative multipliers are also similar.

<table>
<thead>
<tr>
<th></th>
<th>Responses</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\frac{\Delta Y}{\Delta G}$</td>
<td>$\frac{\Delta u}{\Delta G}$</td>
</tr>
<tr>
<td>2 quarters</td>
<td>0.17</td>
<td>-0.01</td>
</tr>
<tr>
<td>1 year</td>
<td>0.86</td>
<td>-0.02</td>
</tr>
<tr>
<td>1.5 year</td>
<td>1.65</td>
<td>-0.04</td>
</tr>
</tbody>
</table>

IV. The model

We develop a discrete-time RBC model with search friction in the labor market. Instead of assuming all government spending is wasteful, we assume that a government supplies goods that are valuable to households.

An economy consists of households, firms, and a government. We assume that all agents live forever. A representative household consists of a continuum of workers whose measure is normalized to one. The labor market is subject to friction. Workers and firms cannot meet instantaneously but must go through a time-consuming search process.

Households consume goods, accumulate capital, and provide labor services. Due to friction in the labor market, some workers are employed and earn wages while others are unemployed and search for jobs. To produce output, firms hire workers in the frictional labor market and rent capital from households. Firms sell their output to households in a competitive market. Besides providing unemployment benefits to unemployed workers, the government conducts fiscal policies. The government levies a lump sum tax on households to finance its expenditure. Due to search friction in the labor market, the wage rate and hours of work are determined through bargaining between firms and workers.

\textsuperscript{11} The actual responses or the multipliers relative to the initial government shock are computed by $\Delta X/\Delta G = (X_t - X)/(G_t - G)$, where $X_t = Y_t$ for the output multiplier, while $X_t = u_t$ for the unemployment multiplier. The variable without time subscript denotes the steady-state value. The cumulative multipliers are computed by $\Sigma\beta\Delta X/\Sigma\beta\Delta G = \Sigma\beta^{t-1}(X_{t+j} - X)/\Sigma\beta^{t-1}(G_{t+j} - G)$, where $\beta$ is a discount factor and set to be 0.996.
Labor market The labor market is modeled in the style of the search and matching model developed by Mortensen and Pissarides (1994). Let $u_t$ be the number of unemployed workers and $v_t$ be the number of vacancies in period $t$. The number of successful job matches is determined by the Cobb-Douglas matching function

$$m_t = \gamma_m u_t \theta_t^{1-\xi} v_t$$

where the parameter $\gamma_m$ represents the efficiency of the matching technology and $0 < \xi < 1$ is the elasticity of the matching function with respect to unemployment. Define $\theta_t = v_t / u_t$ as labor market tightness. The probability that a firm with a vacant job is matched with a worker is $m_t / v_t = \gamma_m \theta_t^{-\xi} \equiv q(\theta_t)$. Similarly, the probability that an unemployed worker is matched with a firm with a vacant job is $m_t / u_t = \gamma_m \theta_t^{1-\xi} = \theta_t q(\theta_t)$. Note that both firms and workers take $q(\theta_t)$ and $\theta_t q(\theta_t)$ as given.

Matches are destroyed at exogenous rate $s$ which takes place at the end of period $t$. Following Lubik (2009), we assume that it takes one period for new matches to be productive and both existing and new matches face the same separation rate. The evolution of employed workers, defined as $n_t = 1 - u_t$, is given by

$$n_t = (1 - s)(n_{t-1} + m_{t-1}).$$

Thus, the number of employed workers in period $t$ is given by the number of employed workers in period $t - 1$ and new matches formed in period $t - 1$ that were not subject to separations.

Household’s problem A representative household consists of a continuum of members of mass one. A member of the household is either employed or unemployed. In period $t$, a fraction $n_t$ of the household’s members are employed and a fraction $(1 - n_t)$ of them are unemployed. Following Merz (1995), we assume that the household provides perfect consumption insurance for its members. Thus, consumption is the same for each person, regardless of whether she or he is employed or not.

Following Linnemann and Schaubert (2003) and Brückner and Pappa (2012), we assume that the household’s utility depends on government consumption. This is because the government typically does not produce only waste, but supplies goods that are valuable to the household. For example, schools, roads, local public utilities and so on. Furthermore they are more or less substitutable with private consumption goods.

The preference of the representative household is given by

$$\mathbb{E}_0 \sum_{t=0}^\infty \beta^t \left\{ \frac{1}{1 - \sigma} \left[ \omega C_t^{\frac{s-1}{\sigma}} + (1 - \omega) G_t^{\frac{s-1}{\sigma}} \right]^{1-\sigma} - \Phi n_t \frac{h_t^{1+\mu}}{1+\mu} \right\},$$

where $\beta \in (0, 1)$ is the household’s subjective discount factor, $C_t$ is consumption of the household, $G_t$ is government consumption, $h_t$ is the individual hours of work, $\Phi > 0$ measures the disutility of working, $\mu$ 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. The share parameter $\omega$ determines how much government consumption affects utility.

Employed household members earn wage $w$, and unemployed ones receive unemployment benefits $z$. The household receives profits $\Pi$ from the firms and pays lump sum taxes $T$ to the government. The household may either consume $C_t$ or accumulate capital $K_{t+1}$ through investment $I_t$ according to $K_{t+1} = (1 - \delta)K_t + I_t$, where $\delta$ is the depreciation rate. Thus, the budget constraint of the representative household is

$$C_t + K_{t+1} = w_t n_t h_t + (1 - n_t)z + r_t K_t + (1 - \delta)K_t + \Pi_t - T_t. \quad (3)$$

The household’s problem yields the following first-order conditions

$$\left\{ \omega C_t^{\frac{\zeta-1}{\zeta}} + (1 - \omega) G_t^{\frac{\zeta-1}{\zeta}} \right\} \frac{1 - \sigma \zeta}{\zeta - 1} \omega C_t^{\frac{-1}{\zeta}} = \lambda_t,$$

and

$$\beta E_t \lambda_{t+1}(1 + r_{t+1} - \delta) = \lambda_t,$$

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

**Firm’s problem** When a firm hires a worker, it produces output according to the Cobb-Douglas production function

$$y_t = A_t k_t^\alpha h_t^{1-\alpha} = A_t f(k_t, h_t),$$

where $A_t$ is a technology factor common to all firms, $k_t$ and $h_t$ are capital input and hours of work per worker, respectively. $0 < \alpha < 1$ is the elasticity of output with respect to capital.

The problems of firms and workers are characterized by the Bellman equations. The value of a firm with a filled job, $J_t$, is characterized by the following Bellman equation:

$$J_t = \max_{k_t} \left\{ A_t f(k_t, h_t) - w_t h_t - r_t k_t + \beta E_t \frac{\lambda_{t+1}}{\lambda_t} [(1 - s) J_{t+1} + s V_{t+1}] \right\}, \quad (4)$$

where $V_t$ is the value of a firm with a vacant job. The value of a firm with a filled job is current profits plus the continuation value. In the current period, the firm produces and pays wage $w_t h_t$ and the rental cost of capital $r_t k_t$. In the next period, the match remains with probability $(1 - s)$ and in this case the firm will receive the value of the job; otherwise, the match is destroyed and becomes vacant. The continuation value of $J$ is a weight average of the above two cases. Note that the expected future value of the job is discounted by the stochastic discount factor $\beta \lambda_{t+1}/\lambda_t$.

The first-order condition for the capital is

$$A_t f_k(k_t, h_t) = r_t.$$
capital rental rate.

The value of a firm with a vacant job is

$$V_t = -(1 - \tau^v_t)\kappa + \beta E_t \left\{ \frac{\lambda_t + 1}{\lambda_t} q(\theta_t) (1 - s) J_{t+1} + \left[ 1 - q(\theta_t) (1 - s) \right] V_{t+1} \right\}, \quad (5)$$

where $\kappa$ is a flow cost of posting a vacancy. A firm is free to enter the labor market and posts a vacancy at flow cost $\kappa$ in order to recruit a worker. The vacancy-posing firm receives subsidies $\tau^v_t\kappa$ from the government. We call this subsidy a *vacancy cost subsidy*. The firm matches with a worker with probability $q(\theta_t)$. If the match is not destroyed, the firm obtains the value of a filled job in the following period; otherwise it remains as a vacancy.

The total profits of the firms are defined as

$$\Pi_t = \left[ A_t f(k_t, h_t) - w_t h_t - r_t k_t \right] n_t - (1 - \tau^v_t)\kappa.$$

In equilibrium, all profit opportunities from new jobs are exploited, so that the following free entry condition holds:

$$V_t = 0.$$

Using equations (4) and (5) and the free entry condition, we have the following job creation condition:

$$\frac{(1 - \tau^v_t)\kappa}{q(\theta_t)} = \beta (1 - s) E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \left[ A_{t+1} f(k_{t+1}, h_{t+1}) - w_{t+1} h_{t+1} - r_{t+1} k_{t+1} + \frac{(1 - \tau^v_{t+1})\kappa}{q(\theta_{t+1})} \right] \right\}. \quad (6)$$

The job creation condition states that expected cost of posting a vacancy, the left-hand side of (6), is equal to the expected value of a match, the right-hand side of (6).

**Worker’s problem** We now turn to the worker’s side. Let $W$ be the value of an employed worker. It satisfies

$$W_t = w_t h_t - \frac{g(h_t)}{\lambda_t} + \beta E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \left[ (1 - s) W_{t+1} + s U_{t+1} \right] \right\},$$

where $U$ is the value of an unemployed worker. The value of an employed worker is composed of the wage income, the disutility from supplying labor $g(h_t) \equiv \Phi_t h_t^{1+\mu}/(1+\mu)$, and the continuation value, which is the value of being employed if the match is not destroyed, or the value of being unemployed if it is destroyed.

The value of an unemployed worker is

$$U_t = z + \beta E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \left[ \theta_t q(\theta_t) (1 - s) W_{t+1} + \left[ 1 - \theta_t q(\theta_t) (1 - s) \right] U_{t+1} \right] \right\}.$$

In the current period, an unemployed worker receives unemployment insurance $z$ and searches for a job. With probability $\theta_t q(\theta_t)$, she matches with a firm posting a vacancy. If the match is not destroyed, the worker becomes productive in the following period and obtains the value of being employed; otherwise, she will remain unemployed.
**Wage bargaining and hours choice**  Wages and hours of work are determined as the outcome of a bilateral bargaining process between workers and firms. In each period, firms and workers negotiate through Nash bargains. Thus, wages and hours of work are chosen to maximize the Nash product:

\[
\max_{w_t, h_t} (W_t - U_t)^\eta (J_t - V_t)^{1-\eta},
\]

where \(\eta \in (0, 1)\) is a worker’s bargaining power.

The first-order condition with respect to \(w_t\) yields the wage equation

\[
w_t h_t = \eta (A_t f(k_t, h_t) - r_t k_t + \kappa (1 - \tau_t^v) \theta_t) + (1 - \eta) \left( \frac{g(h_t)}{\lambda_t} + z \right).
\]

The wage equation is similar to the one in a standard search and matching model.\(^{12}\) The worker is compensated for a proportion \(\eta\) of the flow profits to the firm, and for a measure of the saved cost of searching for new matches. She is also compensated for a fraction \((1 - \eta)\) of the forgone home production and the disutility of supplying labor.

The first-order condition with respect to \(h_t\) yields the hours supply equation,

\[
A_t f_h(k_t, h_t) = \frac{g'(h_t)}{\lambda_t},
\]

which states that hours worked are determined by equalizing the marginal product of hours and the worker’s marginal rate of substitution between leisure and consumption.

**Government policy and resource constraint**  The government finances government spending \(G_t\), the unemployment benefit \(u_t z\), the vacancy subsidy \(\tau_t^v v_t \kappa\) by imposing the lump-sum tax \(T_t\) to households. The government budget constraint is thus given by

\[
T_t = G_t + u_t z + \tau_t^v v_t \kappa.
\]

Government spending \(G_t\) follows a stochastic process

\[
\log(G_t) = (1 - \rho_G) \log(G^*) + \rho_G \log(G_{t-1}) + \varepsilon_{G,t},
\]

where \(G^*\) is the steady-state value of government spending, and \(\varepsilon_{G,t}\) is an i.i.d. innovation. Similarly, the vacancy cost subsidy follows a stochastic process

\[
\log(\tau_t^v) = (1 - \rho_{\tau^v}) \log(\tau_{t}^{v*}) + \rho_{\tau^v} \log(\tau_{t-1}^{v}) + \varepsilon_{\tau^v,t},
\]

where \(\tau_{t}^{v*}\) is the steady-state value of the subsidy. \(\varepsilon_{\tau^v,t}\) is an i.i.d innovation with standard deviations \(\sigma_{\tau^v}\).

Aggregate output and capital are obtained by

\[
Y_t = n_t y_t,
\]

---

\(^{12}\) See, for example, Mortensen and Pissarides (1994) and Pissarides (2000).
and

\[ K_t = n_t k_t, \]

respectively.

By combining the household and government budget constraints as well as profits of firms, we have the resource constraint of the economy

\[ Y_t = C_t + I_t + G_t + \kappa v_t, \]

which implies that aggregate production must equal private and public demand.

**IV-1. Calibration**

We simulate a quantitative version of the model to examine the effects of fiscal stimulus on the economy. To do so, we first calibrate the model to match several dimensions of the data. We then solve the model by approximating the equilibrium conditions around a non-stochastic steady state.

We calibrate the model to match certain Japanese economy’s facts. We choose the model period to be quarter and set the discount rate at \( \beta = 0.996 \). The labor supply disutility \( \Phi \) is pinned down such that, in the steady state, hours of work are equal to \( 1/3 \). The elasticity of intertemporal substitution in the hours supply is given by \( 1/\mu \), and the value of this elasticity has been the subject of some discussion. Kuroda and Yamamoto (2008) estimate the labor supply elasticity in Japan and find that the elasticity for males is in the range of 0.2–0.7. In our benchmark, we set \( \mu \) equal to 2, which implies a labor supply elasticity of 0.5. Based on Hamori and Asako (1999), and Brückner and Pappa (2012), we set the share parameter \( \omega = 0.6 \) and the elasticity of substitution between private and government consumption \( \zeta = 0.4 \).

We set the elasticity of matching with respect to unemployment \( \zeta \) to 0.6. This choice is in line with Kano and Ohta (2002), who estimate the matching function in the Japanese labor market. This value lies in the plausible range of 0.5–0.7 reported by Petrongolo and Pissarides (2001). We use the Hosios (1990) condition to pin down the worker’s bargaining power, so \( \eta = \zeta \). By using the panel property of the monthly LFS, Miyamoto (2011) constructs the job-finding rate and the separation rate in Japan and reports that the mean values of job-finding and separation rates in Japan are 0.142 and 0.0048, respectively. Miyamoto (2011) also reports that the mean value of the vacancy–unemployment ratio is 0.78. With the monthly job-finding rate and the vacancy–unemployment ratio, we solve for the matching efficiency parameter \( \gamma_m \) and the vacancy cost \( \gamma \) from the steady state of the model. See Shimer (2005) for this calibration strategy. We target the monthly separation rate of 0.0048, which implies the quarterly separation rate of 0.012.

We set the capital share \( \alpha = 1/3 \). Following Braun et al. (2006), we choose the depreciation rate \( \delta \) to equal 0.028. Martin (1998) computes the average replacement rates, the ratio of unemployment benefits to average wages, in the OECD countries and reports that
the replacement rate in Japan is about 0.6. We target the unemployment benefits $z$ to be 60% of the average wage of employed workers in the economy.\footnote{This parameter has been the subject of some discussion. For the U.S. labor market, Shimer (2005) sets $z$ by targeting the replacement rate of 0.4. Hagedorn and Manovskii (2008) argue that Shimer’s value is too low and assume that the flow value of unemployment is much larger and close to the productivity level. For Japan, Miyamoto (2011) chooses the value of $z$ by targeting the replacement rate of 0.6. while Esteban-Pretel et al. (2010) set it to 0.4 following Shimer (2005).}

Based on the data, we set the steady-state value for government consumption expenditures to output ratio $G/Y = 0.22$. Following Campolmi et al. (2011), we assume that the steady-state vacancy subsidy rate $\tau^v = 0.01$. The persistency coefficients $\rho_j$, $j \in \{g, \tau^v\}$ are all assumed to take values of 0.990. Thus, we assume that the persistency coefficient for the vacancy cost subsidy is the same as that for the government spending. The parameter values are summarized in Table 2.

Selected endogenous variables in the steady state under the calibrated parameter are reported in Table 3. The job-finding rate, labor market tightness, hours worked, and the ratio of government spending to output are equal to their target values.

Table 2. Parameter values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
<th>Source/target</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>Discount factor</td>
<td>0.996</td>
<td>Data</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Relative risk aversion parameter</td>
<td>1.0</td>
<td>See text</td>
</tr>
<tr>
<td>$\Phi$</td>
<td>Disutility of labor</td>
<td>10.05</td>
<td>See text</td>
</tr>
<tr>
<td>$\mu$</td>
<td>Frisch elasticity</td>
<td>2.0</td>
<td>Kuroda and Yamamoto (2008)</td>
</tr>
<tr>
<td>$\omega$</td>
<td>Share parameter</td>
<td>0.6</td>
<td>Hamori and Asako (1999)</td>
</tr>
<tr>
<td>$\zeta$</td>
<td>Elasticity of utility function</td>
<td>0.4</td>
<td>Brückner and Pappa (2012)</td>
</tr>
<tr>
<td>$\gamma_m$</td>
<td>Matching efficiency</td>
<td>0.471</td>
<td>Miyamoto (2011)</td>
</tr>
<tr>
<td>$\xi$</td>
<td>Matching elasticity</td>
<td>0.6</td>
<td>Kano and Ohta (2002)</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Worker’s bargaining power</td>
<td>0.6</td>
<td>$\rho = \xi$ (efficiency condition)</td>
</tr>
<tr>
<td>$s$</td>
<td>Separation rate</td>
<td>0.012</td>
<td>Miyamoto (2011)</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>Capital share</td>
<td>0.333</td>
<td>Data</td>
</tr>
<tr>
<td>$\delta$</td>
<td>Depreciation rate</td>
<td>0.06</td>
<td>Braun et al. (2006)</td>
</tr>
<tr>
<td>$\kappa$</td>
<td>Vacancy cost</td>
<td>0.138</td>
<td>$v - u$ ratio</td>
</tr>
<tr>
<td>$z$</td>
<td>Unemployment benefits</td>
<td>0.260</td>
<td>Replacement rate</td>
</tr>
<tr>
<td>$\tau^v$</td>
<td>Vacancy cost subsidy</td>
<td>0.01</td>
<td>See text</td>
</tr>
<tr>
<td>$\rho_g$</td>
<td>Gov. spending autoregressive parameter</td>
<td>0.990</td>
<td>Data</td>
</tr>
<tr>
<td>$\rho_{\tau^v}$</td>
<td>Vacancy cost subsidy autoregressive parameter</td>
<td>0.990</td>
<td>See text</td>
</tr>
</tbody>
</table>
IV-2. Effects of the government spending shock

We now study the dynamic responses of the economy to a government spending shock. The solid lines in Figure 4 display the impulse responses of relevant variables to a one standard-deviation shock to government spending.

An increase in government spending increases output, private consumption, and hours of work per worker. In a standard DSGE model, an increase in government spending tends to reduce private consumption and increase labor supply due to a negative wealth effect. However, in our model, substitutability between private and public consumption mitigates the size of the wealth effect. When the elasticity of substitution is low, an increase in public expenditures increases the marginal utility of private consumption, which increases private consumption. A low elasticity of substitution also implies a comparatively strong wealth effect, hence relatively large additional labor input. This leads to a higher output and a higher pressure on wages. As a result, although the responses of output, private consumption and investment, and hours of work are in line with empirical results, our model cannot capture the real wage response. While an increase in government spending increases the real wage in the data, it reduces the real wage in the model.

The positive shock on government spending increases vacancies and employment and reduces unemployment. On impact, vacancies rise and then gradually return to the steady-state value. Unemployment falls and reaches its lowest level in the 7th quarter and then gradually returns to the steady-state value. The response of employment is opposite that of the unemployment rate. The pattern of responses to unemployment, vacancies, and employment are in line with what we observed in the data.

The effect of the positive government spending shock on the labor market variables can be explained as follows. In the model, the level of employment depends on the number of posted vacancies. A firm decides whether to post a vacancy based on the expected value of hiring a worker. A higher value of hiring a worker encourages the firm to post a vacancy. The
Figure 4. Dynamic responses of the economy to a positive government consumption shock.

Note: The solid line labeled “benchmark” plots the effect of a positive government consumption shock on the economy. The dashed line labeled “Model with $\omega = 1$” plots the impulse responses of selected variables to a government consumption shock in the model with $\omega = 1$.

value of hiring a worker is the firm’s share of the expected new surplus from a new job match, which is basically determined by the stochastic discount factor and the pure economic rent in each period. This can be understood by seeing the job creation condition (6). While a higher stochastic discount factor lowers the value of hiring a worker, a higher economic rent increases it.

On one hand, the positive government spending shock increases the interest rate, and so the stochastic discounting factor. This lowers the value of hiring a worker. On the other hand, by reducing the wage it increases the pure economic rent, leading to a higher value of hiring a worker. Under our calibrated parameters, the latter effect dominates the former one, and
firms post more vacancies. As a result, employment rises and unemployment falls.

**The role of government spending** In our model, it is assumed that government consumption affects the household’s utility. We now assess whether or not the results of our model depend on the assumption. To do so, we consider a model in which government consumption is not an argument of the household’s utility function. This model can be obtained by setting $\omega = 1$ in our benchmark model. When we set $\omega = 1$, we recalibrate parameters $z$, $\kappa$ and $\Phi$ in order to maintain our calibration target values. The dashed lines in Figure 4 are the impulse responses to relevant variables to a positive government spending shock in the model with $\omega = 1$.

The most striking finding is that the positive government spending shock reduces private consumption in the model with $\omega = 1$. This is because the force that mitigates a negative wealth effect disappears when the government produces only waste and does not supply goods that are of value to the household.

Equally important, the pattern of responses of labor market variables in the model with $\omega = 1$ is the same as the one in the benchmark model. The positive government spending shock increases employment and reduces unemployment. Thus, although the model cannot capture the empirical pattern of private consumption, it still captures the empirical pattern of labor market variables.

**The role of persistency** Next, we study how the degree of persistency of a government spending shock affects the model’s outcome. Figure 5 displays the impulse responses of relevant variables to a government spending shock for three different values of $\rho^g$. It demonstrates that the effects of the government spending shock on labor market variables depend on the degree of persistency of the shock. When a shock is highly persistent, a positive government spending shock increases employment and reduces unemployment. In contrast, when the shock is short-lived, it tends to reduce employment and increase unemployment in the medium run.

This can be understood by looking at the effect of a government spending shock on hours of work per employee. When the shock is highly persistent, the negative wealth effect is strengthened. Thus, a long-lived shock generates larger effects on hours of work per employee than a short-lived shock. This implies that output increases more in the case of the long-lived shock. Higher output increases the value of hiring a worker, leading to more vacancy creation and thus lower unemployment.
Figure 5. The role of the persistency of government consumption shocks.

Note: The solid line labeled “benchmark” plots the effect of a positive government consumption shock on the economy. The dash-dotted line labeled “\( \rho = 0.9 \)” plots the impulse responses of selected variables to a government consumption shock with \( \rho_g = 0.9 \). The dashed line labeled “\( \rho = 0.8 \)” plots the impulse responses of selected variables to a government consumption shock with \( \rho_g = 0.8 \).

**IV-3. The Effect of hiring subsidy**

As Campolmi et al. (2011) and Faia et al. (2013) point out, a significant portion of fiscal stimulus policies undertaken in the aftermath of the 2007-2008 crisis took the form of labor market subsidies. We now examine the effect of fiscal stimuli in the form of a labor market subsidy on the economy. Specifically, we consider a subsidy for the cost of posting a vacancy.

Figure 6 shows impulse responses of the relevant variables to a one percentage point increase in the vacancy cost subsidy. A positive shock on the vacancy cost subsidy increases
vacancies and employment and reduces unemployment. The channel through which the vacancy cost subsidy affects the economy is straightforward. As we can see in the job creation condition (6), a higher subsidy to the cost of posting a vacancy encourages firms to open more vacancies by reducing the cost of posting them. The increase in vacancies makes it easier for unemployed workers to find jobs, leading to lower unemployment and higher employment.

Since the qualitative effects of the vacancy cost subsidy shock on unemployment are similar to those of the government spending shock, we now study which policy instrument is more effective in lowering unemployment. To do so, we compare the performance of two alternative forms of fiscal expansion by computing the unemployment multiplier. Following Faia et al. (2013), we compute the net present value unemployment multiplier:
where $\Omega_t$ is the cost associated with the fiscal shock and the variables without a subscript denote the steady-state values. When we consider a traditional government spending shock, the cost is given by $\Omega_t = G_t$. On the other hand, when we consider an increase in the vacancy cost subsidy, the cost is given by $\Omega_t = \tau v \kappa$.

Figure 7 shows the results. The unemployment multipliers for the vacancy cost subsidy policy are much larger (in absolute values) that that for the government spending policy. Thus, the vacancy cost subsidy is more effective in lowering unemployment than government spending. This result is in line with Campolmi et al. (2011).

\[UMulti_{i,t+j} = \frac{\sum_{i=1}^{j} \beta^i \left( u_{t+i} - u \right)}{\sum_{i=1}^{j} \beta^i (\Omega_{t+i} - \Omega)}\]
V. Conclusion

This paper studies the effect of fiscal stimulus on the labor market dynamics in Japan. We first empirically examined the effects of a government spending shock on the Japanese labor market by employing a structural VAR model. Our empirical analysis demonstrated that an increase in government spending increases output, private consumption and private investment and reduces unemployment. We also found that an increase in government spending increases the job finding rate and reduces the separation rate. Furthermore, we found that effectiveness of fiscal stimulus in reducing unemployment in the post-2000s is larger than that in the pre-2000s.

We then developed a DSGE model with search friction in the labor market. Instead of assuming that all government spending is wasteful as in standard DSGE models, we assumed that the government supplies goods that are of value to households. While the calibrated model can generate a pattern of responses of labor market variables to the government spending shock that is similar to that of VAR, it fails to predict the exact size of the impact of the government spending shock on labor market variables.

By using our model, we also analyzed the effect of fiscal stimulus in the form of a job creation subsidy. We demonstrated that the qualitative effect of the job creation subsidy is similar to that of the traditional government spending, but quantitatively the job creation subsidy is more effective in reducing unemployment that the government spending.

A number of important issues remain for future research. One issue to be considered is incorporating endogenous job separation into the model. Our model assumes that while a worker’s transition from unemployment to employment is endogenously determined through a matching market, employed workers lose their jobs due to exogenous separation shock. However, recent empirical studies demonstrate that both inflow and outflow of unemployment are important determinants of unemployment dynamics. Since our empirical analysis shows that a change in government spending affects both job finding and separation rates, it is worth studying the effects of fiscal stimuli in a model with endogenous job separation. Also, considering the incorporation of non-Ricardian consumers into the model is important. Our model assumes infinitely-lived households and thus the Ricardian equivalence holds. Since most Japanese citizens are now seriously concerned with negative effects and risks of the piled-up fiscal deficits, it is worth extending our model by incorporating non-Ricardian consumers. Furthermore, considering a more realistic fiscal setup with distortionary taxes is a fruitful avenue for research.
References


Japanese case,” Discussion Paper No. 967, Institute of Policy and Planning Sciences, University of Tsukuba, Tsukuba, Japan.


retrospective,” IMF Staff-Papers 47, pp. 259-77.
American Economic Review, 95, pp. 25-49.