The Effects of Anticipated Fiscal Policy Shock on Macroeconomic Dynamics in Japan

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Abstract

This study investigates the effects of fiscal policy on macroeconomic dynamics in Japan with a particular focus on the effects of anticipated fiscal policy shock and the recent policies of Abenomics. We identify anticipated fiscal policy shock by combining excess stock returns for the construction industry and the VAR model with robust sign restrictions derived from a theoretical model. The primary result is that GDP and consumption respond positively to anticipated fiscal policy shock. Additionally, the result of historical decomposition that focused on the period of Abenomics reveals that anticipated fiscal policy shock positively contributes to consumption dynamics.

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1. Introduction

Amidst the recent global financial crisis, large-scale fiscal stimulus packages (e.g., the American Recovery and Reinvestment Act in the US and the countermeasures to address the economic crisis in Japan.) have been implemented worldwide. The need for stimulus packages continues to provoke debate on the macroeconomic effects of fiscal policy throughout the world and has prompted the question: Does fiscal policy stimulate economic activity? To answer this question, this study employs a vector autoregressive (VAR) model to evaluate the effects of fiscal policy using macroeconomic time series of the Japanese economy for the sample period 1980Q1 to 2015Q2. The Japanese economy has suffered a long depression since the collapse of the bubble economy in the early 1990s and many fiscal stimulus packages have been enforced throughout the sample period. Therefore, the Japanese economy is an appropriate subject for this study.

Extensive literature has already investigated the effects of fiscal policy in Japan using VAR analysis (e.g., Bayoumi 2001; Kuttner and Posen 2002; Watanabe et al. 2011). However, these previous works overlook anticipated changes in fiscal policy. As noted in Blanchard and Perotti (2002) and Ramey (2011), fiscal policy is subject to two lags: the decision lag and the implementation lag. The former denotes a period between the time a regulation is submitted and the time when it is enacted; the latter refers to the period from the enactment of the regulation to its enforcement. An implementation lag implies a possibility that people are aware of a change in stance with respect to future fiscal policy and they can immediately react. Therefore, if an anticipated increase in government spending is identified as unanticipated fiscal policy shock, there may be a failure in the evaluation of the true effects of fiscal policy. Hence, this study examines the effects of fiscal policy by considering the possibility that fiscal policy is anticipated. The foreseeability of fiscal policy is called fiscal foresight (Leeper et al. 2012; Leeper et al. 2013). This study investigates the effects of both anticipated and unanticipated fiscal policy shocks.[1]

[1] With respect to news shock, Beaudry and Portier (2005, 2006) are seminal works that identify news shock about future productivity using stock price in the framework of a VAR model and thus are significantly related to our study.

The Japanese economy has recently experienced news shocks concerning a large fiscal stimulus package – the economic recovery policy proposed by Prime Minister Shinzo Abe called "Abenomics." Stock prices in Japan (the Nikkei average) soared to over ten thousand yen after Shinzo Abe won the general election without any policy implementation. Moreover, Fukuda and Yamada (2011) find that most fiscal stimulus packages in the 1990s and 2000s affected stock prices, which demonstrates that fiscal foresight is the key to understanding the true effects of fiscal policy in Japan. Similar findings have been repeatedly observed and provide additional motivation for an analysis of the Japanese economy and the Abenomics policy.

The identification of anticipated fiscal policy shock in this study proceeds based on the approach of Fisher and Peters (2010). The central idea is as follows. If the financial market is efficient and agents are forward looking, the asset prices reflect the information that is currently available. Hence, news on fiscal policy change causes fluctuations in the stock prices of companies that are related to fiscal policy. Based on this assumption, Fisher and Peters (2010) identify anticipated government (military) spending shocks as innovations on the excess stock returns of large US military contractors. This study applies this identification strategy to the relationship between government spending and the construction industry in Japan. We do this because fiscal policy aimed at an economic stimulus in Japan is usually performed through public works, which are undertaken by the construction industry.[2]

However, there are some caveats to the direct application of Fisher and Peters's (2010) method to our analysis. First, as Fisher and Peters (2010) state, not all variations in stock returns are a result of fiscal news, because firms sell to the public sector and the private sector. Additionally, stock prices are also influenced by the workings of the entire economy. To resolve

[2]Public works in Japan have tended to decrease since the early-2000s under Koizumi's structural reform. However, public works seem to have revived since the Lehman shock and the Great East Japan Earthquake. For example, from a total of 56.8 trillion yen, about 5 trillion yen is allocated for public investment in a "low-carbon revolution" and "realization of the potential of the Japanese economy and development of infrastructure to deal with the challenges of the 21st century" in "countermeasures to address the economic crisis" announced in April 2009. Additionally, approximately 5.5, 4.5, and 1.7 trillion yen are included as public works for "measures for post-quake reconstruction and disaster prevention" in a series of emergency economic measures by Prime Minister Shinzo Abe that were announced in January 2013, December 2013, and December 2014, respectively. Those amounts correspond to a quarter to a half of total investment.

this problem, the authors specify the top three military contractors and derive the excess stock returns as defined by the deviation of the stock returns of those military contractors from the market returns. While we also adopt the excess stock returns concept, the unavailability of data makes it impossible to specify the construction firms that undertake the largest amount of public works projects in Japan. Therefore, we adopt the sign-restriction VAR methodology developed by Uhlig (2005) in addition to the method using excess stock returns. Because the sign-restricted VAR model identifies structural shocks by imposing restrictions on the shape of the impulse response function (IRF), this approach enables us to isolate the changes in stock returns that result from anticipated fiscal policy shock involving future increases in government spending. Thus, we characterize anticipated fiscal policy shock as a shock that raises excess stock returns at the first period and, thereafter, increases government spending gradually.

A second problem that is uniquely associated with this study stems from using the stock returns of the construction industry as a variable which is prognostic of future fiscal policy. In general, the construction industry tends to be affected by the health of the Japanese economy more than other industries, and the influence of business fluctuations persist, despite using excess stock returns. Thus, there is a possibility that excess stock returns of the construction industry also respond to other shocks. To confront this problem, we adopt the robust sign restriction that is employed in Dedola and Neri (2007), Gambetti et al. (2008), and Pappa (2009). In this methodology, sign restrictions imposed on the IRFs are derived from the theoretical model. The theoretical IRFs for each structural shock are calculated under a sufficiently wide range of parameters and the features that are common to any combination of parameter values are adopted as robust sign restrictions. We build a New Keynesian (NK) model in which several structural shocks other than anticipated fiscal policy shock are incorporated and, additionally, the stock price of firms related to fiscal policy explicitly matches the empirical model. Based on the prediction derived from the theoretical model, we determine the characteristics that distinguish anticipated fiscal policy shock from other possible structural shocks.

In addition to the calculation of the IRFs, we examine the relative importance of fiscal policy shock with respect to the fluctuation in Japanese business cycles and investigate the role of fiscal policy shock in the recent Abenomics period. We conduct forecast error variance decomposition (FEVD), historical decomposition (HD), and an IRF analysis. These methods evaluate the effects of fiscal policy shock both qualitatively and quantitatively.

Since Ramey (2011) noted that the standard VAR analysis without fiscal foresight fails to capture the true effects of fiscal policy, several studies have attempted to estimate the effects of anticipated fiscal policy in the US (e.g., Mountford and Uhlig 2009; Tenhofen and Wolff 2010; Fisher and Peters 2010; Mertens and Ravn 2010). To the best of our knowledge, however, this is the first study that explores the effects of anticipated fiscal policy shock in Japan.[3] Moreover, this study makes a theoretical contribution by extending the model of Galí et al. (2007) to explicitly incorporate excess stock returns of the public goods sector and fiscal news process into the model. As a result, the variables in the theoretical model exactly correspond to the variables in the empirical model. The new method presented in this study clarifies the research of Fisher and Peters (2010) and is widely applicable to the analysis of other countries for which firm data related to fiscal policy cannot be sufficiently collected.

The results of this study are summarized as follows. First, our identification strategy seems likely to capture the fiscal news shock correctly. The dates of innovation in the estimated series of anticipated fiscal policy shock are substantially consistent with the announcement dates of fiscal stimulus packages reported in Fukuda and Yamada (2011). Second, the IRF analysis reveals that fiscal policy shock has a positive effect on consumption but a negative effect on investment. Consumption and GDP persistently respond positively to anticipated fiscal policy shock while investment is heavily crowded out by unanticipated fiscal policy shock. Third, the results of FEVD show that anticipated fiscal policy shock plays a large role in the variation of

[3] Bold monetary policy implemented by the Bank of Japan is also one of the three arrows of Abenomics along with flexible fiscal policy. Kano and Morita (2015) examine the effects of monetary policy news shock on exchange rates using the dynamics stochastic general equilibrium model that can replicate the random-walk property of exchange rates.

consumption. Finally, the HD, which focuses on Abenomics, discloses that positive fiscal news shock occurs during periods of Abenomics and positively contributes to consumption dynamics.

The remainder of this study is organized as follows. Section 2 presents the theoretical model and derives the robust sign restrictions from the calculated theoretical IRFs. Section 3 explains the estimation method of the sign-restricted VAR model and describes the data series and the specifications of the estimation model. Section 4 shows the estimation results of the IRF, FEVD, and HD analyses. Finally, Section 5 provides the concluding remarks.

2. Theoretical model

To extract the robust sign restrictions characterizing fiscal policy shock, we adopt the methodology used in Dedola and Neri (2007) and Pappa (2009). Following this method, we first construct an NK model that is a variant of Galí et al. (2007) and explore the common features of the dynamic properties in response to fiscal policy shock by calculating the IRFs under various parameter values.

To replicate the positive response of consumption to an unanticipated increase in government spending, which is usually observed in the empirical results of the VAR analysis, the model of Galí et al. (2007) originally contains the following prominent characteristics: price stickiness, rule-of-thumb household, debt financing, and wage union. Additionally, we incorporate wage stickiness, public capital, and the news process of fiscal policy shocks into our model and extend the fiscal and monetary policy rules to react to the output gap. These extensions allow us to obtain the IRFs that correspond to a wide-class model and mitigate the problem of misspecification in the theoretical model. The structural shocks other than fiscal policy shocks (i.e., technology, monetary policy, and labor preference shocks) are also included in our model to ensure that the dynamics characterizing fiscal policy shocks are unique and cannot be generated by other shocks.

Most importantly, we extend Galí et al. (2007) to the two-sector model in which final-goods consumed by the public sector (i.e., government spending) and private sector (i.e., consumption and investment) are separately produced by two types of final-goods producing firms. By doing so, the excess stock returns used in the empirical analysis can be explicitly introduced to the theoretical model. Specifically, we regard the discounted present value of profit obtained from the sale of intermediate-goods to each sector by firms as the stock price in each sector and calculate the excess stock returns of the public sector relative to the private sector as was done for the empirical analysis.

2.1. Households

The economy is populated by a continuum of households indexed by $i \in [0, 1]$, and each household is composed of a continuum of members. The households are divided into two types: optimizing or Ricardian (R) households that have access to the capital market and rule-of-thumb or non-Ricardian (N) households that face liquidity constraints and consume all of their disposable income in each period. As in Galí et al. (2007) and Colciago (2011), we assume that a fraction $\mu \in [0, 1]$ of the population are non-Ricardian households and the remaining population $1 - \mu$ are Ricardian households.

2.1.1. Labor market structure

We begin by explaining the labor market structure. Following Colciago (2011), we assume a continuum of differentiated labor input indexed by $l \in [0, 1]$. Moreover, labor unions exist that correspond to each differentiated labor input, and each union sets their wage rate. As adopted in Schmit-Grohe and Uribe (2006) and Colciago (2011), each member of a household is assumed to provide each possible type of labor input, that is, each household belongs to every labor union. As stated in Galí et al. (2007), labor supply is assumed to be determined by labor demand (not by the optimal choice of households) given the wage fixed by the labor union. The labor supply to a differentiated labor input l is given by

$$n_t(l) = \left(\frac{W_t(l)}{W_t}\right)^{-\varepsilon_w} n_t^d \tag{1}$$

where ε_w is the elasticity of substitution between labor inputs. Here, n_t^d is the labor demand for effective labor, and W_t is the aggregate nominal wage. The formal derivation of this equation is denoted in Section 2.2, which is devoted to wage setting. Moreover, we assume that the members in each household are distributed uniformly across unions, irrespective of the type of household. This assumption ensures that the labor demand for differentiated labor input l is spread uniformly across the households and that there is no difference in labor supply across the household type, that is, $n(i,l) = n_t^R(i,l) = n_t^N(i,l)$. Because each household supplies each type of differentiated labor input $n_t(i,l)$ and obtains the nominal wage $W_t(l)$, the total labor income for every household is evenly given by $\int_0^1 W_t(l)n_t(i,l)dl$.

2.1.2. Ricardian households

Let $c_t^R(i)$ be the real consumption of Ricardian households. Then, the lifetime utility of Ricardian households is written by

$$U = E_0 \sum_{t=0}^{\infty} \left[\frac{c_t^R(i)^{1-\gamma} - 1}{1-\gamma} - \chi_t \frac{n_t(i)^{1+\lambda}}{1+\lambda}\right], \tag{2}$$

where $n_t(i) = \int_0^1 n_t(i,l)dl$ denotes hours worked, and superscript R is omitted because of the assumption stated above. Moreover, χ_t captures the labor preference that follows an exogenous process, and β, γ, and λ represent the discount rate, risk aversion, and inverse of the Frisch labor elasticity, respectively. Ricardian households maximize the lifetime utility function subject to the budget constraint

$$P_t c_t^R(i) + P_t x_t^R(i) + B_t^R = \int_0^1 W_t(l)n_t(i,l)dl + P_t r_t^k k_{t-1}^R(i) + R_{t-1}B_{t-1}^R + D_t(i) - P_t \tau_t^R(i), \tag{3}$$

and the capital accumulation equation,

$$k_t^R(i) = (1-\delta)k_{t-1}^R + \left\{1 - S\left(\frac{x_t^R(i)}{x_{t-1}^R(i)}\right)\right\} x_t^R(i). \tag{4}$$

In the theoretical model, uppercase letters denote nominal variables. P_t, B_t, and R_t are the price level of private sector goods, a one-period riskless nominal bond, and the gross nominal return on bond, respectively. Because the intermediate goods producing firms face monopolistic competition and make excess profits, a Ricardian household receives dividends $D_t^R(i)$. The lump-sum tax paid by Ricardian households is denoted by $\tau_t^R(i)$. Additionally, $x_t^R(i)$, $k_t^R(i)$, and r_t^k respectively indicate real investment, real capital stock, and the real rental rate on capital. In this study, the adjustment costs of investment are assumed to be proportional to the rate of change in investment, as in Christiano et al. (2005), where $S(1) = S'(1) = 0$, and $S''(1) > 0$. Although this setting differs from that of Galí et al. (2007), most studies estimating the dynamic stochastic general equilibrium (DSGE) model for the Japanese economy adopt the Christiano et al. (2005) type investment adjustment cost. Hence, we employ it to simplify the model calibration.

2.1.3. Non-Ricardian households

Non-Ricardian households simply consume their current disposable income in each period. By denoting the consumption of non-Ricardian households as $c_t^N(i)$, their budget constraints are written as

$$P_t c_t^N(i) = \int_0^1 W_t(l) n_t(i,l) dl - P_t \tau_t^N(i), \tag{5}$$

where $\tau_t^N(i)$ denotes the lump-sum tax paid by non-Ricardian households. Following Galí et al. (2007), we assume that a steady state value of lump-sum tax is different between Ricardian and non-Ricardian households to equate steady-state consumption across household types.

2.2. Wage setting

Each household provides a differentiated labor input indexed by $l \in [0,1]$ and each household belongs to every labor union. A perfectly competitive labor-bundling firm bundles a differentiated labor input $n_t(l)$ into an effective labor n_t according to

$$n_t = \left[\int_0^1 n_t(l)^{\frac{\varepsilon_w - 1}{\varepsilon_w}} dl \right]^{\frac{\varepsilon_w}{\varepsilon_w - 1}}. \tag{6}$$

The profit maximization problem for the labor bundler derives the demand function for each differentiated labor input to be expressed as (1) for all l. Additionally, the aggregate nominal wage is equal to

$$W_t = \left[\int_0^1 W_t(l)^{1-\varepsilon_w} dl \right]^{\frac{1}{1-\varepsilon_w}}. \tag{7}$$

With respect to wage setting, we follow the model used in Galí et al. (2007), in which each labor union sets its nominal wage to maximize the weighted average of the lifetime utility of Ricardian and non-Ricardian households. We incorporate the Calvo (1983)-type wage stickiness into the nominal wage setting, as in Colciago (2011). Therefore, the labor union resets the optimal nominal wage $W_t^*(l)$ with a probability $1-\rho_w$ in each period, and the problem for labor union l is written as

$$\max_{W_t^*(l)} E_t \sum_{s=0}^{\infty} \rho_w \Lambda_{t,t+s} \left[(1-\mu) \frac{c_{t+s}^R(l)^{1-\gamma} - 1}{1-\gamma} + \mu \frac{c_{t+s}^N(l)^{1-\gamma} - 1}{1-\gamma} - \chi_t \frac{n_{t+s}(l)^{1+\lambda}}{1+\lambda} \right] \tag{8}$$

subject to (1), (3), and (5), where $\Lambda_{t,t+s} = \beta^s (c_{t+s}^R / c_t^R)^{-1}$ denotes the stochastic discount factor. After solving this problem, the first-order condition in the symmetric equilibrium can be expressed as

$$W_t^*(l) = \frac{\varepsilon_w}{\varepsilon_w - 1} \frac{E_t \sum_{s=0}^{\infty} \rho_w^s \Lambda_{t,t+s} \chi_t n_{t+s}^{1+\lambda}}{E_t \sum_{s=0}^{\infty} \rho_w^s \Lambda_{t,t+s} \left[(1-\mu) \frac{n_{t+s}}{P_{t+s} {c_{t+s}^R}^{\gamma}} + \mu \frac{n_{t+s}}{P_{t+s} {c_{t+s}^N}^{\gamma}} \right]}. \tag{9}$$

Combining the optimal wage denoted in (9) with (7), the evolution of the aggregate nominal wage is given by

$$W_t = \left[(1-\rho_w) {W_t^*}^{1-\varepsilon_w} + \rho_w W_{t-1}^{1-\varepsilon_w} \right]^{\frac{1}{1-\varepsilon_w}}. \tag{10}$$

Then, the log-linearization of (9) and (10) around the steady state yields the dynamic equation of real wage as

$$\hat{w}_t = \Gamma \hat{w}_{t-1} + \Gamma \beta E_t \hat{w}_{t+1} + \Gamma \beta E_t \hat{\pi}_{t+1} - \Gamma \hat{\pi}_t + \kappa_w \Gamma \gamma \hat{c}_t + \kappa_w \Gamma \lambda \hat{n}_t + \kappa_w \Gamma \hat{\chi}_t, \tag{11}$$

where a hat denotes the deviation from the steady state value, $\Gamma = \rho_w/(1+\beta\rho_w^2)$, and $\kappa_w = (1-\beta\rho_w)(1-\rho_w)/\rho_w$.

2.3. Firms

The production sector consists of two types of firms: monopolistically competitive firms that produce differentiated intermediate goods and perfectly competitive firms that produce final-goods by using intermediate goods as the input. Moreover, two types of final-goods firms exist that produce the final-goods for the public and private sectors. For the intermediate goods, each intermediate goods firm, indexed by $j \in [0,1]$, produces an intermediate good $y_t(j)$, and its production function is assumed to have the Cobb-Douglas form:

$$y_t(j) = z_t n_t(j)^{1-\alpha} k_{t-1}(j)^{\alpha} {k_{t-1}^g}^{\alpha_g} \tag{12}$$

where $k_{t-1}(j)$ and $n_t(j)$ respectively denote the capital stock and the labor input used by firm j, and k^g_{t-1} denotes the public capital stock. z_t indicates the total factor productivity (TFP), which is given exogenously. Intermediate goods are assumed to be purchased by both types of final-goods firms.

Although the market for intermediate goods is monopolistically competitive, the factor market faced by intermediate-goods firms is assumed to be competitive. Because of the cost minimization problem for intermediate-goods firms, the real marginal cost mc_t is given by

$$mc_t = \frac{w_t}{(1-\alpha) z_t k_t^{g\alpha_g}} \left(\frac{(1-\alpha) r_t^k}{\alpha w_t} \right)^{\alpha}. \tag{13}$$

For final-goods firms, let y_t^c and y_t^g be the final-goods for the private and public sectors, respectively. The final-goods in each sector are produced by the constant elasticity of substitution (CES) technology:

$$y_t^c = \left[\int_0^1 y_t^c(j)^{\frac{\varepsilon_p - 1}{\varepsilon_p}} dj \right]^{\frac{\varepsilon_p}{\varepsilon_p - 1}} \quad \text{and} \quad y_t^g = \left[\int_0^1 y_t^g(j)^{\frac{\varepsilon_p - 1}{\varepsilon_p}} dj \right]^{\frac{\varepsilon_p}{\varepsilon_p - 1}}, \tag{14}$$

where $y_t^c(j)$ and $y_t^g(j)$ are the amount of intermediate goods j as an input in each sector, and ε_p is the elasticity of substitution across each type of intermediate good. By solving a profit maximization problem for each final-goods firm, the demand function for the intermediate goods is obtained by

$$y_t^c(j) = \left(\frac{P_t(j)}{P_t} \right)^{-\varepsilon_p} y_t^c \quad \text{and} \quad y_t^g(j) = \left(\frac{P_{g,t}(j)}{P_{g,t}} \right)^{-\varepsilon_p} y_t^g, \tag{15}$$

where $P_{g,t}$ indicates the price level for public sector goods. Moreover, the final-goods pricing rule is written as

$$P_t = \left[\int_0^1 P_t(j)^{1-\varepsilon_p} dj \right] \quad \text{and} \quad P_{g,t} = \left[\int_0^1 P_{g,t}(j)^{1-\varepsilon_p} dj \right]. \tag{16}$$

2.4. Price setting

Intermediate goods firms sell their products to both private and public final-goods producing firms, and these prices are determined separately according to the demand in each market. As in a wage union, intermediate goods firms are assumed to set their prices under Calvo (1983)-type price stickiness. Therefore, the price-setting problem for intermediate goods firm j for the private and public final-goods firms are respectively written as

$$\max_{P_t^*(j)} E_t \sum_{s=0}^{\infty} \rho_c^s \Lambda_{t,t+s} \left[P_t^*(j) y_{t+s}^c(j) - P_{t+s} y_{t+s}^c(j) mc_{t+s} \right], \tag{17}$$

$$\max_{P_{g,t}^*(j)} E_t \sum_{s=0}^{\infty} \rho_g^s \Lambda_{t,t+s} \left[P_{g,t}^*(j) y_{t+s}^g(j) - P_{t+s} y_{t+s}^g(j) mc_{t+s} \right] \tag{18}$$

subject to (15), where ρ_c and ρ_g denote the probability that the price cannot be reoptimized for each sector. For each type of good, the laws of motion for the optimal and aggregate prices are written similar to those of wages:

$$P_t^* = \frac{\varepsilon_p}{\varepsilon_p - 1} \frac{E_t \sum_{s=0}^{\infty} \rho_c \Lambda_{t,t+s} P_{t+s} y_{t+s}^c(j) mc_{t+s}}{E_t \sum_{s=0}^{\infty} \rho_c \Lambda_{t,t+s} y_{t+j}^c(j)}, \tag{19}$$

$$P_{g,t}^* = \frac{\varepsilon_p}{\varepsilon_p - 1} \frac{E_t \sum_{s=0}^{\infty} \rho_g \Lambda_{t,t+s} P_{t+s} y_{t+s}^g(j) mc_{t+s}}{E_t \sum_{s=0}^{\infty} \rho_g \Lambda_{t,t+s} y_{t+j}^g(j)} \tag{20}$$

and

$$P_t = \left[(1-\rho_c) P_t^{*1-\varepsilon_p} + \rho_c P_{t-1}^{1-\varepsilon_p} \right]^{\frac{1}{1-\varepsilon_p}}, \tag{21}$$

$$P_{g,t} = \left[(1-\rho_g) {P_{g,t}^*}^{1-\varepsilon_p} + \rho_g P_{g,t-1}^{1-\varepsilon_p} \right]^{\frac{1}{1-\varepsilon_p}}. \tag{22}$$

The New-Keynesian Phillips curves for each type of goods are obtained by log-linearization from (19) to (22), as follows:

$$\hat{\pi}_t = \beta E_t \hat{\pi}_{t+1} + \kappa_c \hat{mc}_t \tag{23}$$

and

$$\hat{\pi}_{g,t} = \beta E_t \hat{\pi}_{g,t+1} + \kappa_g \left[\hat{mc}_t + \hat{P}_t - \hat{P}_{g,t} \right] \tag{24}$$

where $\kappa_c = (1 - \beta \rho_c)(1 - \rho_c)/\rho_c$ and $\kappa_g = (1 - \beta \rho_g)(1 - \rho_g)/\rho_g$.

2.5. Fiscal policy and monetary policy

The government budget constraint is

$$P_t \tau_t + B_t = P_{g,t} g_t + R_{t-1} B_{t-1} \tag{25}$$

where g_t denotes real government spending and its price is equal to $P_{g,t}$. We assume a tax rule of the form

$$\hat{\tau}_t = \phi_b \hat{b}_{t-1} + \phi_g \hat{g}_t + \phi_y \hat{y}_t \tag{26}$$

where $\hat{\tau}_t \equiv (\tau_t - \tau)/y$, $\hat{b}_t = (b_t - b)/y$, and $\hat{g}_t = (g_t - g)/y$. Additionally, the public capital simply accumulates as follows:

$$k_t^g = (1 - \delta) k_{t-1}^g + g_t. \tag{27}$$

On the other hand, the monetary authority is assumed to set the nominal interest rate according to a simple Taylor rule:

$$\hat{r}_t = \psi_\pi \hat{\pi}_t + \psi_y \hat{y}_t + \hat{u}_t^m, \tag{28}$$

where u_t^m denotes monetary policy disturbance, which is assumed to be exogenous.

2.6. Aggregate and market clearing

Aggregate consumption, lump-sum taxes, capital, investment, bonds, and dividends are given respectively by

$$c_t = (1-\mu)c_t^R + \mu c_t^R; \quad k_t = (1-\mu)k_t^R; \quad b_t = (1-\mu)b_t^R;$$
$$\tau_t = (1-\mu)\tau_t^R + \mu \tau_t^R; \quad x_t = (1-\mu)x_t^R; \quad d_t = (1-\mu)d_t^R.$$

The clearing conditions of the factor and goods market are expressed as

$$n_t = \int_0^1 n_t(j)dj; \quad k_t = \int_0^1 k_t(j)dj;$$
$$y_t^c = c_t + x_t; \quad y_t^g = g_t$$
$$y_t = c_t + x_t + g_t$$

2.7. Dynamics of exogenous variables

The dynamics of exogenous variables g_t, z_t, u_t^m, and χ_t are respectively assumed to be

$$\hat{g}_t = \rho_f \hat{g}_{t-1} + \varepsilon_t^g + \xi_{t-p}^g \tag{29}$$

$$\hat{z}_t = \rho_z \hat{z}_{t-1} + \varepsilon_t^z + \xi_{t-p}^z \tag{30}$$

$$\hat{u}_t^m = \rho_m \hat{u}_{t-1}^m + \varepsilon_t^m + \xi_{t-p}^m \tag{31}$$

$$\hat{\chi}_t = \rho_\chi \hat{\chi}_{t-1} + \varepsilon_t^\chi + \xi_{t-p}^\chi \tag{32}$$

where $\varepsilon_t^h, h \in [g, z, m, \chi]$ denotes an unanticipated shock in period t. $\xi_{t-p}^h, h \in [g, z, m, \chi]$ denotes an anticipated shock that is realized in period t but that was announced in period $t-p$.

2.8. Excess stock returns

Stock prices for each sector at period t can be described as the discounted sum of profit flow given by

$$V_{c,t} = \sum_{s=0}^{\infty} \Lambda_{t,t+s} \left[P_{t+s} y_{t+s}^c - P_{t+s} y_{t+s}^c mc_{t+s} \right], \tag{33}$$

$$V_{g,t} = \sum_{s=0}^{\infty} \Lambda_{t,t+s} \left[P_{g,t+s} y_{t+s} - P_{t+s} y_{t+s}^g mc_{t+s} \right]. \tag{34}$$

For the responses to each structural shock, we first obtain the log-deviation values from a steady state for the variables on the right-hand side of (33) and (34) because the model is solved in the form of log-linearization. Thereafter, the dynamics of each variable in level are recalculated by combining the value of log-deviation and the steady state value. The stock prices $V_{c,t}$ and $V_{g,t}$ can then be computed based on (33) and (34). Practically, it is impossible to calculate the discounted sum of profit flow for an infinite horizon. Therefore, we calculate it using the profit flows during the 100 periods. Additionally, the initial value of stock price, which is equal to the steady state value, is computed by the steady state value of profit. Given the initial value and dynamics of stock price for each sector, we calculate the variations of stock returns in response to structural shocks as a log-differential of stock prices and subsequently obtain the excess stock returns for the public sector relative to the private sector by subtracting private sector stock returns from public sector stock returns.

2.9. Parameter range

The sign restrictions imposed on our VAR model are based on the IRFs derived from the above theoretical model. To determine the robust sign restrictions, the IRFs are computed from the ranges of certain parameters. More precisely, the theoretical IRFs in this study are calculated as follows. Our process for finding the robust sign restrictions follows Pappa (2009). Let Θ denote the parameters in the interval $[\theta_l, \theta_h]$. Θ is assumed to be uniformly distributed in the interval $[\theta_l, \theta_h]$, namely, $\Theta \sim U(\theta_l, \theta_h)$. We randomly draw Θ and calculate the IRFs. Repeating this process sufficiently provides the range of IRFs that correspond to the combination of the various parameter values. Only robust signs are adopted as restrictions imposed on the empirical model. The values of the parameters are selected based on the results estimated in the previous studies or on the values used in the calibration exercises.

In this study, a quarter is selected as the unit period to match the frequency of the data used in the empirical analysis. Previous studies have estimated the degree of risk aversion γ to be in the range of 1.25 (Sugo and Ueda 2008) to 1.91 (Iiboshi et al. 2008). Thus, we restrict γ to the interval $[1, 2]$. The inverse of labor supply substitution λ was estimated to be 2.08 in Iiboshi et al. (2008) and 2.15 in Sugo and Ueda (2008), whereas Galí et al. (2007) adopted 0.5. Thus, this study restricts λ to the interval $[0.5, 2]$.

The parameter μ indicates the proportion of non-Ricardian households and determines the dynamics of aggregate consumption, as presented in Galí et al. (2007). Previous analyses using macro time-series data have estimated the value of μ for Japan to be from 0.3 (Hatano 2004; Iwata 2009) to 0.47 (Morita 2015); other analyses using micro data (Kohara and Horioka 2006) estimate values between 0.08 and 0.15. Considering these results, we limit μ to the interval $[0.1, 0.5]$. Subsequently, the lower and upper bounds of price stickiness for private sector goods are selected as 0.2 and 0.9, respectively. The upper bound is consistent with the result using the aggregate data reported in Watanabe and Fuchi (2002), while the lower bound is the same as the value in Pappa (2009). On the other hand, the upper bound of price stickiness for public sector goods is set at 0.8. This is also based on the result of Watanabe and Fuchi (2002) in which the degree of price stickiness in the construction industry is estimated to be less than the degree of price stickiness in other industries. For wage stickiness, we limit the range to $[0.2, 0.9]$. The upper bound is set to be larger than the value estimated in Iiboshi et al. (2008) and Sugo and

Ueda (2008). Additionally, the interval for the investment adjustment cost κ is set at $[0, 0.3]$, which is centered on the value of 0.15 used in Sugo and Ueda (2008).

The elasticities of tax with respect to government spending and bonds (i.e., ϕ_g and ϕ_b) are selected based on Galí et al. (2007). However, the calibration parameter values in Galí et al. (2007) were based on the US economy. Thus, we adopt wider intervals for these parameters to mitigate this problem. Specifically, the interval for the tax elasticity with respect to government spending is $[-0.25, 0.25]$ and the tax elasticity with respect to debt is $[0, 0.5]$.[4] The elasticity of tax to output is set at $[0.125, 0.175]$ based on the results presented in Watanabe et al. (2011). The parameters in the monetary policy rule are set as follows. The response of the interest rate to inflation is limited to the interval $[1.01, 1.5]$. This range fulfills the Taylor principle and is often used in calibration exercises. The interval of the coefficient on the output gap is set at $[0, 0.2]$ based on the results in Iiboshi et al. (2008) and Sugo and Ueda (2008).

The parameters for the persistence of the exogenous variables and the elasticity of substitution in production and labor are assumed to be in the ranges of $[0.8, 0.95]$ and $[6, 11]$, respectively. The remaining parameters are then fixed to particular values. Table 1 shows all of the parameter values and intervals.

[Table 1 about here.]

2.10. Sign restrictions

Figures 1 and 2 display the 5th and 95th quantiles, respectively, of the sampled responses of government spending, excess stock returns, output, inflation for private goods, consumption, and investment – which coincide with the variables in the empirical VAR model – to unanticipated (Figure 1) and anticipated (Figure 2) fiscal policy, technology, monetary policy, and labor preference shocks.[5] To unify the effect on output of each shock into a positive, the figures show

[4] In Galí et al. (2007), ϕ_g and ϕ_b were set at 0.13 and 0.33, respectively.

[5] Because each parameter is randomly drawn from a uniform distribution, the calculated IRFs show an unrealistic path on rare occasions depending on the combination of parameter values. Hence, we trim the lower and upper 5th percentiles of the samples to eliminate such outliers.

that fiscal policy and technology shocks are positive shocks on government spending and TFP, whereas that monetary policy and labor preference shocks are negative shocks on the interest rate and labor preference. In the benchmark calibration, the foresight period p is assumed to be two, and the news announced in the first period is realized in the third period. In this exercise, the number of the random draw is set at $10,000$.

[Figure 1 about here.]

[Figure 2 about here.]

The first column in Figure 1 depicts the responses of the variables to unanticipated fiscal policy shock. The theoretical model predicts that an unanticipated increase in government spending raises excess stock returns, output, and inflation but lowers investment without depending on parameter values. We cannot theoretically determine whether government spending shock increases consumption. This is because the range of parameters in which the behavior of non-Ricardians who increase consumption in response to government spending shock dominates that of Ricardians who decrease consumption because of a negative wealth effect. Accordingly, we assign a positive sign to excess stock returns, output, and inflation and government spending and a negative sign to investment to characterize unanticipated fiscal policy shock. Compared with the IRFs shown in the remaining columns of Figure 1, we confirm that the sign restrictions imposed on inflation and investment distinguish fiscal policy shock. Specifically, the positive sign for inflation separates fiscal policy shock from supply shocks, such as technology and labor preference shocks, because supply shocks decrease inflation. Moreover, monetary policy shock stimulates investment and, therefore, the negative response of investment can discriminate between fiscal policy and monetary policy.

The first column in Figure 2 shows the responses of variables to anticipated fiscal policy shock. First, we confirm that the theoretical model succeeds in replicating a contemporaneous positive response of excess stock returns to fiscal news shock, as discussed in Section 1.[6] The stock price of the public goods sector reflects the discounted sum of profit flows in the public goods sector as written in (34) and increases when agents receive news of a future increase in government spending even if the news remains unrealized. In contrast to excess stock returns, only when the news is realized, output and inflation show a definite positive sign. On the other hand, investment responds negatively to the news and continues to indicate a negative response when the news is realized. Similar to unanticipated fiscal policy shock, these theoretical predictions distinguish anticipated fiscal policy shock from other shocks sufficiently. The positive response of inflation in the third period cannot be observed in the responses to technology and labor preference shocks, and anticipated fiscal policy shock is the only shock with declining investment during the first three periods.

Based on the theoretical predictions, we set the sign restrictions imposed on the VAR model as summarized in Table 2. As discussed above, unanticipated fiscal policy shock is simply assumed to be a shock that increases government spending, excess stock returns, output, and inflation but decreases investment. To sample the valid draws efficiently, the restrictions assigned to the variables except for government spending are imposed only at the impact period while the restrictions for government spending are set in the first three periods. In return, the restrictions characterizing anticipated fiscal policy shock are more complex than the restrictions characterizing unanticipated fiscal policy shock. According to the theoretical model and the discussion in Section 1, we first assume that anticipated fiscal policy shock raises excess stock returns contemporaneously. In contrast, we assume that government spending does not change for the two periods after the news is announced and, thereafter, government spending increases from the third to the fifth periods. Here, we apply strict zero restriction on the response of

[6] Barsky and Sims (2011) criticize the method using stock price to identify the (technology) news shock such as the method of Beaudry and Portier (2006), because the behavior of firm value derived from the theoretical model is not aligned with the dynamics of stock price obtained in the empirical model. Here, the value of firm in Barsky and Sims (2011) corresponds to capital stock in a simple real business cycle model. Because the model developed in this study is more complex than that of Barsky and Sims (2011), we overcome this criticism and replicate a positive response of excess stock returns to fiscal news shock.

government spending during the first two periods following the method of Mountford and Uhlig (2009). Moreover, the responses of output and inflation are assumed to be positive in the third period when the news is just realized. Finally, a negative sign restriction is associated with investment during the first three periods to be consistent with the theoretical prediction.

Although the restrictions mentioned sufficiently identify both types of fiscal policy shock, we impose an additional restriction on government spending to assure its exogeneity in the spirit of Blanchard and Perotti (2002). Therefore, government spending is assumed to be affected only by unanticipated fiscal policy shock at the impact period. Because our VAR model contains six endogenous variables, in principle, four types of structural shocks exist in addition to both fiscal policy shocks. The exogeneity condition for government spending is imposed on the structural shocks that are not characterized by sign restrictions. That is, we assume that unspecified structural shocks have no contemporaneous effect on government spending. This assumption is widely employed in most previous studies (e.g., Blanchard and Perotti, 2002; Galí et al., 2007). The restriction for exogeneity is imposed on the contemporaneous matrix and, in practice, is introduced to the empirical model in the same manner as zero restriction for anticipated fiscal policy shock. The implementation of identifying structural shocks is explained in detail in Section 3.2.

[Table 2 about here.]

3. Estimation methodology

3.1. Sign-restricted VAR model

The reduced-form VAR model employed in this study is given by

$$Y_t = c(t) + \sum_{s=1}^{k} B_s Y_{t-s} + u_t, u_t \sim N(0, \Sigma), \tag{35}$$

where Y_t is the vector of endogenous variables that includes (in this order) government spending, excess stock returns of the construction industry, GDP, inflation for consumer price index (CPI), private consumption, and non-residential investment; $c(t)$ includes all the deterministic components of data; B_s's are coefficient matrices with lag length k, and u_t is a vector of the reduced-form residuals with the variance-covariance matrix, Σ. We define the vector of structural shocks, which is mutually independent and normalized to be of variance 1 as ε_t, and assume that the reduced-form residuals are expressed by a linear combination of structural shocks as follows:

$$u_t = A\varepsilon_t, \varepsilon_t \sim N(0, I). \tag{36}$$

This study identifies the structural shocks based on the sign restriction method presented by Mountford and Uhlig (2009). Here, the identification in the VAR literature indicates how to determine the structure of the matrix A.

The process of identification with sign restriction comprises two stages. In the first stage, we draw the random samples of the VAR coefficients $B = [B_1, \cdots, B_k]$ and the variance matrix Σ from their posterior distributions. Using the non-informative normal-Wishart family as the priors, the posterior distributions of $vec(B)$ and Σ^{-1} become $N(vec(\hat{B}), \hat{\Sigma} \otimes (X'X)^{-1})$ and $W(\hat{\Sigma}^{-1}/T, T)$, where $\hat{B}$ and $\hat{\Sigma}$ are OLS estimators, X is the matrix of the explanatory variables, and T is the sample size. For each draw of B and Σ, we perform a random sampling of matrix A as second-stage randomizations. In this stage, the random sampling of A is implemented as follows. Given the realization of Σ in each draw, we calculate a lower triangular matrix A_0 obtained from the Cholesky decomposition of Σ and randomly generate the orthogonal matrix Q such that $QQ' = I$. Combining A_0 and Q, matrix A can be constructed as

$$u_t = A_0\tilde{\varepsilon}_t = A_0QQ'\tilde{\varepsilon}_t = A\varepsilon_t, \tag{37}$$

where $\tilde{\varepsilon}_t$ is a vector of structural shocks in term of the recursive approach derived from Cholesky decomposition, and thereby

$$\varepsilon_t = Q'\tilde{\varepsilon}_t, \qquad A = A_0 Q. \tag{38}$$

Then,

$$E\left[A\varepsilon_t\varepsilon_t' A'\right] = E\left[A_0 Q Q' \tilde{\varepsilon}_t \tilde{\varepsilon}_t' Q Q' A_0'\right] = A_0 A_0' = \Sigma, \tag{39}$$

so that matrix A is constructed to maintain the variance-covariance structure Σ. The procedure for generating matrix Q is explained in detail in Section 3.2.

Based on the random samples of (B, Σ, A), we calculate the IRFs. If the calculated IRFs satisfy the sign restrictions in Table 2, they are preserved as a valid draw; otherwise, they are discarded. A set of valid draws that are compatible with the sign restrictions describes the range of IRFs and is used for further analysis such as FEVD and HD. In this study, we perform a random sampling of matrix A 100 times for each draw of (B, Σ) and repeat this process until we have $3,000$ valid IRFs as our final samples.

3.2. Identification

The candidates of contemporaneous matrix A are produced by the method of Mountford and Uhlig (2009), in which each column of Q matrix is respectively generated to calculate the each column of the A matrix.[7] Let us denote the i-th column of Q as q_i, and the i-th column of A, denoted as a_i, can be computed by

$$a_i = A_0 q_i, \tag{40}$$

[7] We identify the structural shocks via a combination of sign restrictions and zero restriction, as in Baumeister and Benati (2013). However, zero restriction adopted in this study differs from a *single* zero restriction in Baumeister and Benati (2013) to represent anticipated fiscal policy shock and to ensure an exogeneity of government spending. Therefore, the method of Mountford and Uhlig (2009) is employed in this study.

where a_i is called the impulse response vector and indicates the contemporaneous response of the variables to the i-th structural shock. Note that each q vector is generated subject to the orthonormality condition (i.e., $QQ' = I$) and zero restrictions imposed on the response of government spending to some structural shocks. For the six-variable VAR model in this study, given the random draw of (B, Σ) in the first stage, we specify six kinds of different q vectors that construct the impulse response vectors corresponding to two types of fiscal policy shocks and four types of non-specified structural shocks.

Among the structural shocks, we first calculate the impulse response vectors a_1 associated with anticipated fiscal policy shock by using q_1, where q_1 satisfies $q_1' q_1 = 1$ and the zero restriction on government spending for the first two periods.[8] Following Mountford and Uhlig (2009), the zero restrictions imposed on q_1 can be written as

$$0 = R_1 q_1, \tag{41}$$

where R_1 is a 2×6 matrix, denoted as

$$R_1 = \begin{bmatrix} r_1^g(1) & \cdots & r_6^g(1) \\ r_1^g(2) & \cdots & r_6^g(2) \end{bmatrix}. \tag{42}$$

Here, $r_i^g(l)$ is the response of government spending (g) to the i-th column of A_0 at horizon l. Computationally, such a q vector is identified by using the fsolve function in MATLAB. Because the initial value for solving the function is randomly generated from the uniform distribution $U(-0.5, 0.5)$, a different value for q is drawn for each randomization.

Subsequently, the impulse response vectors for non-specified shocks $a_n, n = 2, \cdots, 5$ are calculated using $q_n, n = 2, \cdots, 5$, in order. As discussed in Section 2.10, the structural shocks

[8] To confirm the robustness, we also estimate the case in which the foresight period is set to be three and four. The key findings (e.g., anticipated fiscal policy shock exerts positive effects on the dynamics of consumption) are unchanged even if the foresight period is altered. However, the acceptance rate, which denotes the ratio of valid draws to all draws, is the highest in the case of foresight period being two. Hence we show the result from two periods ahead foresight as a benchmark.

are assumed to have no contemporaneous impact on government spending and, thus, the zero restrictions are assigned to q_n as follows:

$$0 = R_2 q_n, \tag{43}$$

where R_2 is a 1×6 vector and coincides with the first row of R_1. Moreover, to ensure orthonormality, each q_n is respectively subject to the constraints given as

$$q_2' \times [q_1, q_2] = [0, 1], \tag{44}$$

$$q_3' \times [q_1, q_2, q_3] = [0, 0, 1], \tag{45}$$

$$q_4' \times [q_1, q_2, q_3, q_4] = [0, 0, 0, 1], \tag{46}$$

$$q_5' \times [q_1, q_2, q_3, q_4, q_5] = [0, 0, 0, 0, 1]. \tag{47}$$

Finally, the impulse response vector to unanticipated fiscal policy shock a_6 is derived using q_6, which simply satisfies the orthonormality conditions, that is, $q_6' \times [q_1, q_2, q_3, q_4, q_5, q_6] = [0, 0, 0, 0, 0, 1]$. Locating each of the impulse response vectors in the column element, we obtain the candidate of the contemporaneous matrix A. As stated in Mountford and Uhlig (2009), this matrix A computes the structural shock that is mutually orthogonal. After constructing matrix A, we calculate the IRFs to both fiscal policy shocks and check whether the IRFs satisfy the sign restrictions.

3.3. Data and specification

We employ the quarterly data of government spending, excess stock returns, GDP, inflation of consumer price index (CPI), private consumption, and non-residential investment for the period 1980Q1 to 2015Q2. Government spending is defined as the sum of government consumption and public investment. The real seasonally adjusted series of government spending, GDP, consumption, and investment are downloaded from the System of National Accounts (SNA) and converted into per capita and their logarithms are taken. With respect to inflation, first, the monthly series of a non-seasonally adjusted CPI (all items, less fresh food) is obtained from the CPI (Ministry of Internal Affairs and Communications). Second, we subtract 1.4% in 1989, 1.5% in 1997, and 2% in 2014 from the year-on-year inflation rate to eliminate the effects of an increase in consumption tax. Third, we recalculate the level series and perform seasonal adjustment using X-12 ARIMA. Finally, the quarterly series is constructed by taking the average of three months and we compute the log-differentials to obtain the inflation rate. The data on excess stock returns are calculated as follows. The closing prices of the monthly data in both the construction industry and the whole market are obtained from the Nikkei NEEDS Financial QUEST database. Then, we calculate the series of stock returns as the growth rate of stock prices and translate the monthly series to the quarterly series. Thereafter, following Fisher and Peters (2010), the series of excess stock returns is calculated by subtracting the returns of the whole market from the construction industry returns. In the estimation, we use the accumulated excess stock returns as in Fisher and Peters (2010). Figure 3 shows the plotted data used in this study.

The estimated system is a six-variable VAR model that contains linear and quadratic time trends and a constant term. To detrend the data series so that it is consistent with the DSGE model, we incorporate the time trends in the estimated system. In the spirit of Sims et al. (1990), taking the differences of time series may result in the loss of important information, and therefore, the estimation is conducted in level except for inflation. Additionally, the number of lag lengths is set to three based on the Akaike information criterion.

[Figure 3 about here.]

4. Empirical results

4.1. Estimated structural shocks

Figure 4 shows a plot of the estimated series of anticipated fiscal policy shock; the solid line and shaded areas denote the median and 68% bands, respectively. Compared with Fukuda and Yamada (2011), who report the announcement dates of fiscal stimulus packages between 1992 and 2010, we confirm that our identification method correctly captures the news shock with respect to fiscal policy.

For the estimated series of anticipated fiscal policy shock, twenty points of significant positive shocks exist between the years 1992 and 2010. Among them, eight shocks (i.e., 1992Q1, 1993Q3, 1994Q1, 1998Q4, 2008Q3, 2009Q2, 2010Q3, and 2010Q4) are exactly consistent with the date reported in Fukuda and Yamada (2011), and three shocks (i.e., 1995Q1, 2001Q1, and 2002Q3) are observed in one period ahead of the announcement dates. Hence, for the latter three shocks, there is a possibility that people foresaw the implementation of fiscal policy prior to the day that the outline of the fiscal package was published in the newspaper. Considering this possibility, we consider that the latter three shocks mostly capture the news shocks concerning fiscal policy.

Beyond the period explored in Fukuda and Yamada (2011), we confirm that our result captures several fiscal events.[9] After 2011Q1, significant positive shocks are observed in 2011Q3, 2012Q1, 2012Q4, and 2013Q3. The positive shocks for 2011Q3 and 2012Q1 correspond with the announcement dates of the reconstruction budget for the Great East Japan Earthquake, whereas 2012Q4 and 2013Q3 respectively correspond to the date of the inauguration of the Abe administration and the date of the announcement of the hosting of the Tokyo Olympic Games. Therefore, we conclude that our identification method adequately captures anticipated fiscal policy shocks.

[Figure 4 about here.]

[9] Shioji and Morita (2015) extend the announced dates of fiscal stimulus packages until the end of 2013.

4.2. Impulse response functions

Figures 5 and 6 display the IRFs for unanticipated and anticipated fiscal policy shocks. The solid blue lines and shaded area indicate the median of the sampled IRFs and 68% bands, respectively. We plot the IRFs that are the closest (in terms of minimizing the sum of the squares of the differences) to the median responses among those obtained in each Q matrix randomization, shown by the red dotted line, to overcome the problem noted by Fry and Pagan (2011) and Inoue and Kilian (2013). As noted by the studies, the median responses in the sign-restricted VAR model summarize the information from a different structural model because each IRF is computed based on a different Q matrix. The response that fully corresponds to the median might not exist in the set of admissible structural models, and thus the inference using the median response might fail to provide correct results. However, in our case, this problem is deemed to be less serious because the median responses and the closest responses share similar dynamics.

First, we examine the responses to unanticipated fiscal policy shock shown in Figure 5. Following the sign restrictions, the expansionary government spending shock shows positive effects on excess stock returns, GDP, and inflation at the impact period. However, there is no persistence in the responses. On the other hand, investment is significantly crowded out by an increase in government spending beyond the impact period as predicted by the theory. Therefore, we consider that this reduction in investment causes the significant negative response of GDP after the third period. Consumption rises temporarily in response to unanticipated fiscal policy shock. Because our theoretical model fails to find the common feature for the response of consumption to unanticipated fiscal policy shock, the sign restriction is not imposed and the positive response of consumption is fully derived from the data. This result is consistent with the findings presented in the preceding literature in Japan and the US and supports the theoretical model of Galí et al. (2007) that replicates the positive response of consumption to fiscal policy shock by incorporating the ROT households into the NK model.

Next, we focus on the IRFs for anticipated fiscal policy shock shown in Figure 6. Unlike the case of unanticipated fiscal policy shock, the top-left chart shows that the response of government spending remains at zero during the first two periods and gradually increases after the third period. We confirm that the excess stock returns, inflation, and investment follow the sign restrictions. Additionally, the excess stock returns and investment show significant responses beyond the period of imposed sign restrictions. However, the investment decline in response to anticipated fiscal policy shock is less than the decline in response to the unanticipated fiscal policy shock. Most importantly, the results reveal that GDP and consumption rise immediately in response to good news concerning a future fiscal policy and remain significantly positive. The positive response of consumption is also reported in Fisher and Peters (2010) but is inconsistent with the result presented in Ramey (2011). Moreover, compared with unanticipated fiscal policy shock, the persistence of the response in GDP and consumption is considerably high. This result can be interpreted as the spillover effects of an increase in government spending functions because firms can adjust their employment sufficiently before government spending actually increases. The result reveals that anticipated fiscal policy shock plays a significant role in the dynamics of the Japanese economy, particularly with respect to GDP and consumption, compared with unanticipated fiscal policy shock. Therefore, we conclude that our new method, which identifies fiscal news shock in Japan, reveals the true effects of fiscal policy shock in Japan.

[Figure 5 about here.]

[Figure 6 about here.]

4.3. Forecast error variance decomposition

Tables 3 and 4 summarize the results of FEVD. The estimated time horizon is set as 10 quarters, as in the earlier IRF analysis. These tables show the relative importance of each shock in terms of the variations in each variable. To overcome the problem noted by Fry and Pagan (2011) and Inoue and Kilian (2013), we perform the FEVD based on every sampled IRF and take their medians. We present the median results computed using every valid IRF, not the results that are computed based on the medians of the sampled IRFs.

The principal finding from this exercise is that anticipated fiscal policy shock explains approximately 15% to 25% of the forecast error variances in consumption. The importance of anticipated shock in the variation of consumption is confirmed by comparing the result with the unanticipated result. As with consumption, the variation of GDP is also explained by anticipated shock rather than unanticipated shock. Anticipated fiscal policy shock explains over 10% of the variation in GDP at the impact period. On the other hand, investment is affected by unanticipated fiscal policy shock, which is predicted in the results of the IRFs where investment is crowded out by unanticipated shock. We find that both fiscal policy shocks have minimal effects on inflation.

With respect to government spending, while most variations are explained by unanticipated fiscal policy shock, the ratio explained by anticipated shock gradually increases after the news shock has been realized. Finally, approximately 20% of the variations in excess stock returns is explained by anticipated fiscal policy shock. Therefore, not all of the variation in excess stock returns are caused by the fiscal news shock. The effect of anticipated fiscal policy shock might be overestimated if we simply regard the innovation in excess stock return as anticipated fiscal policy shock, as in Fisher and Peters (2010). Therefore, this result justifies our identification method, which combines sign restrictions with the ideas presented in Fisher and Peters (2010).

[Table 3 about here.]

[Table 4 about here.]

4.4. Historical decomposition

Finally, we conduct the HD to evaluate the quantitative effects of Abenomics, particularly with anticipated fiscal policy shock. Figure 7 shows the results of HD conditioning on deterministic components and the data before 2012Q2, which is the date just before Prime Minister

Shinzo Abe won the Liberal Democratic Party presidential election. Similar to the FEVD, the results represent the median values across the decompositions using every valid draw. In the figure, the blue and red bars indicate the contribution of unanticipated and anticipated fiscal policy shocks, while the solid lines denote the total variation of forecast error calculated on the basis of all identified structural shocks. The Appendix explains the implementation of the HD in detail.

We first observe the positive contributions of anticipated fiscal policy shock to excess stock returns during the period from 2012Q3 to 2014Q3. The contribution persistently increases until just before the consumption tax rises to 8% in 2014Q2. The result implies that positive innovations categorized as anticipated fiscal policy occurred continuously in this period. Moreover, government spending is affected positively by anticipated fiscal policy shock after 2013Q1 while unanticipated fiscal policy shock negatively contributes to government spending. This implies that our model captures an increase in government spending from Abenomics as anticipated shock.

For other endogenous variables, our results reveal the following. First, a series of positive anticipated fiscal policy shocks positively contributes to the dynamics of consumption. In return, investment shows negative effects of influence from anticipated fiscal policy shock until 2014Q1. Consequently, the positive effects on consumption dominate the negative effects on investment. However, GDP is affected by positive contributions from anticipated fiscal policy shock, although the effects on GDP are more gradual than the effects on consumption. With respect to inflation, both fiscal policy shocks minimally explain the dynamics, which is expected from the results of the IRFs and FEVD.

[Figure 7 about here.]

5. Conclusion

This study analyzes the effects of fiscal policy shock in Japan and particularly sheds light on the effects of anticipated fiscal policy shocks. We identify anticipated increases in government spending using excess stock returns in the construction industry and employing robust sign restrictions based on a variant of the NK model presented in Galí et al. (2007).

The main results are as follows. First, the identification method presented in this study captures anticipated fiscal policy shock because the estimated series of this shock corresponds to the announcement date of fiscal packages. Second, we discover that consumption and GDP persistently respond positively to this shock. This finding is evidence that people react to fiscal news shocks immediately and emphasizes the importance of considering fiscal foresight when evaluating the effects of fiscal policy. Third, the results of FEVD show the importance of anticipated fiscal policy shock in the movement of consumption. The result that not all variation in excess stock returns is explained by anticipated fiscal policy shock justifies our hybrid method that incorporates the ideas of Fisher and Peters (2010) into a sign-restricted VAR model. Finally, the results of the HD featuring the period referred to as Abenomics reveal that a positive anticipated fiscal policy shock occurred during the period between 2012Q3 to 2014Q1 and immediately contributed to the dynamics of consumption and GDP.

To conclude, the novel finding in this study is that anticipated fiscal policy shock has expansionary effects on consumption. Consequently, previous works ignoring fiscal foresight underestimated the effects of fiscal policy in Japan. Therefore, future evaluations of macroeconomic policy should consider fiscal foresight to evaluate the true effects of economic policies.

Appendix A. How to implement historical decomposition

Conditional on the data before the period $t-1$ and omitting the deterministic terms for simplicity, the VAR model with lag length k can be rewritten as the following VMA representation:

$$Y_{t+p} = \sum_{j=1}^{k} \Phi_j Y_{t-j} + \sum_{i=0}^{p} \Psi_i \varepsilon_{t+i}, \tag{A.1}$$

where Φ_j are calculated as a mixture of VAR coefficients B_i in (35), and the (m,n) element of Ψ_i represents the IRF of the m-th variable to the n-th innovation at horizon i. Given the data before period $t-1$ and the VAR coefficients, the p-period ahead forecast error, denoted by $e_{t+p|t-1}$, can be given as

$$e_{t+p|t-1} = Y_{t+p} - \sum_{j=1}^{k} \Phi_j Y_{t-j} = \sum_{i=0}^{p} \Psi_i \varepsilon_{t+i}. \tag{A.2}$$

Because we have already calculated the IRFs and obtained a series of structural shocks, the forecast errors can be simply computed using (A.2).

In this study, the period $t-1$ is set as 2012Q2. First, the total variations of forecast error depicted by the solid lines in Figure 7 are derived using all types of estimated structural shocks. Thereafter, to highlight the contributions of both types of fiscal policy shocks among all variations, we calculate the forecast errors again based on the vector of ε_{t+i} in which the structural shocks except for each fiscal policy shock is set at zero. The constructed estimated series are shown by the blue and red bars in Figure 7.

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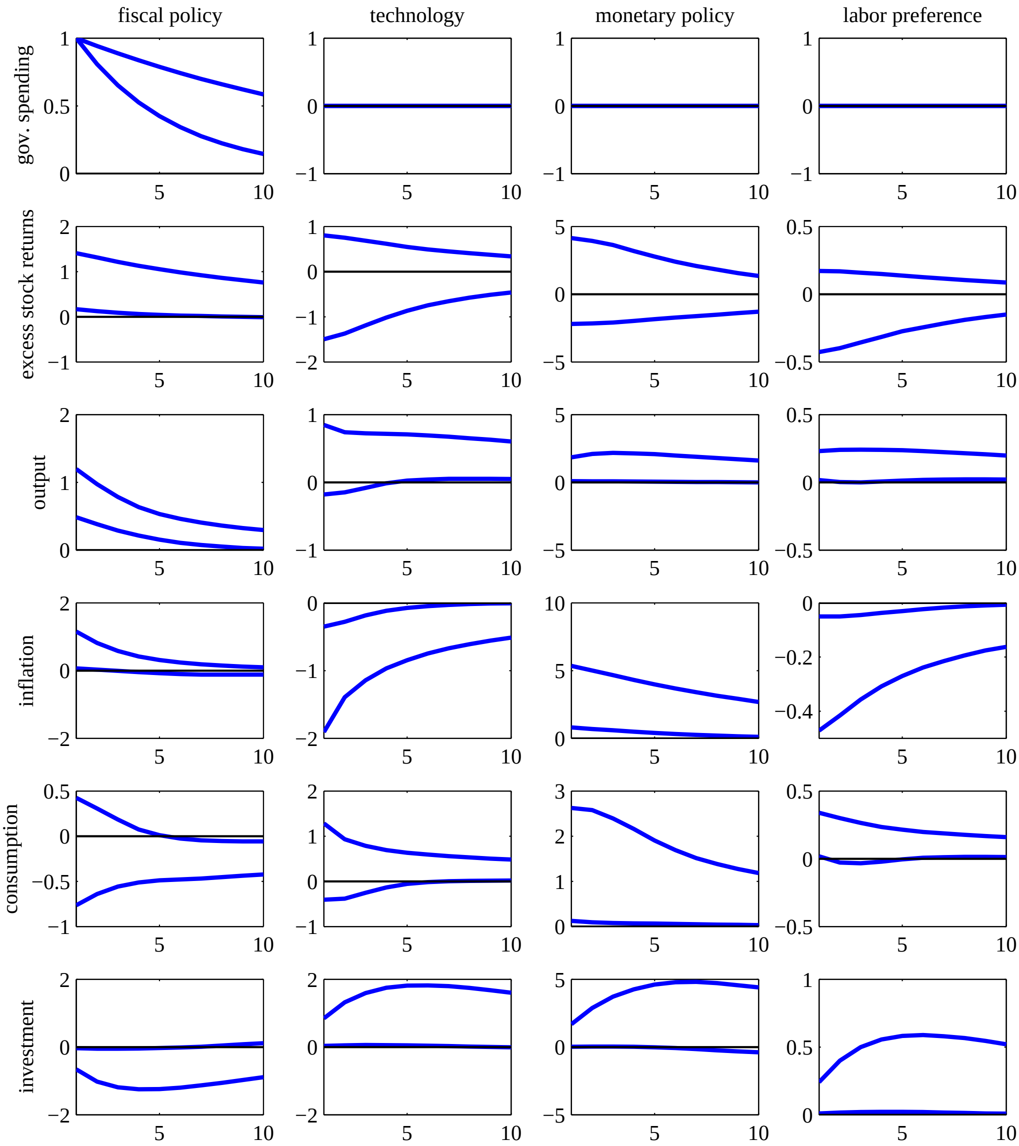

Figure 1: The 90% bands for the theoretical responses to unanticipated fiscal policy, technology, monetary policy, and labor preference shocks

Note: Each row and column correspond to each variable and shock, respectively. Variables are placed in order of government spending, excess stock returns, output, inflation for private sector goods, consumption, and investment from the top, and the shocks are placed in order of fiscal policy, technology, monetary policy, and labor preference shocks from the left.

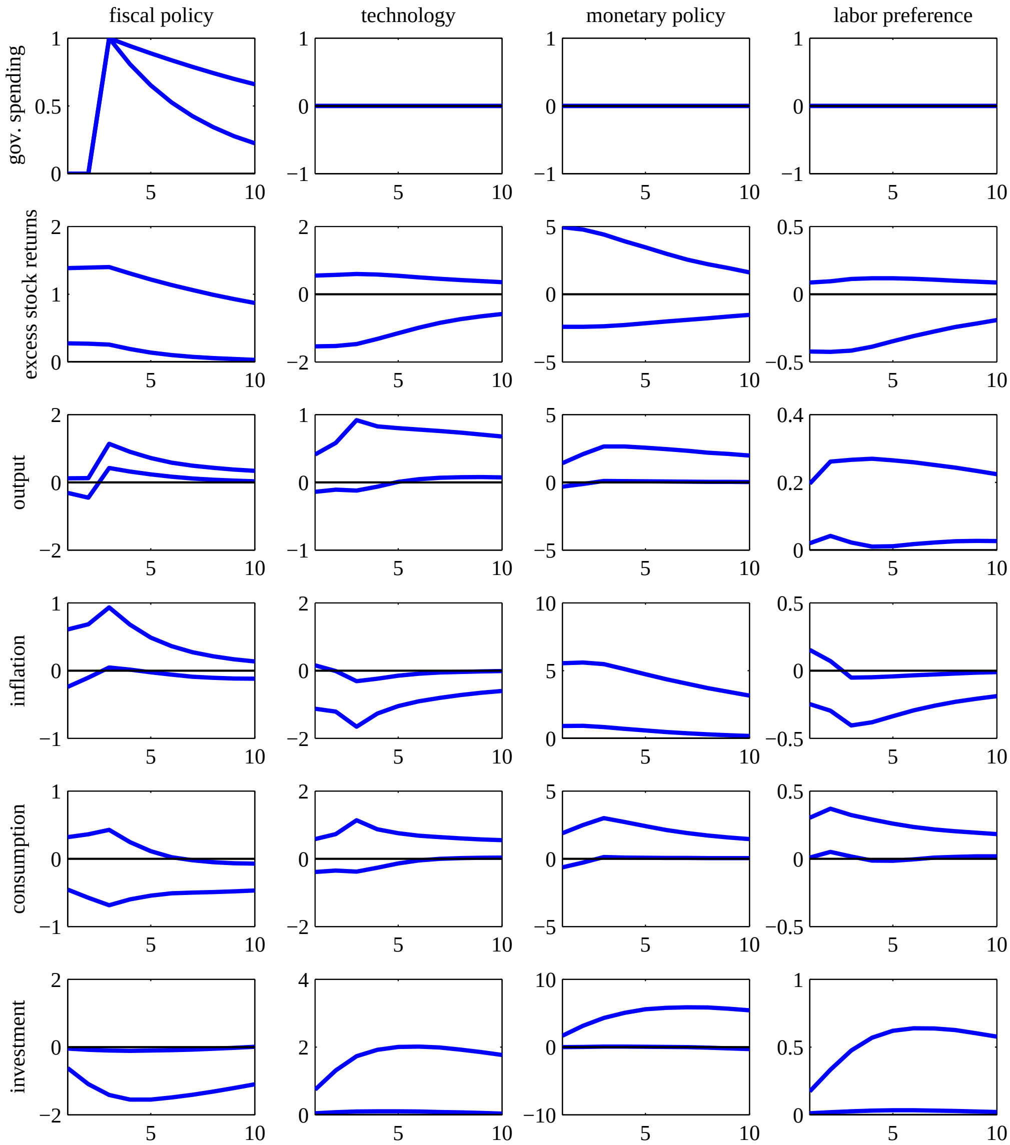

Figure 2: The 90% bands for the theoretical responses to anticipated fiscal policy, technology, monetary policy, and labor preference shocks

Note: Each row and column correspond to each variable and shock, respectively. Variables are placed in order of government spending, excess stock returns, output, inflation for private sector goods, consumption, and investment from the top, and the shocks are placed in order of fiscal policy, technology, monetary policy, and labor preference shocks from the left.

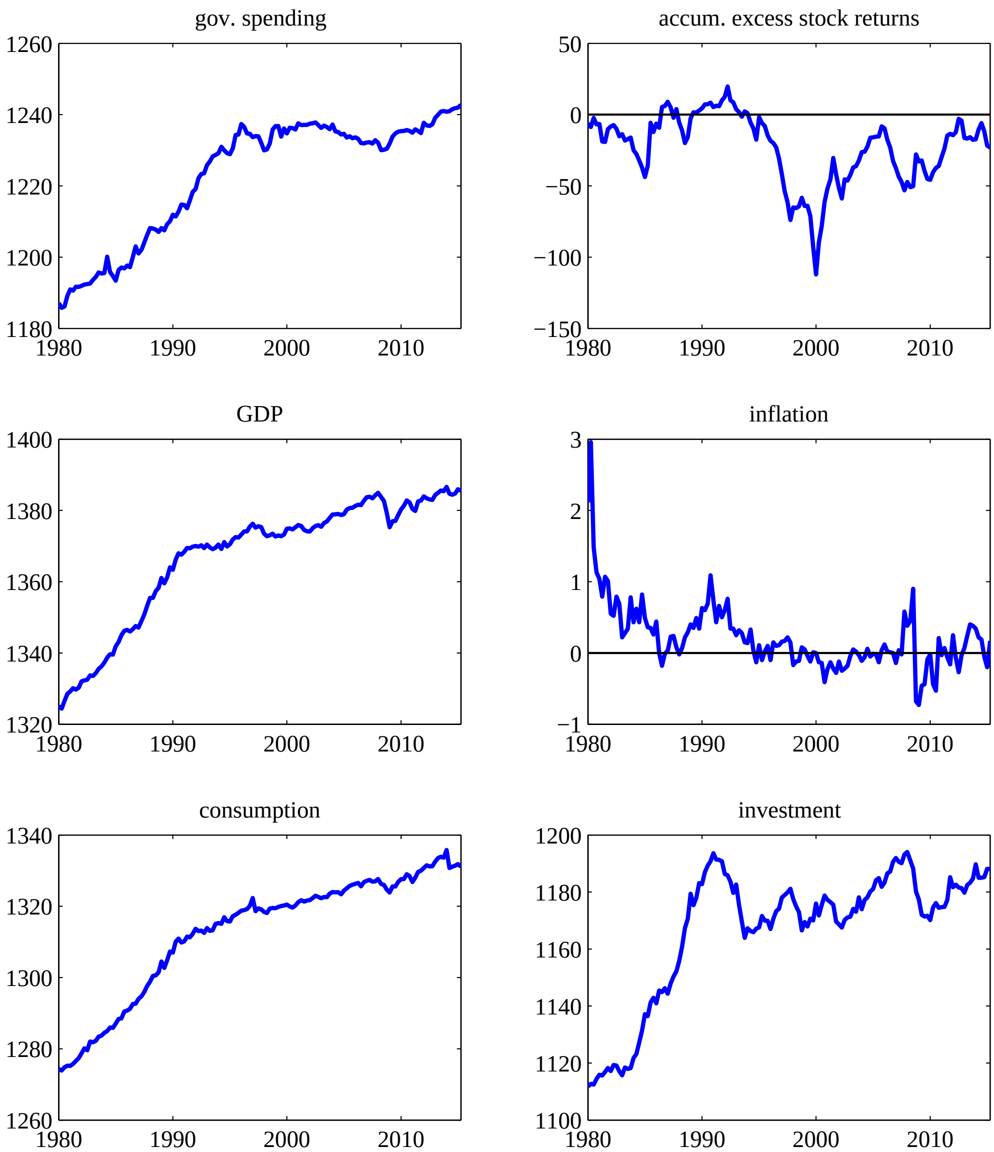

Figure 3: The data used in the VAR model

Note: Except for accumulated excess stock returns and inflation, the series are taken to their logarithmic values. To interpret the results in percentages, the series are multiplied by 100.

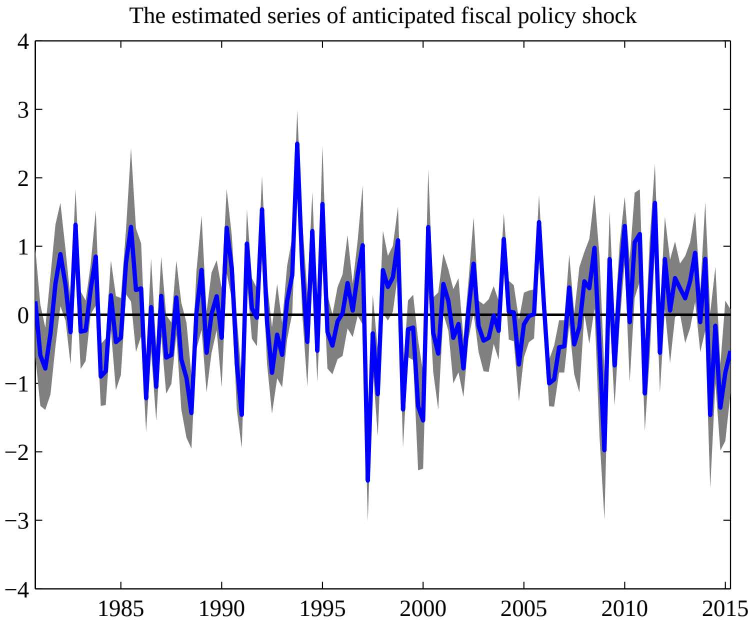

Figure 4: The series of anticipated fiscal policy shock

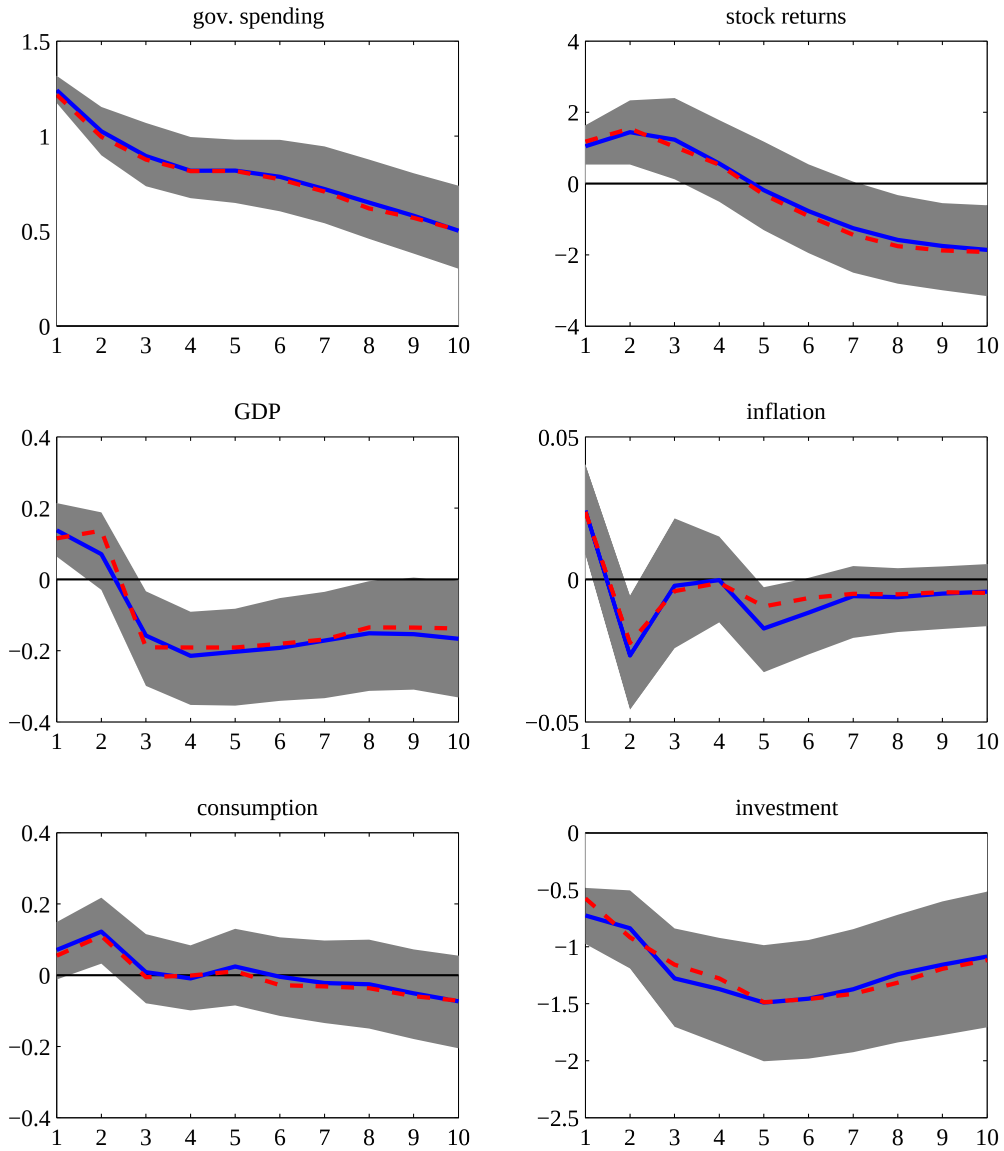

Figure 5: Responses of the variables to unanticipated fiscal policy shock

Note: This figure shows the estimated IRFs to unanticipated fiscal policy shock. The solid lines and shaded area indicate the median of sampled IRFs and the 68% band, respectively. The dotted lines indicate the IRFs that are the closest to the median responses among those obtained in each admissible randomization.

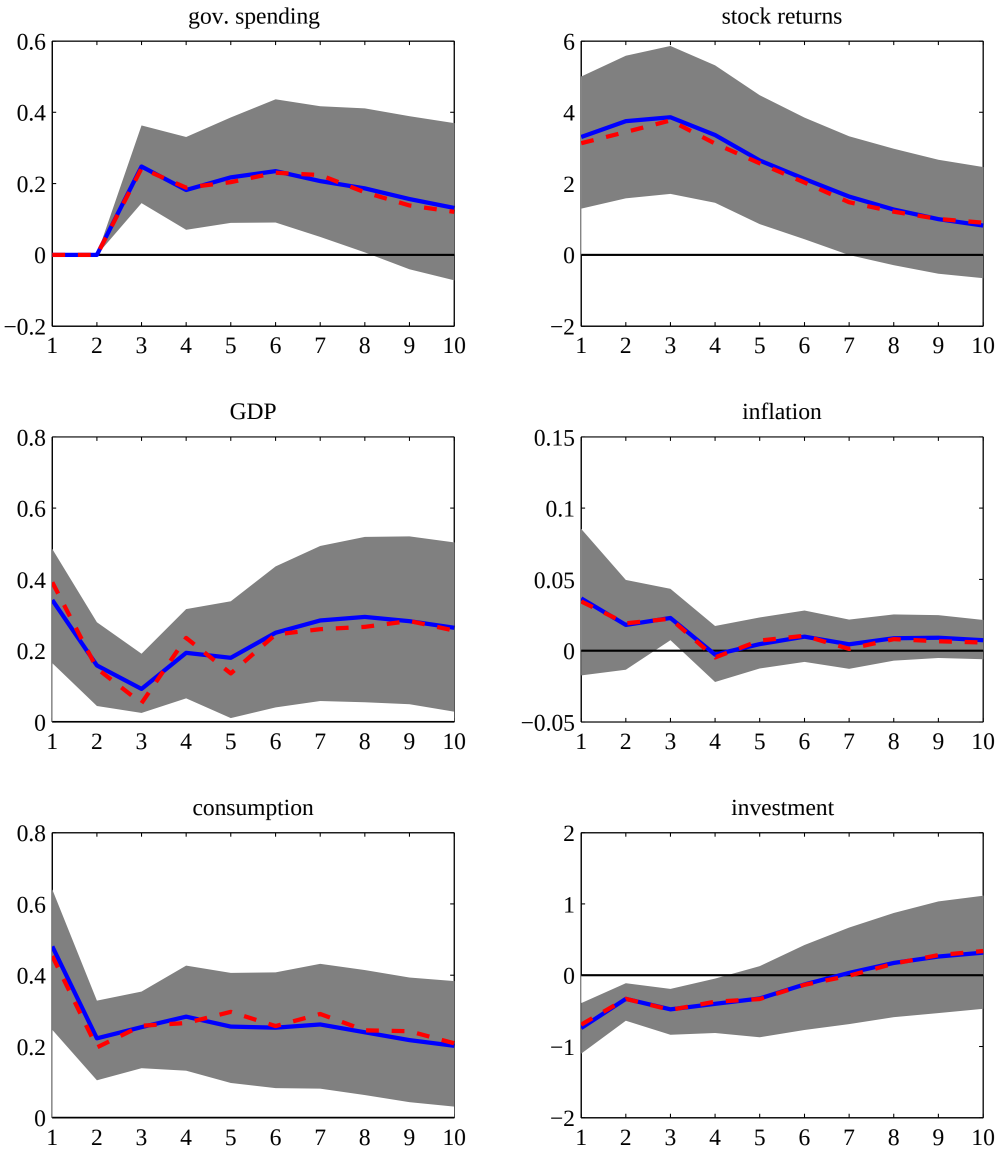

Figure 6: Responses of the variables to anticipated fiscal policy shock

Note: This figure shows the estimated IRFs to anticipated fiscal policy shock. The solid lines and shaded area indicate the median of sampled IRFs and the 68% band, respectively. The dotted lines indicate the IRFs that are the closest to the median responses among those obtained in each admissible randomization.

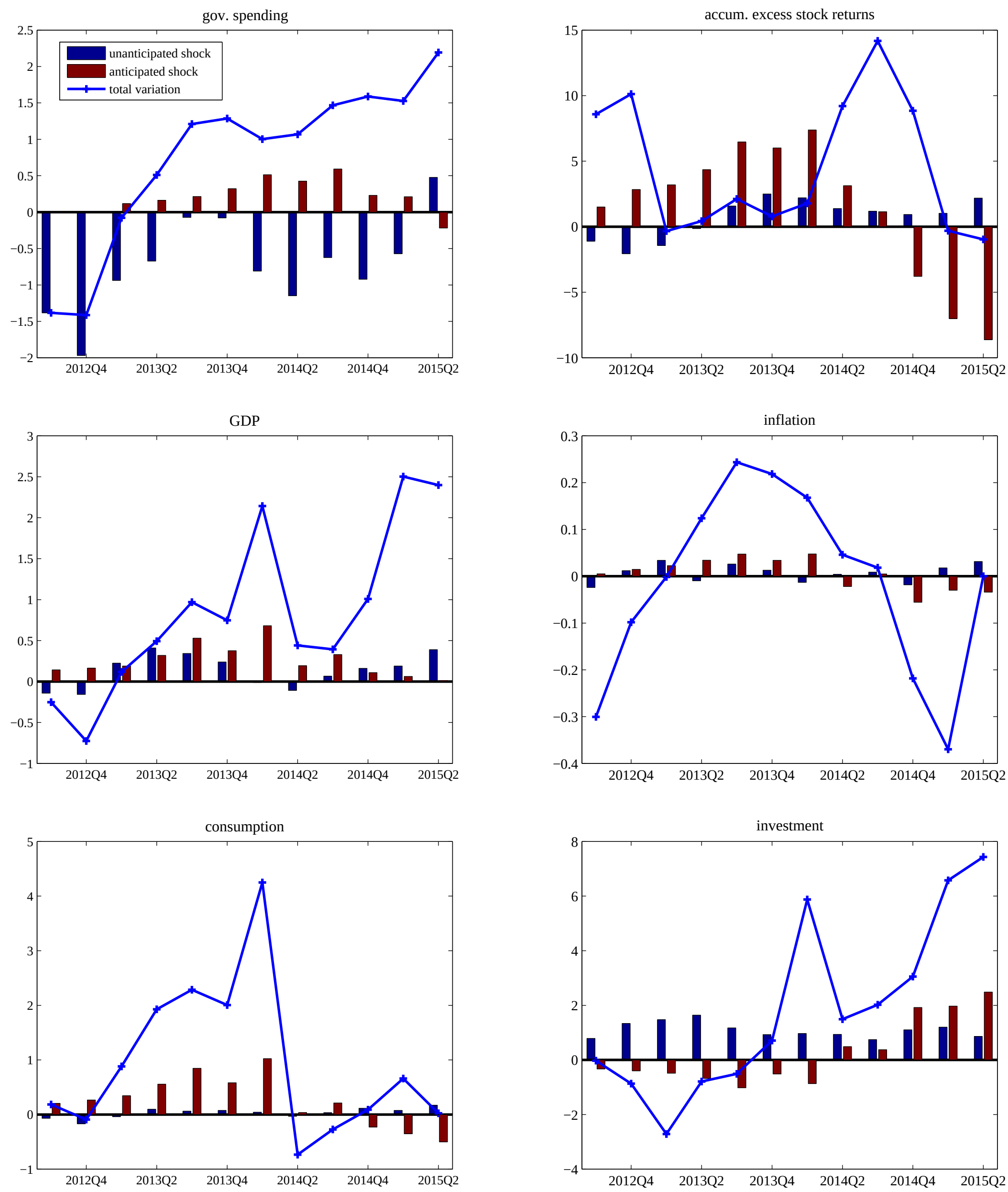

Figure 7: Historical decomposition conditioning on the data before 2012Q2

Note: This figure shows the results of historical decomposition conditioning on the data before 2012Q2. The solid lines indicate the total variation of each variable described by all shocks while the blue and red bars present the contribution of unanticipated and anticipated fiscal policy shocks to each variable, respectively.

Table 1: Calibration parameters

Parameter	Value	Description
β	0.99	Subjective discount factor
δ	0.025	Depreciation rate
α	0.3	Share of capital
γ	$[1, 2]$	Risk aversion
λ	$[0.5, 2]$	Inverse of labor supply elasticity
α_g	$[0, 0.2]$	Productivity of public capital
κ	$[0, 0.3]$	Investment adjustment cost
μ	$[0.1, 0.5]$	Share of non-Ricardian households
ε_p	$[6, 11]$	Elasticity of substitution in production
ε_w	$[6, 11]$	Elasticity of substitution in labor
ρ_c	$[0.2, 0.9]$	Calvo parameters on price of private sector goods
ρ_g	$[0.2, 0.8]$	Calvo parameters on price of public sector goods
ρ_w	$[0.2, 0.9]$	Calvo parameters on wages
ϕ_g	$[-0.25, 0.25]$	Elasticity of tax to government spending
ϕ_b	$[0, 0.5]$	Elasticity of tax to bond
ϕ_y	$[0.125, 0.175]$	Elasticity of tax to output
ψ_π	$[1.01, 1.5]$	Monetary policy response of inflation
ψ_y	$[0, 0.2]$	Monetary policy response of output
ρ_h	$[0.8, 0.95]$	Persistence of exogenous shocks

Note: The ranges of parameter value are set up according to the previous studies.

Table 2: Sign restrictions for fiscal policy shocks

	gov. spending	stock returns	output	inflation	investment
unanticipated	> 0 for 1-3Q	> 0 for 1Q	> 0 for 1Q	> 0 for 1Q	< 0 for 1Q
anticipated	$= 0$ for 1-2Q > 0 for 3-5Q	> 0 for 1Q	> 0 for 3Q	> 0 for 3Q	< 0 for 1-3Q

Note: Sign restrictions denoted in this table are based on the theoretical IRFs shown in Figures 1 and 2. A positive sign for inflation distinguishes fiscal policy shock from supply shocks such as technology and labor preference shocks, while a negative sign for investment discriminates between fiscal policy and monetary policy shocks.

Table 3: Forecast error variance decomposition: Unanticipated fiscal policy shock

	gov. spending	stock returns	GDP	inflation	consumption	investment
1	100.0	1.9	2.0	1.3	0.6	6.3
2	92.4	2.5	1.7	3.0	2.1	7.4
3	83.2	2.5	3.1	3.1	2.2	9.8
4	77.2	2.3	3.8	3.2	2.0	11.4
5	72.3	2.3	4.2	3.8	1.9	13.1
6	68.3	2.8	4.4	4.0	1.9	14.1
7	65.5	3.4	4.5	4.0	1.9	14.9
8	63.3	4.1	4.3	4.1	2.0	15.2
9	61.3	4.8	4.2	4.1	2.1	15.5
10	59.5	5.6	4.2	4.2	2.2	15.8

Note: This table denotes the results of forecast error variance decomposition. The values in this table indicate the ratio of forecast error variance in each variable explained by unanticipated fiscal policy shock.

Table 4: Forecast error variance decomposition: Anticipated fiscal policy shock

	gov. spending	stock returns	GDP	inflation	consumption	investment
1	0.0	18.5	13.0	4.9	26.1	6.5
2	0.0	19.4	8.7	5.4	24.2	4.2
3	1.5	20.6	6.7	6.0	23.3	3.2
4	1.9	20.5	6.5	6.2	21.7	2.8
5	2.3	19.9	6.5	6.4	20.6	2.6
6	2.6	19.2	7.3	6.7	19.7	2.6
7	2.8	18.4	7.9	6.9	19.1	2.8
8	2.9	17.9	8.4	7.2	18.7	3.0
9	3.0	17.4	8.7	7.5	18.1	3.3
10	3.1	17.0	9.0	7.6	17.4	3.6

Note: This table denotes the results of forecast error variance decomposition. The values in this table indicate the ratio of forecast error variance in each variable explained by anticipated fiscal policy shock.