Effects of Fiscal Policy on Employment under the Zero Lower Bound in Japan: An Empirical Investigation with Gender and Regional Heterogeneity

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Effects of Fiscal Policy on Employment under the Zero Lower Bound in Japan: An Empirical Investigation with Gender and Regional Heterogeneity

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Abstract

We examine the effects of fiscal policy on employment when short-term interest rates were stuck at the zero lower bound (ZLB) in Japan. To do this, we consider both gender and regional differences. Our empirical results demonstrate that regardless of specification, government consumption benefited Southern Kanto and Kansai during the ZLB period. We also robustly show that it created jobs for female workers in these two metropolitan areas under the ZLB environment. These results suggest that since employers expect employment recovery by virtue of fiscal expansion as a temporal phenomenon, they increase female employees, most of whom are part-time workers.

JEL classification: E24, E62, R23

Keywords: Fiscal stimulus, zero-lower bound economy, female employment, local projection method, FAVAR

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... the employment of a given number of men on public works will (on the assumptions made) have a much larger effect on aggregate employment at a time when there is severe unemployment, than it will have later on full employment is approached.[1]

1 Introduction

After the global financial crisis (GFC) in 2008, many developed countries experienced a protracted recession. The significant fall in aggregate demand due to the recession drove the economy into a situation where short-term nominal interest rates approached the zero-lower bound (ZLB), leaving little room for central banks to cut policy interest rates. As represented by famous words of Keynes (1936), fiscal stimulus is a strong ammunition to achieve employment recovery in such severe recessions. As a matter of fact, many countries crafted fiscal stimulus packages to pull the economy out of great job losses as well as the severe economic doldrums after the GFC.

However, individual region within a country may exhibit different responses to nation-wide fiscal policy, a common macroeconomic shock.[2] Furthermore, fiscal policy response may also be different depending on the characteristics of workers. Especially, as Fukui et al. (2023) and Albanesi (2025) highlight, female employment is a key determinant of the business cycle, which is related with fiscal policy: for instance, the number of part-time workers whose fraction of female workers is larger than that of male counterparts, may rise to meet temporal increase in labor demand caused by fiscal stimulus packages. From these points of view, it is worthwhile to investigate the effects

[1] Please see Chapter 10 of Keynes (1936).

[2] Some studies like Clark (1998) and Campolieti et al. (2014) indicate that each region may react asymmetrically depending on the different sensitivities of regional economic activities with respect to common a macroeconomic shock.

of fiscal policy on employment under the ZLB environment by considering the gender differences of workers as well as regional heterogeneity. To answer this research question, we focus on Japan.

The Japanese case has a number of features that make it attractive for our study. First, the nominal interest rate was near the ZLB from the late 1990s to the early 2020s. Furthermore, the government implemented economic stimulus packages even before the nominal interest rate neared zero, which makes it easier for us to compare its effects between the non-ZLB and ZLB periods. Second, while Japan experienced job recovery under the ZLB environment, we can observe gender differences in the job recovery during the ZLB period. For example, the job recovery was confirmed in the 2010s when the Japanese government implemented a series of policy packages including the fiscal expansion called "Abenomics" under the supervision of then Prime Minister Shinzo Abe. Here, Lincoln (2020) and Kawaguchi et al. (2021) point out that the job recovery during the Abenomics period was primarily attributed to an increase in female workers.[3] Third and relatedly, there is a dispute over the effects of fiscal policy on regional employment in Japan by taking the Abenomics policy as an example: on the one hand, policy makers, including former Prime Minister Abe, have reiterated that employment recovery spread to rural areas thanks to a series of the Abenomics policy packages.[4] On the other hand, some economists cast doubt on this view.[5]

[3] Meanwhile, the Shinzo Abe cabinet also promoted women's active participation as one of its attention-grabbing policies. However, according to the Japanese government, the promotion of women's active participation was classified as a part of structural reforms. Thus, this should be examined by other frameworks.
[4] Please see the following website: https://japan.kantei.go.jp/98_abe/statement/201801/_00001.html.
[5] For example, Endo (2016) pointed out that although Abenomics led to employment recovery in the Tokyo metropolitan area, it did not necessarily increase employment in rural areas.

To examine the impact of fiscal stimulus, we take two steps. At the first stage, we estimate macro-level fiscal policy shocks using a factor-augmented VAR (FAVAR) estimation to calculate common macroeconomic shock among regions. At the second stage, by using the estimated shock as a regressor, we calculate impulse response functions (IRFs) using the local projection method developed by Jordà (2005) and Stock and Watson (2007) for each of the 10 regions of Japan.[6][7]A positive correlation between fiscal policy and employment figures would be considered, which makes it difficult to capture the causal effects of fiscal policy on employment figures. To avoid this, we first calculate national level fiscal policy shocks, which is common among the 10 regions; next, we use the purified shocks to estimate local projections. We use local projections because it has several advantages for IRF estimation. First, this approach is relatively robust against misspecifications of the data generating process. Second, we can economize on the number of estimated parameters compared to the panel vector autoregression model.

Our results can be summarized as follows. Regardless of specification, we observe government consumption contributed to an increase in employment in Southern Kanto and Kansai during the ZLB period. Since the two regions correspond to the two major metropolitan areas in Japan, our results imply that employment recovery—thanks to fiscal expansion under the ZLB—mainly benefited the major metropolitan areas.

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[6] Afterword, we use the word "region" to indicate a group of prefectures. Incidentally, the Ministry of Internal Affairs and Communications (MIC), which provides the Labour Force Survey, warns against the use of the prefectural data. According to the MIC, the prefectural level data is less accurate than the data for the entire country or regional level survey because its sample size is too small. Therefore, we avoid using prefectural level data.

[7] We address the generated regressor problem by estimating one-equation specification following Miyamoto et al. (2018). Concretely, we estimate a simple VAR model instead of taking the aforementioned two steps for estimation. The point estimates and the standard errors from the alternative specifications are almost the same as the baseline results.

Especially, by dividing the category of the type of workers, we robustly show that government consumption shocks increased female employment in the two metropolitan areas under the ZLB environment.

The remainder of this paper proceeds as follows. Section 2 introduces related literature. Section 3 discusses the empirical framework of the study. Section 4 presents the empirical results. Section 5 concludes the paper.

2 Literature review

This study is related to three bodies of literature. The first deals with fiscal policy effectiveness under the ZLB. There have been numerous theoretical and empirical studies on this topic, including Christiano et al. (2011), Eggertsson (2010), Ramey (2011), Woodford (2011), Auerbach and Gorodnichenko (2013), Bouakez et al. (2017), Miyamoto et al. (2018), Ramey and Zubairy (2018), Bilbiie et al. (2019), Amendola et al. (2020), Bouakez et al. (2020), Di Serio et al. (2020), Woodford and Xie (2022), Miyazaki et al. (2024), and Arden et al. (2025). In particular, Miyamoto et al. (2018) examine the effects of fiscal policy on the unemployment rate in a ZLB environment by using Japanese data. However, they do not consider gender and regional heterogeneity. Our focus on the regional effects by considering the type of workers differentiates our study from that of Miyamoto et al. (2018).

Second, our study contributes to the literature on fiscal policy effectiveness at the regional level in Japan. Several studies have recently been conducted on this topic in Japan, inlucing Brückner and Tuladhar (2014), Funashima and Ohtsuka (2019), Kameda et al. (2021), Bessho (2021), Imai (2022), and Morita (2022). However, to the best of our knowledge, nobody has examined the fiscal policy effectiveness at the regional level not only by comparing the non-ZLB and ZLB periods but also by considering the gender differences of workers in Japan. We aim to empirically fill the gap between the extant studies and our research question.

Finally, our research is related to studies examining the effects of fiscal policy on employment. A multitude of recent studies have addressed this topic, including Pappa (2009), Mayer et al. (2010), Monacelli et al. (2010), Campolmi et al. (2011), Brückner and Pappa (2012), Chodorow-Reich et al. (2012), Wilson (2012), Conley and Dupor (2013), Faia et al. (2013), Kato and Miyamoto (2013, 2014), Albertini and Poirier (2015), Dupor and Saif Mehkari (2016), Bredemeier et al. (2017), Dupor and McCrory (2018), Akitoby et al. (2022), and Lu and Kameda (2024). Among them, Bredemeier et al. (2017) and Akitoby et al. (2022) examine fiscal policy effectiveness considering gender differences: Akitoby et al. (2022) also examine the effect by dividing into economic boom and recession. Albertini and Poirier (2015) demonstrate the unemployment benefit extension has reduced unemployment under the ZLB environment. While these earlier studies examine the effectiveness of fiscal policy at the national level, they do not use regional data. While Chodorow-Reich et al. (2012), Wilson (2012), and Dupor and Saif Mehkari (2016) use regional level data, they do not consider gender differences. We try to complement these studies by considering gender and regional heterogeneity, as well as the ZLB and non-ZLB environments.

3 Empirical framework

3.1 Outline and the procedure to extract policy shocks

We calculate fiscal policy shocks using the FAVAR estimation method developed by Bernanke et al. (2005).[8] Appendix 1 details our FAVAR estimation and how to extract fiscal policy shocks. Like Boehm (2020), we divide government expenditure into government consumption and public investment when we calculate the fiscal policy shocks.

To extract the fiscal policy shocks, we estimate using quarterly macroeconomic time series data for 121 variables, following Shibamoto (2007) and Fujii et al. (2013). The FAVAR model allows the inclusion of numerous variables by adding as many observable large size macroeconomic variables as possible and facilitate avoiding the misspecification of the model due to omitted variables. Therefore, we use this method when we calculate the fiscal policy shocks at the first stage.[9]

3.2 Our empirical framework

To address the effects on employment figures in the short run, the framework to confirm Okun 's (1962) law is useful, following Bova et al. (2015).[10]

$$e_t = a + by_t + \varepsilon_t, \tag{1}$$

[8] The use of a factor-augmented integrated VAR (FAIVAR) model like Di Serio et al. (2020) can also be considered as a future extension to address the effects of the ZLB when we extract the shocks.
[9] We also extracted the policy shocks based on the structural VAR model by Blanchard and Perotti (2002). However, in this case we could not yield favorable results when we estimated the IRFs by local projection method. This may be because FAVAR enables us to calculate policy shocks using a number of dataset and hence alleviates omitted variables bias, but we only use several variables, at most, under the framework by Blanchard and Perotti (2002).
[10] We follow the notation of Bova et al. (2015).

where e_t is the employment gap (the deviation of the logarithm of current employment from its trend), y_t is the output gap, and ε_t is the disturbance. We purify the cyclical factor of employment because stabilization policy particularly affects cyclical components.

We run local projections for the 10 regions in Japan. The basic specification is as follows:

$$E_{i,t+k} = I_t \times (\alpha_A^k + \beta_{A,k} Gshock_t + \sum_{j=1}^{l} \gamma_{A,j}^k E_{i,t-j} + \sum_{j=1}^{l} \sum_{-i} \gamma_{A,j}^k E_{i,t-j} + \varphi_A(L) y_{t-1})$$
$$+ (1 - I_t) \times (\alpha_B^k + \beta_{B,k} Gshock_t + \sum_{j=1}^{l} \gamma_{B,j}^k E_{i,t-j} + \sum_{j=1}^{l} \sum_{-i} \gamma_{B,j}^k E_{i,t-j} + \varphi_B(L) y_{t-1})$$
$$+ \varepsilon_{i,t}^k, \quad (2)$$

where E_{it} is the employment gap (the deviation of the logarithm of current employment from its trend) for each region (i) in quarter t and ε_{it}^k is the disturbance. I_t^{ZLB} is the dummy variable which takes 1 if the economy is in the ZLB at period t and 0 otherwise. We define the ZLB period to be after 1995 Q4, following Miyamoto et al. (2018).[11] For each region, we estimate Equation (2) for both female and male workers.

With respect to control variables, we first add the output gap of the entire country in period, which is used to address the business cycle of the entire country.[12] This is

[11] Since our objective is to examine the policy effects between the ZLB and other periods, we apply the state-dependent local projection setup by Miyamoto et al. (2018) and Ramey and Zubairy (2018). The use of regime switching models with local projection methods like Auerbach and Gorodnichenko (2013) can also be considered as a future extension to investigate whether the regime shifts are associated with the ZLB or to detect possible regime changes within the ZLB regime.
[12] The Cabinet Office's Annual Report on Prefectural Accounts does not provide the data regarding the regional GDP and each item of private sector demand (private consumption and capital formation, etc.) on a quarterly basis. Although the Ministry of Economy, Trade and Industry offers quarterly level data on

equivalent to y_{t-1} with a lag operator $\varphi_A(L)$ or $\varphi_B(L)$. This is done to be consistent with the framework to check Okun's (1962) law. We also add the indicator of other regions, $\sum_{-i} E_{it-j}$. We do so to address the effects of employment in those regions. This follows Owyang and Zubairy (2013). Even though we do not use techniques such as spatial VAR or global VAR, regional feedback effects should be addressed as far as we use the regional data. In this respect, we use the framework by Owyang and Zubairy (2013), which consider spatial factors in a simple VAR estimation for each area separately like our studies.

$Gshock_t$ is the structural government consumption or public investment shock, which is calculated using the Cholesky decomposition as shown in Appendix 1.

Lag lengths for the lagged dependent variable and the control variables are set to two to keep the degree of freedom. In addition to time trend, we also add three dummy variables to address the introduction and increase of consumption tax during our sample period (1989 Q2, 1997 Q2, and 2014 Q2).[13]

The key parameters in Equation (2) are $\beta_{A,k}$ and $\beta_{B,k}$, representing the response of *k*-period-ahead employment gap with respect to a current government consumption or public investment shock. Note that all coefficients in Equation (2) are separately estimated for each horizon *k*. We directly estimate Equation (2), and the IRFs are computed using the estimated $\beta_{A,k}$ and $\beta_{B,k}$ for *k*=0, …., 8, with confidence bands computed using the standard errors of estimated coefficients $\beta_{A,k}$ and $\beta_{B,k}$.

Like a standard local projection estimation, Equation (2) is estimated using least squares with White's (1980) robust standard errors.

Indices of Industrial Production, the regional classification is different from ours. Therefore, we were unable to add regional level output, consumption, and investment.

[13] We did not add the dummy variable capturing the consumption tax hike in October 2019 because this dummy variable is dropped due to collinearity when we add this.

4 Empirical results and discussion

4.1 Data

Our sample period is from 1983 Q1 to 2021 Q3.[14] To capture the effects on employment, we used the employment (= the number of workers).[15] These data come from the Labour Force Survey by the Statistics Bureau of the MIC. The data on GDP, government final consumption, and government capital formation (public investment) comes from the Cabinet Office, Government of Japan.[16] The regional data of the Labour Force Survey consists of 10 regions as shown in Figure 2: Hokkaido, Tohoku, Southern Kanto, Northern Kanto, Hokuriku, Tokai, Kansai, Chugoku, Shikoku, and Kyushu. All the data is seasonally adjusted using the X12-ARIMA method. The data on GDP is expressed in real terms.

We used Hamilton's (2018) filter to extract the trend of employment, and the underlying GDP. There are several advantages to using this filter over the Hodrick and Prescott (1997) filter, including that Hamilton's (2018) filter is robust to seasonal adjustment. Since we have to take several lags while filtering, the initial quarter in our VAR estimation is set as 1986 Q1.

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[14] The data frequency is per quarter as the Labour Force Survey only offers quarterly updates for data at the regional level. Meanwhile, we also estimated the model by limiting the sample period to 2019 Q4 to eliminate the effects of the Covid-19 pandemic: the results are basically the same as our basic models shown in Section 4.2. Detailed results are available upon request.

[15] With regard to unemployment data, only U3 is available at a regional level in the Labour Force Survey. However, the scope of U3 is narrow because this does not encompass discouraged or peripheral workers, and becomes less accurate to capture the conditions of the labor market. Thus, we do not use the data on the unemployment rate.

[16] The data for the FAVAR estimation is reported in Appendix 1. In the meantime, since the data on government consumption include the depreciation of public capital, we subtracted the consumption of government fixed capital from the government consumption data. Snce the data on the consumption of government fixed capital is only available at an annual basis, we interpolated the quarterly data using the growth rate of the government consumption data.

4.2 Estimation results

Figures 2 to 11 plot the estimated IRFs of the employment gaps for female and male workers with respect to a government consumption or public investment shock from periods 0 to 8, based on Equation (2). This is our basic case. The two upper charts indicate the results on female workers, and the two bottom charts report the ones on male workers. We report the 90% confidence intervals. In each figure, with respect to the responses of the ZLB period, the red solid line represents the impulse response, and the red dotted lines represent the 90% confidence intervals. Regarding the non-ZLB period, the blue solid line indicates the impulse response, and the blue dotted lines represent the 90% confidence intervals.

We first present the results of our basic case in Section 4.2. and robustness checks in Section 4.3. Afterward, we proceed to discussion in Section 4.4.

Figures 2 and 3 report the results on Hokkaido and Tohoku. The figures show that with respect to these two regions, the effects on the employment gap are not substantially different between the ZLB and non-ZLB periods for both workers because the 90% confidence intervals overlap each other for most quarters.

As shown in Figure 4, regardless of the types of workers, the policy shocks of government consumption in Southern Kanto are basically positive and statistically significant in the ZLB period. In particular, the top-left chart of Figure 4 shows that the effect on the female employment gap with respect to the government consumption shock is estimated to be positive and statistically significant in the ZLB period for more than one year, while the estimated impulse response functions are negative and statistically significant outside of the ZLB period for most quarters. The government consumption shock has positive and statistically significant effects on the male labor gap between second and fourth quarters, which is shorter that of its female counterparts. The reason why confidence intervals do not include zero in the short run (< 2 periods ahead) is that there are some lags because of labor market adjustments. Conversely, government consumption shocks have negative effects on the female and male employment gap in the non-ZLB period. This implies that as explained by a standard search and matching model, government consumption in the Southern Kanto region may directly crowd out female employment in the private sector under the non-ZLB environment, where the labor market is relatively tight. Although public investment has positive effects in the ZLB period, the 90% confidence intervals overlap each other for both types of workers.

Figures 5 and 6 report the results on Northern Kanto and Hokuriku. Both figures show that the effects on the employment gap are not substantially different between the ZLB and non-ZLB periods for both workers.

The upper left chart of Figure 7 shows the government consumption shock has positive and statistically significant effects on the female employment gap in the ZLB period in the Tokai region. However, the confidence intervals in the ZLB and non-ZLB periods overlap each other for most quarters.

Figure 8 reports the results in the Kansai region. The government consumption shock has positive and statistically significant effects on the female labor gap between the third and sixth quarters period ahead. Although it also has positive impact on the male employment gap, the 90% confidence intervals overlap for most quarters.

Figures 9 to 11 demonstrate that with respect to the Chugoku, Shikoku, and Kyushu regions, the effects between the ZLB and the non-ZLB periods are not as salient as those observed in urban areas. In fact, the 90% confidence intervals overlap each other in most quarters for both types of workers in the Chugoku, Shikoku, and Kyushu regions. Since these three regions are classified as the rural parts of Japan, our results reveal that fiscal expansion under the ZLB period did not contribute to employment recovery in rural regions of the Western Japan.

4.3 Robustness check

To check the robustness of our results, we calculate IRFs under alternative model specifications. First, we add the lags of $Gshock_t$ in Equation (2), following Teulings and Zubanov (2014). The lag length of $Gshock_t$ is set to two to be consistent with other regressors. Second, we re-estimate Equation (2) by setting the lag length as four for the right-hand side variables except $Gshock_t$.

The results are shown in Tables 1a to 2d.[17] Tables 1a to 1d report the results when we add the two-period lags of $Gshock_t$ to Equation (2). Table 1a demonstrates that the effects of government consumption on the female employment gap under the ZLB environment are estimated to be positive and statistically significant in Hokkaido (horizon 0), Southern Kanto (horizon 4), Northern Kanto (horizon 0), Kansai (horizons 4 and 8), and Shikoku (horizon 8). However, Table 1b shows that public investment has positive and statistically significant impacts on the female employment gap under the ZLB period on Southern Kanto (horizon 4) and Kansai (horizons 4 and 8). Regarding the male employment gap, Table 1c reveals that the effects of government consumption under the ZLB period are positive and statistically significant in Hokkaido (horizon 8),

[17] Since our estimation reports a massive number of figures of IRFs, we omit these figures for the sake of brevity. Instead, we present the results in tables. Graphs of the IRFs can be obtained from the authors upon request.

Southern Kanto (horizons 4 and 8), and Shikoku (horizon 4). However, Table 1d shows that the positive response under the ZLB period is only observed in the Southern Kanto region with respect to public investment shock.

Tables 2a to 2d report the results when we set the lags of control variables (except $Gshock_t$) of Equation (2) as four. According to Table 2a, the positive and statistically significant responses with respect to the government consumption shock on the female employment gap under the ZLB period are observed in Tohoku (horizons 4 and 8), Southern Kanto (horizon 4), Northern Kanto (horizon 0), Kansai (horizons 4 and 8), and Shikoku (horizon 0). However, Table 2b reveals that the effects of public investment shock on the female employment gap under the ZLB period are estimated to be positive and statistically significant on Hokkaido (horizon 0), Southern Kanto (horizon 8), and Hokuriku (horizon 8). Table 2c demonstrates that the effects of government consumption on the male employment gap under the ZLB period are estimated to be positive and statistically significant in Tohoku (horizon 4), Southern Kanto (horizons 4 and 8), Northern Kanto (horizons 0 and 4), Kansai (horizons 4 and 8), and Shikoku (horizons 4 and 8). However, Table 2d shows that public investment has no positive and statistically significant impacts on the male employment gap under the ZLB period in any region.

4.4 Discussion of the results

Overall, regardless of specifications, we show an increase in employment in the ZLB period with respect to government consumption shocks in Southern Kanto and Kansai as shown in Figure 4, Figure 8, Table 1a, and Table 2a. Above all, we robustly observe the positive and statistically significant effects of government consumption on the female labor gap for the two major metropolitan areas. Obviously, when the economy is in a liquidity trap, we face a severe recession. Akitoby et al. (2022) demonstrate that fiscal policy shocks increase female employment in a recession using the data of the G-7 countries. Our results suggest that the results of Akitoby et al. (2022) are also applicable to the two metropolitan areas in Japan when the nominal interest rate was stuck at zero.

There are two interpretations from both demand and supply sides. One interpretation from the demand side is as follows. Thanks to fiscal expansion under the ZLB, employers expect economic recovery. However, most of them also assume the recovery would be temporary because the government cannot permanently implement fiscal expansions given the intertemporal government budget constraint. As long as the economic recovery is assumed to be temporary, it would be difficult for employers to hire additional full-time workers. Consequently, employers may be inclined to increase part-time workers, most of whom are female. In fact, the Employment Status Survey, which the Statistics Bureau of the MIC provides, reports that the number of part-time female workers is relatively large in Saitama, Kanagawa, Chiba, Shiga, Kyoto, Osaka, and Nara in comparison to other prefectures according to the recent figure.[18] This supports our empirical results that fiscal expansions during the ZLB period increased the number of female part time workers in the two metropolitan areas.

Another interpretation, which is from the supply side, can be explained by the content of government expenditure. The government consumption encompasses expenditures related to child-rearing and elderly care. In Japan, women are still in charge of these domestic chores. If the government increases the related expenditures to reduce the

[18] Please also see Suzuki and Tanabe (2021).

household tasks of women, it may help women have a job. In fact, as Miyazaki et al. (2015) show, the Japanese government gradually increased the share of government consumption within its expenditures after the mid-1990s, which corresponds to the ZLB period in our estimation. Our results suggest that the increased government consumption under the ZLB environment would promote the entrance of more women into workforce especially in the two metropolitan areas.

Meanwhile, we do not necessarily observe the positive response of the employment gap with respect to public investment shocks in all regions. One possible explanation from the theoretical perspective is as follows: on the one hand, the positive income effects—which is caused by the enhancement of productivity by public capital—may increase private consumption but have employees work less. On the other hand, consumers expect that given the intertemporal government budget constraint, the increase in public investment is ultimately financed by tax hikes even if it is procured by bond issuance: since they assume their permanent income goes down, workers decrease their consumption and work more through the negative income effects.[19] Since both the positive and negative effects of public investment on workers are mixed, we cannot necessarily yield positive responses on the employment gap with respect to public investment shocks.[20] Another interpretation is that since the number of construction workers has declined in recent decades, the increase in public investment does not lead to job creation in the related industries.[21]

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[19] Sunakawa (2025) demonstrates that households in Japan assume that current government spending will be financed by future tax hikes by using the dynamic stochastic general equilibrium model. This finding of Sunakawa (2025) supports our interpretation.

[20] From the theoretical point of view, the reason why we observe the positive and significant responses with respect to the government consumption shock on the employment gap in some cases can also be interpreted by the negative income effects, which increase labor based on the path that we explain here.

[21] For instance, please see the article: https://www.reuters.com/article/business/japans-aging-labor-starved-construction-industry-gives-economy-a-capex-boost-idUSKBN1XF0LW/.

5 Conclusion

This study examines the effects of fiscal policy on employment when the economy was in the ZLB environment in Japan. To do this, we consider both regional and gender heterogeneity. Overall, we show that increases in employment under the ZLB are observed in Southern Kanto and Kansai with respect to government consumption shocks. In particular, the responses of the female employment gap are robust in the two metropolitan areas.

The results can also be generalized to apply to other countries. For example, we recommend policy makers consider gender differences in employment when they craft economic stimulus measures to tackle protracted recession. This suggests that these factors should be taken into account when a government crafts a stabilization policy.

The caveat is that, in terms of quantitative evaluation, the improvement in the employment gap is less than one percent. Therefore, even if we show statistically significant results, fiscal expansion in the ZLB period would not be a panacea in terms of its quantitative effects.

This study’s analysis can be fruitfully extended in four ways. First, due to the data inaccuracy, we avoided using prefectural-level data from the Labour Force Survey. However, if more accurate data became available in the future, we would be able to examine the effects of the policy interaction at the prefectural level. Second and relatedly, while we address the influences of other regions by adding the indicator of other regions as a control variable, it would be an option to use the local projection method considering spatial factors if such method was developed in the future. Third, although we focus on examining the effects of nation-wide common fiscal policy shocks on regional employment, local governments are involved in macro-stabilization policy in Japan, as explained by Miyazaki (2010). Thus, it is also worthwhile examining whether local government expenditures can affect regional employment. Finally, although we focused on empirical analyses, a theoretical model could be constructed to strengthen our results.

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Appendix 1. Explanation of the FAVAR model

We explain the econometric framework of the FAVAR model in this appendix.[22] Let Y_t be an $M \times 1$ vector of observable economic variables. Although the lags of Y_t are used as explanatory variables in a standard VAR, they alone may not provide sufficient economic information. We therefore assume that a $K \times 1$ vector of unobserved factors,

[22] This section follows Bernanke et al. (2005) and Miyazaki et al. (2024).

where K is small, provides the remaining information. The joint dynamics of (F_t, Y_t) are given by

$$\begin{bmatrix} F_t \\ Y_t \end{bmatrix} = \Phi(L) \begin{bmatrix} F_{t-1} \\ Y_{t-1} \end{bmatrix} + u_t, \tag{A.1}$$

where $\Phi(L)$ is a matrix of polynomials of finite order d and the error term u_t has mean 0 with covariance matrix Σ. The equation is in reduced form and contains a recursive restriction that the unobservable factors (F_t) do not respond to the fiscal policy shock contemporaneously. By also considering the strategy used by Blanchard and Perotti (2002), we use a four-variable system, where the ordering of the variables is F_t (which contains three factors), the logarithm of tax revenue, the logarithm of government investment or the logarithm of government consumption, and the logarithm of GDP.[23] We take first differences for all the variables to induce stationarity.

We use the two-step approach of Bernanke et al. (2005): after identifying F_t using principal component analysis, we estimate Equation (A.1) and compute the structural shocks using Cholesky decomposition as done in Bernanke et al. (2005), Shibamoto (2007), Fujii et al. (2013), and Miyazaki et al. (2024).[24]

Equation (A.1) cannot be estimated because the factors are unobservable. We must therefore assume that the factors affect a large number of variables to estimate Equation

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[23] We also check the robustness of the results by changing the order among tax revenue, government consumption or public investment, and GDP while keeping the order of F_t. The results are not substantially changed from our basic specification. Meanwhile, it would be an option to calculate shocks based on structural FAVAR model developed by Belviso and Milani (2006). However, since we use the two-step approach instead of a Bayesian method used by Belviso and Milani (2006), we do not employ structural FAVAR estimation.

[24] Although Bernanke et al. (2005) estimate the FAVAR using the two-step approach and a Bayesian method based on Gibbs sampling, they suggest that the two-step approach tends to produce more plausible responses.

(A.1). This assumption allows us to infer the unobservable factors from observable economic time series variables. Let X_t be an $N \times 1$ vector of informational time series, where N is large such that $K + M \ll N$.[25] We also assume that the informational time series X_t are related to the unobservable factors F_t and the observable variables Y_t as follows:

$$X_t = \Lambda^f F_t + \Lambda^y Y_t + e_t, \quad \text{(A.2)}$$

where Λ^f is an $N \times K$ matrix of factor loadings, Λ^y is $N \times M$, and e_t is an $N \times 1$ vector of the error terms, which is weakly correlated with mean 0.

We perform the following procedure as the first step. Initially, the common components, C_t, are estimated using the first $K + M$ principal components of X_t. After that, following Bernanke et al. (2005), the variables are classified as slow-moving or fast-moving. Table A1 shows the list of the slow-moving and the fast-moving variables. These are quarterly macroeconomic time series data. We follow Fujii et al. (2013) when we chose these variables.[26] We take the first difference for all the 121 variables to induce stationarity.

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[25] As Bernanke et al. (2005) point out, it is acceptable for N to be greater than T.

[26] Although we take the logarithm for almost all the variables, we did not do this for (i) Bank of Japan Accounts, Asset, Loans, (ii) Banking Accounts, City Banks, Liabilities, Borrowed Money, and (iii) Banking Accounts, Regional Banks, Liabilities, Borrowed Money. Which is why some data of these three variables are zero. Furthermore, we could not include some data used in Fujii et al. (2013) like the Index of Shipment in Small and Medium Sized Enterprises and the Index of Sales in Small and Medium Sized Enterprises because the government does not collect the data after 2008.

Finally, after a principal component analysis is applied to the slow-moving variables to derive a vector of slow-moving factors, F_t^S. Finally, the following regression is estimated:

$$\hat{C}_t = b_{F^S}\hat{F}_t^S + b_Y Y_t + e_t, \quad \text{(A.3)}$$

where the estimated factors, $\hat{F}_t$, are obtained from $\hat{C}_t - b_Y Y_t$.

As the second step, we estimate Equation (A.1) by replacing F_t with $\hat{F}_t^S$, which is a vector of estimated slow-moving factors. We can also calculate the structural shock $u_t = \Psi^{-1}\varepsilon_t$, where Ψ^{-1} is the inverse of the coefficient matrix in the related structural model. We assume that $\Psi = I - \Psi_0$ (I is a 4×4 identity matrix) such that $u_t = \Psi^{-1}\varepsilon_t$ can be written as $u_t = \Psi_0 u_t + \varepsilon_t$. The recursive identification procedure implies that Ψ_0 becomes lower triangular, and the ordering in the VAR determines the degree of exogeneity of the variables.

Here the logarithm of government consumption or the logarithm of public investment is placed after F_t and the logarithm of tax revenues as mentioned earlier. Innovations in the logarithm of government consumption or the logarithm of public investment are fiscal policy shocks, which is equivalent to $Gshock_t$ of Equation (2).

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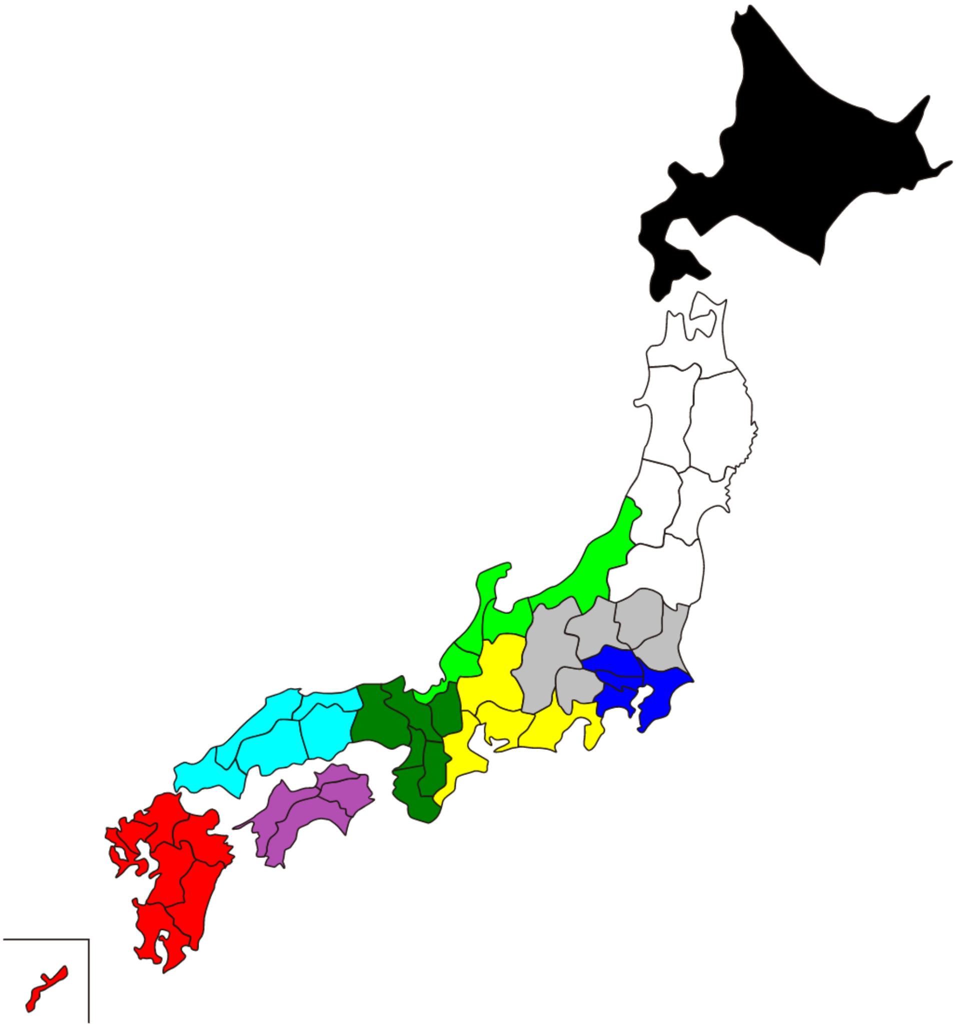
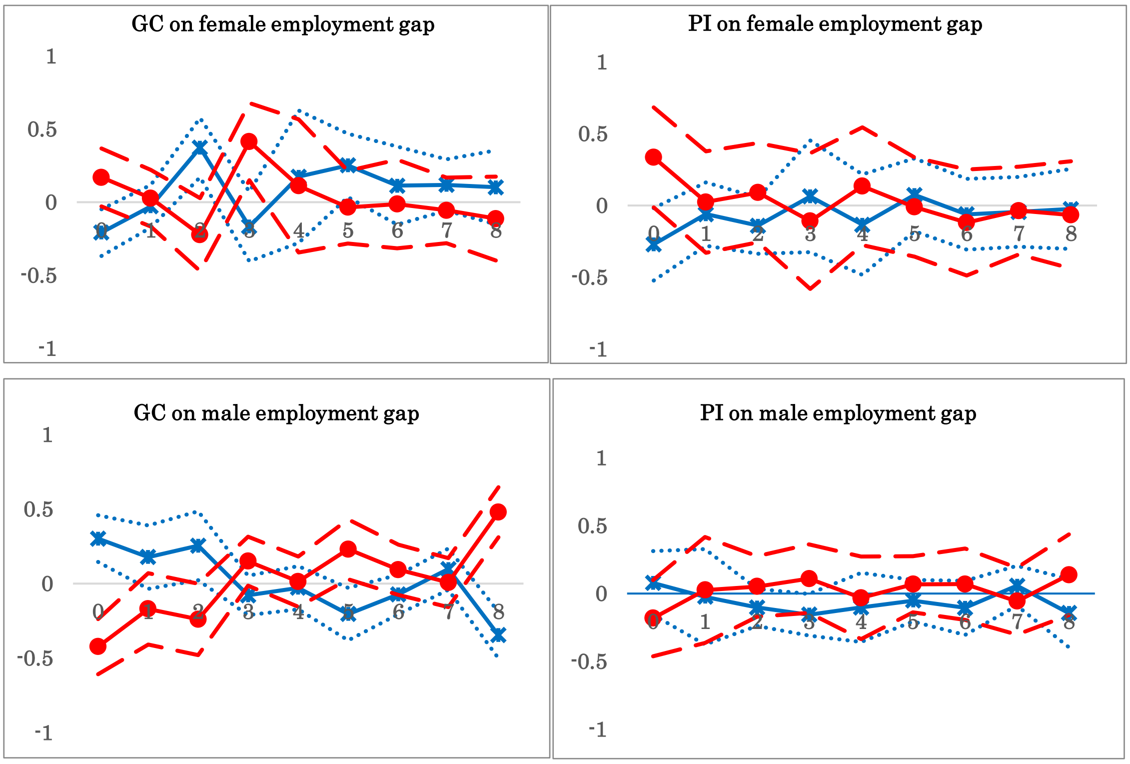
Fig. 1 The map of the 10 regions of the Labor Force Survey



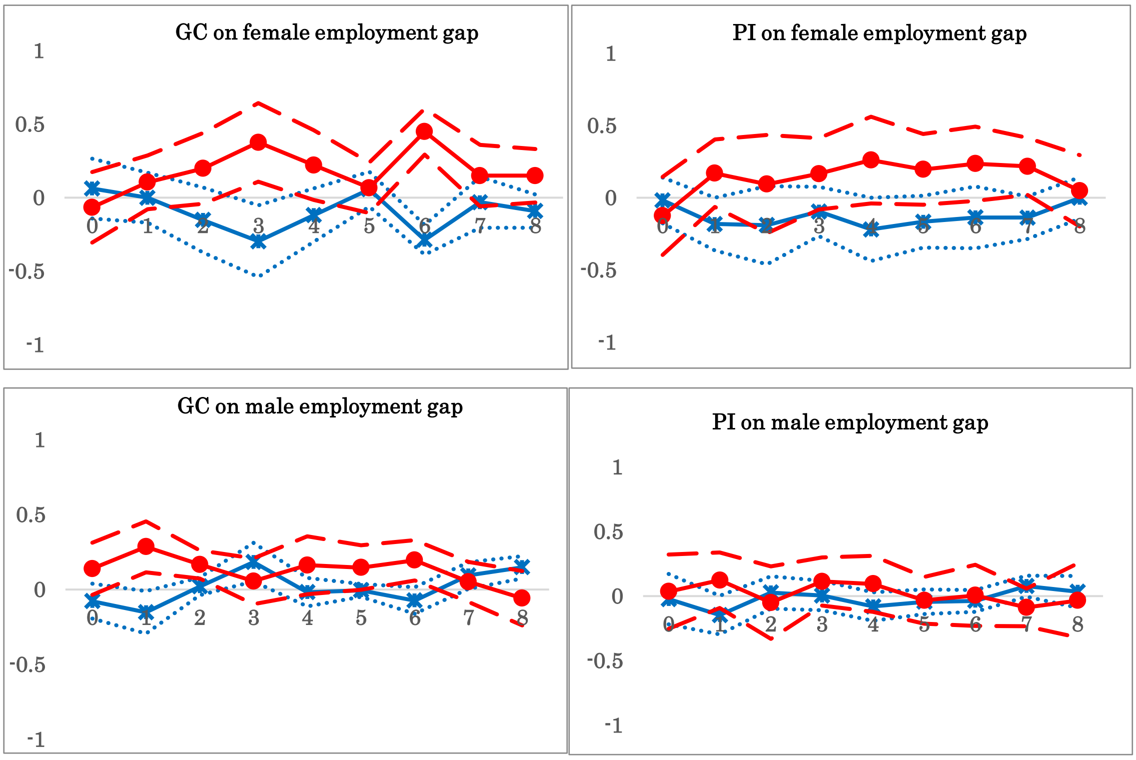
Note: The black area is Hokkaido, the white areas are Tohoku, the area of the four prefectures marked in blue is equivalent to Southern Kanto, and the grey areas are Northern Kanto and Koshin (we shorten this to Northern Kanto). Likewise, the light-green areas are Hokuriku, the group of prefectures in yellow is Tokai, the group of prefectures marked in green is Kansai, the light-blue areas are Chugoku, the purple areas are Shikoku, and the group of the islands in red is equivalent to Kyushu and Okinawa (we refer to this as Kyushu).

Fig. 2 Results of response functions on Hokkaido (Basic case)



Note: "GC" indicates government consumption and "PI" means public investment, respectively. The red solid line represents the impulse response, and the red dotted lines indicate the 90% confidence intervals in the ZLB period. The blue solid line represents the impulse response, and the blue dotted lines indicate the 90% confidence intervals outside the ZLB period.

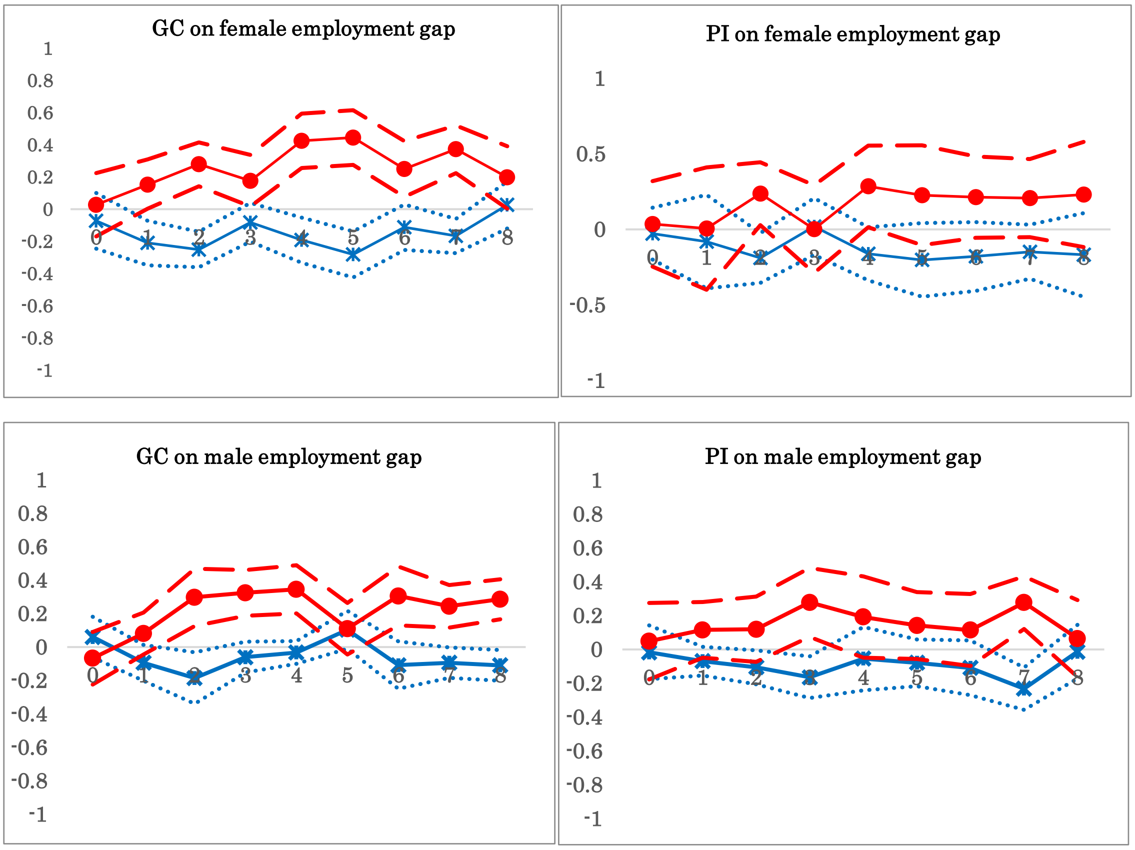
Fig. 3 Results of response functions on Tohoku (Basic case)



Note: "GC" indicates government consumption and "PI" means public investment, respectively.

The red solid line represents the impulse response, and the red dotted lines indicate the 90% confidence intervals in the ZLB period. The blue solid line represents the impulse response, and the blue dotted lines indicate the 90% confidence intervals outside the ZLB period.

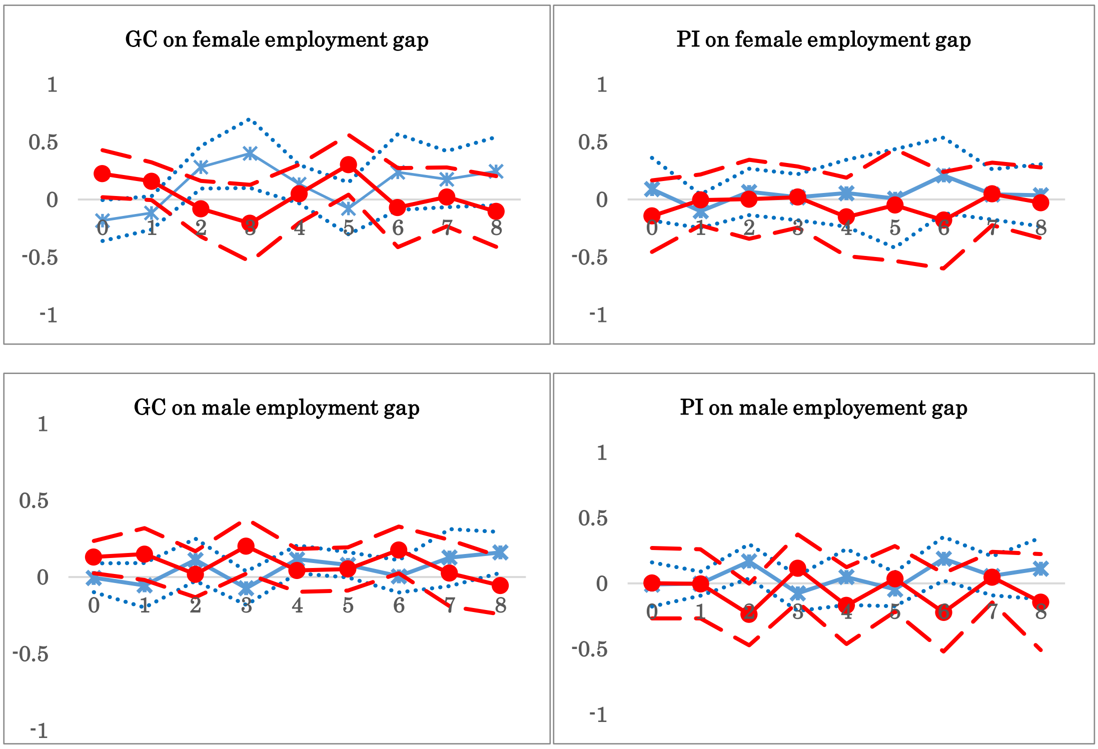
Fig. 4 Results of response functions on Southern Kanto (Basic case)



Note: "GC" indicates government consumption and "PI" means public investment, respectively.

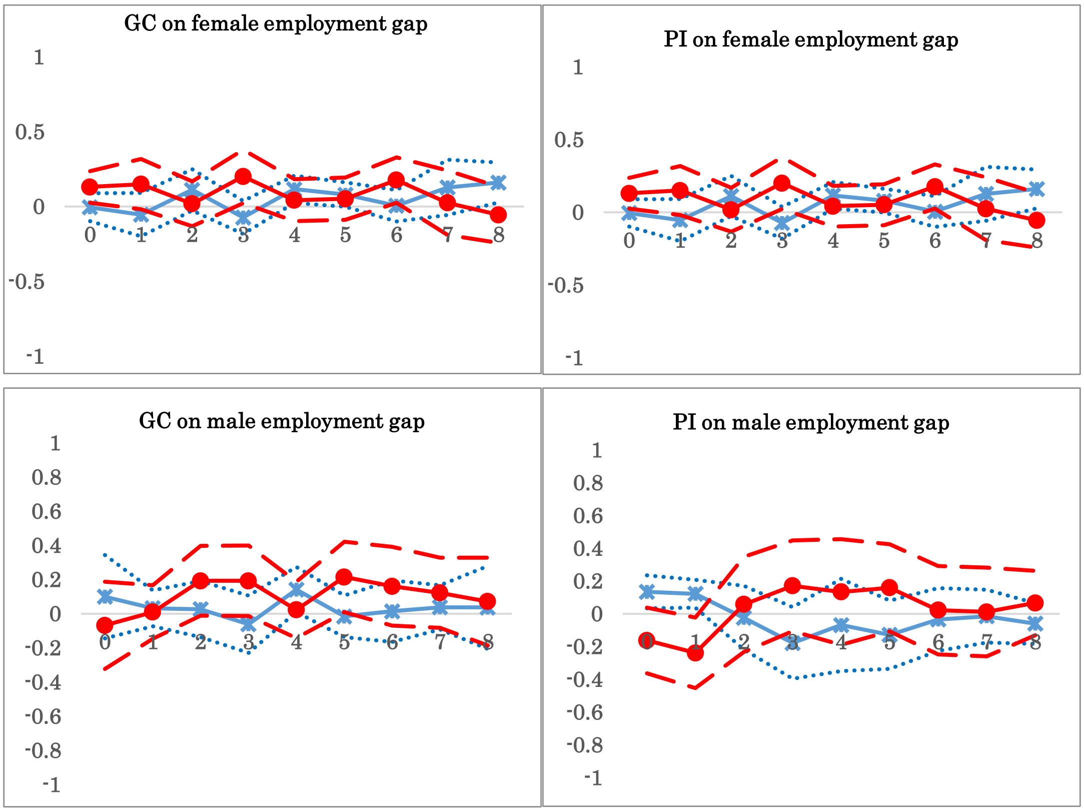
The red solid line represents the impulse response, and the red dotted lines indicate the 90% confidence intervals in the ZLB period. The blue solid line represents the impulse response, and the blue dotted lines indicate the 90% confidence intervals outside the ZLB period.

Fig. 5 Results of response functions on Northern Kanto (Basic case)



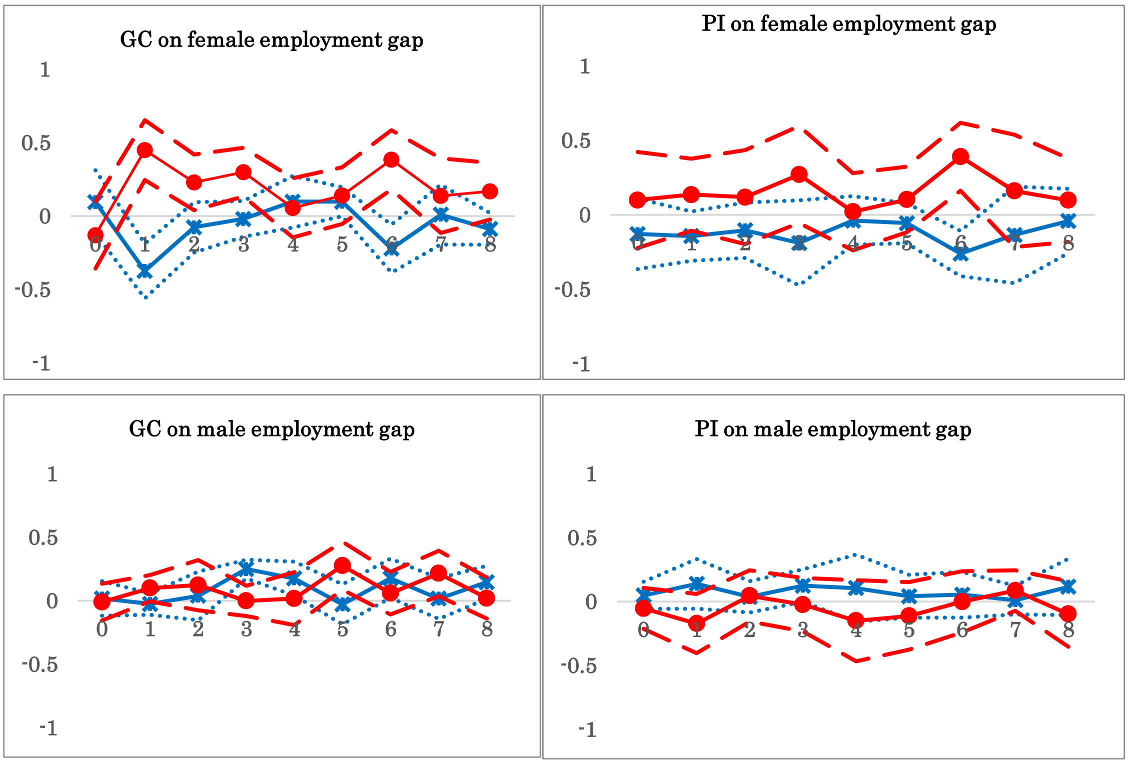
Note: "GC" indicates government consumption and "PI" means public investment, respectively. The red solid line represents the impulse response, and the red dotted lines indicate the 90% confidence intervals in the ZLB period. The blue solid line represents the impulse response, and the blue dotted lines indicate the 90% confidence intervals outside the ZLB period.

Fig. 6 Results of response functions on Hokuriku (Basic case)



Note: "GC" indicates government consumption and "PI" means public investment, respectively. The red solid line represents the impulse response, and the red dotted lines indicate the 90% confidence intervals in the ZLB period. The blue solid line represents the impulse response, and the blue dotted lines indicate the 90% confidence intervals outside the ZLB period.

Fig. 7 Results of response functions on Tokai (Basic case)



Note: "GC" indicates government consumption and "PI" means public investment, respectively. The red solid line represents the impulse response, and the red dotted lines indicate the 90% confidence intervals in the ZLB period. The blue solid line represents the impulse response, and the blue dotted lines indicate the 90% confidence intervals outside the ZLB period.

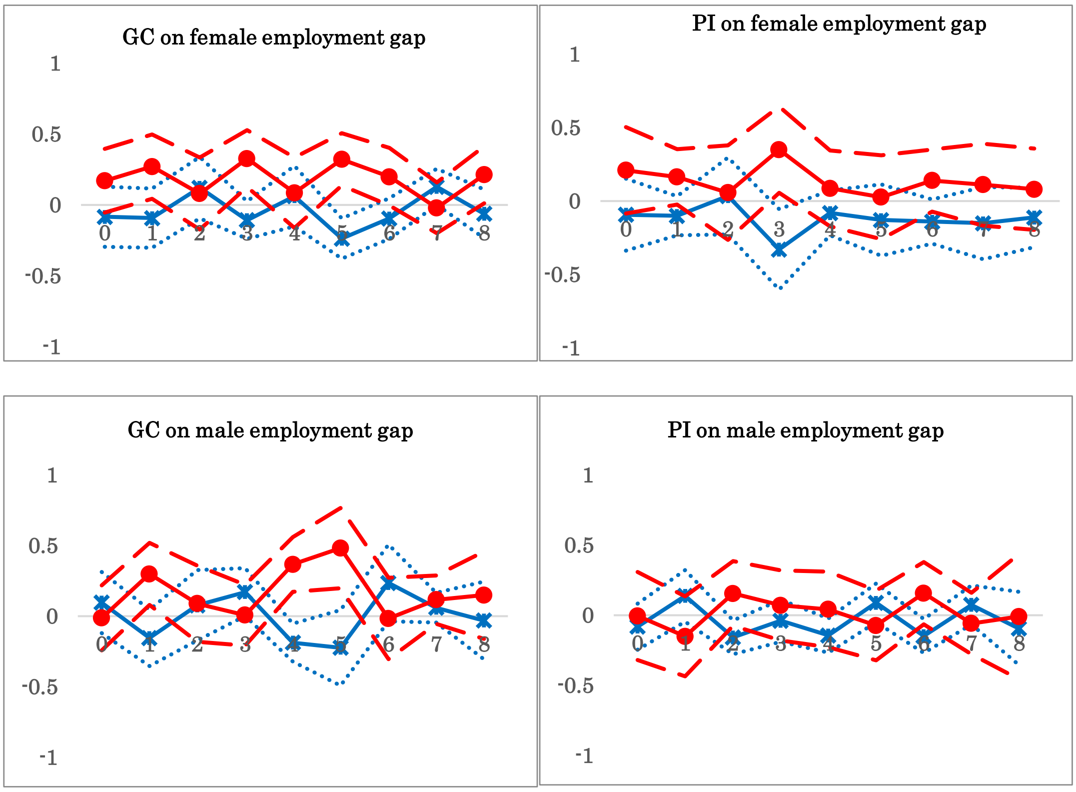
Fig. 8 Results of response functions on Kansai (Basic case)

Note: "GC" indicates government consumption and "PI" means public investment, respectively. The red solid line represents the impulse response, and the red dotted lines indicate the 90% confidence intervals in the ZLB period. The blue solid line represents the impulse response, and the blue dotted lines indicate the 90% confidence intervals outside the ZLB period.

Fig. 9 Results of response functions on Chugoku (Basic case)

Note: "GC" indicates government consumption and "PI" means public investment, respectively. The red solid line represents the impulse response, and the red dotted lines indicate the 90% confidence intervals in the ZLB period. The blue solid line represents the impulse response, and the blue dotted lines indicate the 90% confidence intervals outside the ZLB period.

Fig. 10 Results of response functions on Shikoku (Basic case)



Note: "GC" indicates government consumption and "PI" means public investment, respectively.
The red solid line represents the impulse response, and the red dotted lines indicate the 90% confidence intervals in the ZLB period. The blue solid line represents the impulse response, and the blue dotted lines indicate the 90% confidence intervals outside the ZLB period.

Fig. 11 Results of response functions on Kyushu (Basic case)

Note: "GC" indicates government consumption and "PI" means public investment, respectively. The red solid line represents the impulse response, and the red dotted lines indicate the 90% confidence intervals in the ZLB period. The blue solid line represents the impulse response, and the blue dotted lines indicate the 90% confidence intervals outside the ZLB period.

Table 1a. Results of response functions (Effects on female labor gap, GC, and its lag length=2)

	On impact (Horizon 0)	**Horizon 4**	**Horizon 8**		**On impact (Horizon 0)**	**Horizon 4**	**Horizon 8**
Hokkaido				**Chugoku**			
Non-ZLB	-0.287 *	0.336	-0.045	Non-ZLB	0.544 *	0.077	-0.001
ZLB	0.239 *	-0.092	0.154	**ZLB**	-0.452 *	0.123	0.039
Tohoku				**Shikoku**			
Non-ZLB	0.020	-0.094	0.040	Non-ZLB	-0.069	-0.008	-0.198 *
ZLB	-0.058	0.173	0.049	**ZLB**	0.119	0.148	0.344 *
Southern Kanto				**Kyushu**			
Non-ZLB	-0.111	-0.270 *	0.123	Non-ZLB	0.141 *	0.128	-0.022
ZLB	0.074	0.475 *	0.066	**ZLB**	-0.149	-0.052	0.022
Northern Kanto							
Non-ZLB	-0.202 *	0.175 *	0.356				
ZLB	0.244 *	-0.044	-0.207				
Hokuriku							
Non-ZLB	-0.035	0.099	0.167				
ZLB	-0.091	-0.127	-0.051				
Tokai							
Non-ZLB	-0.105	0.187	0.081				
ZLB	0.051	-0.081	0.010				
Kansai							
Non-ZLB	0.239 *	-0.436 *	-0.299				
ZLB	-0.183 *	0.686 *	0.567 *				

Note: "GC" means government consumption. A^{*} indicates that 0 is outside the region between the 90% confidence intervals. "ZLB" refers to the period during which the short-term nominal interest rate is close to the zero lower bound, and "non-ZLB" indicates the outside of the ZLB period.

Table 1b. Results of response functions (Effects on female labor gap, PI, and its lag length=2)

	On impact (Horizon 0)	Horizon 4	Horizon 8		On impact (Horizon 0)	Horizon 4	Horizon 8
Hokkaido				**Chugoku**			
Non-ZLB	-0.394	-0.009	0.053	Non-ZLB	0.083	0.248	-0.339
ZLB	0.464	0.057	-0.167	**ZLB**	0.006	-0.376	0.331
Tohoku				**Shikoku**			
Non-ZLB	-0.064	-0.391	0.179	Non-ZLB	-0.119	-0.245	-0.304
ZLB	-0.140	0.451	-0.085	**ZLB**	0.271	0.179	0.237
Southern Kanto				**Kyushu**			
Non-ZLB	-0.043	-0.371 *	0.377	Non-ZLB	0.295	0.250	0.190
ZLB	0.016	0.538 *	-0.167	**ZLB**	-0.244	-0.311	-0.256
Northern Kanto							
Non-ZLB	-0.081	0.069	0.248				
ZLB	-0.027	-0.226	-0.306				
Hokuriku							
Non-ZLB	0.163	0.210	-0.419 *				
ZLB	-0.257	-0.195	0.606				
Tokai							
Non-ZLB	-0.295 *	0.058	0.171				
ZLB	0.225	-0.043	-0.101				
Kansai							
Non-ZLB	-0.011	-0.821 *	-0.734 *				
ZLB	-0.038	1.137 *	0.988 *				

Note: "PI" means public investment. A^* indicates that 0 is outside the region between the 90% confidence intervals. "ZLB" refers to the period during which the short-term nominal interest rate is close to the zero lower bound, and "non-ZLB" indicates the outside of the ZLB period.

Table 1c. Results of response functions (Effects on male labor gap, GC, and its lag length=2)

	On impact (Horizon 0)	**Horizon 4**	**Horizon 8**		**On impact (Horizon 0)**	**Horizon 4**	**Horizon 8**
Hokkaido				**Chugoku**			
Non-ZLB	0.466 *	-0.200	-0.366	Non-ZLB	0.178 *	0.123	0.019
ZLB	-0.613	0.180	0.477 *	**ZLB**	-0.121	0.015	0.101
Tohoku				**Shikoku**			
Non-ZLB	-0.146	-0.026	0.180	Non-ZLB	0.083	-0.317 *	0.049
ZLB	0.177	0.150	-0.069	**ZLB**	-0.032	0.453 *	0.051
Southern Kanto				**Kyushu**			
Non-ZLB	-0.035	-0.003	-0.066	Non-ZLB	-0.070	0.150	0.236
ZLB	0.037	0.289 *	0.219 *	**ZLB**	0.049	-0.167	0.961
Northern Kanto							
Non-ZLB	-0.044	0.122	0.282				
ZLB	0.164	0.014	-0.193				
Hokuriku							
Non-ZLB	0.113	0.073	0.107				
ZLB	-0.062	0.104	0.013				
Tokai							
Non-ZLB	0.071	0.253 *	0.221 *				
ZLB	-0.086	-0.107	-0.048				
Kansai							
Non-ZLB	0.030	0.111	0.074				
ZLB	0.048	0.066	0.069				

Note: "GC" means government consumption. A^* indicates that 0 is outside the region between the 90% confidence intervals. "ZLB" refers to the period during which the short-term nominal interest rate is close to the zero lower bound, and "non-ZLB" indicates the outside of the ZLB period.

Table 1d. Results of response functions (Effects on male labor gap, PI, and its lag length=2)

	On impact (Horizon 0)	**Horizon 4**	**Horizon 8**		**On impact (Horizon 0)**	**Horizon 4**	**Horizon 8**
Hokkaido				**Chugoku**			
Non-ZLB	0.174	-0.181	-0.214	Non-ZLB	0.060	0.104	-0.024
ZLB	-0.279	0.015	0.235	**ZLB**	-0.014	-0.211	-0.070
Tohoku				**Shikoku**			
Non-ZLB	-0.221 *	-0.150	0.109	Non-ZLB	0.111	-0.157 *	-0.126
ZLB	0.213	0.144	-0.061	**ZLB**	-0.189	0.046	0.076
Southern Kanto				**Kyushu**			
Non-ZLB	-0.089	-0.097	-0.024	Non-ZLB	0.126	0.272 *	0.256
ZLB	0.120	0.330 *	0.065	**ZLB**	-0.156	-0.238	-0.240
Northern Kanto							
Non-ZLB	-0.059	0.011	0.277				
ZLB	0.023	-0.164	-0.291				
Hokuriku							
Non-ZLB	0.344 *	-0.223	-0.234 *				
ZLB	-0.409 *	0.361	0.258				
Tokai							
Non-ZLB	0.211 *	0.227	0.292				
ZLB	-0.233 *	-0.307	-0.359 *				
Kansai							
Non-ZLB	0.035	0.285	-0.154				
ZLB	0.034	-0.107	0.131				

Note: "PI" means public investment. A^* indicates that 0 is outside the region between the 90% confidence intervals. "ZLB" refers to the period during which the short-term nominal interest rate is close to the zero lower bound, and "non-ZLB" indicates the outside of the ZLB period.

Table 2a. Results of response functions (Effects on female labor gap, GC, lag of the control variables (except $Gshock_t$) of Equation (1) =4)

	On impact (Horizon 0)	Horizon 4	Horizon 8		On impact (Horizon 0)	Horizon 4	Horizon 8
Hokkaido				**Chugoku**			
Non-ZLB	-0.201	0.182	-0.037	Non-ZLB	0.490 *	0.145 *	-0.167
ZLB	0.186	0.056	0.026	**ZLB**	-0.329	0.055	0.185
Tohoku				**Shikoku**			
Non-ZLB	0.115	-0.029	-0.109 *	Non-ZLB	-0.144	0.108	-0.009
ZLB	-0.116	0.159 *	0.168 *	**ZLB**	0.256 *	0.041	0.119
Southern Kanto				**Kyushu**			
Non-ZLB	-0.059	-0.192 *	0.031	Non-ZLB	-0.025	0.211 *	-0.025
ZLB	-0.003	0.421 *	0.185	**ZLB**	0.044	-0.097	-0.008
Northern Kanto							
Non-ZLB	-0.165 *	0.113 *	0.170				
ZLB	0.213 *	0.086	-0.032				
Hokuriku							
Non-ZLB	-0.015	0.140	-0.078				
ZLB	-0.102	-0.143	0.169				
Tokai							
Non-ZLB	0.075	0.131	0.000				
ZLB	-0.096	0.066	0.081				
Kansai							
Non-ZLB	0.198 *	-0.206 *	-0.147				
ZLB	-0.133	0.495 *	0.425 *				

Note: "GC" means government consumption. A^* indicates that 0 is outside the region between the 90% confidence intervals. "ZLB" refers to the period during which the short-term nominal interest rate is close to the zero lower bound, and "non-ZLB" indicates the outside of the ZLB period.

Table 2b. Results of response functions (Effects on female labor gap, PI, lag of the control variables (except $Gshock_t$) of Equation (1) =4)

	On impact (Horizon 0)	Horizon 4	Horizon 8		On impact (Horizon 0)	Horizon 4	Horizon 8
Hokkaido				**Chugoku**			
Non-ZLB	-0.558 *	-0.339	0.295	Non-ZLB	-0.126	-0.094	-0.356
ZLB	0.614 *	0.365	-0.417	**ZLB**	0.207	0.057	0.264
Tohoku				**Shikoku**			
Non-ZLB	0.054	-0.021	0.039	Non-ZLB	0.176	0.140	-0.240
ZLB	-0.183	0.021	0.005	**ZLB**	-0.055	-0.100	0.248
Southern Kanto				**Kyushu**			
Non-ZLB	0.080	-0.201	-0.237 *	Non-ZLB	0.062	0.035	0.136
ZLB	-0.136	0.338	0.330 *	**ZLB**	0.000	0.007	-0.192
Northern Kanto							
Non-ZLB	-0.014	-0.055	-0.139				
ZLB	-0.020	-0.005	0.125				
Hokuriku							
Non-ZLB	0.114 *	0.168	-0.224				
ZLB	-0.231 *	-0.260	0.295 *				
Tokai							
Non-ZLB	-0.124	-0.045	-0.108				
ZLB	0.116	0.024	0.123				
Kansai							
Non-ZLB	-0.164	-0.107	-0.135				
ZLB	0.179	0.256	0.316				

Note: "PI" means public investment. A^* indicates that 0 is outside the region between the 90% confidence intervals. "ZLB" refers to the period during which the short-term nominal interest rate is close to the zero lower bound, and "non-ZLB" indicates the outside of the ZLB period.

Table 2c. Results of response functions (Effects on male labor gap, GC, lag of the control variables (except $Gshock_t$) of Equation (1) =4)

	On impact (Horizon 0)	Horizon 4	Horizon 8		On impact (Horizon 0)	Horizon 4	Horizon 8
Hokkaido				**Chugoku**			
Non-ZLB	0.230 *	-0.034	-0.289 *	Non-ZLB	0.233 *	0.231 *	-0.069
ZLB	-0.352	0.052	0.442	**ZLB**	-0.173 *	-0.073	0.198
Tohoku				**Shikoku**			
Non-ZLB	-0.018	-0.078	0.060	Non-ZLB	0.099 *	-0.206 *	-0.117
ZLB	0.078	0.253 *	0.049	**ZLB**	0.004	0.385 *	0.230 *
Southern Kanto				**Kyushu**			
Non-ZLB	-0.013	-0.099 *	-0.138 *	Non-ZLB	-0.101 *	0.054	0.123 *
ZLB	0.025	0.370 *	0.301 *	**ZLB**	0.081	0.056	-0.041
Northern Kanto							
Non-ZLB	-0.012	-0.001	0.132 *				
ZLB	0.150 *	0.176 *	-0.024				
Hokuriku							
Non-ZLB	0.121	0.141 *	0.028				
ZLB	-0.105	0.101	0.104				
Tokai							
Non-ZLB	0.002	0.071	0.139 *				
ZLB	0.021	0.121	-0.001				
Kansai							
Non-ZLB	0.102	0.056	-0.049				
ZLB	-0.029	0.157 *	0.224 *				

Note: "GC" means government consumption. A^* indicates that 0 is outside the region between the 90% confidence intervals. "ZLB" refers to the period during which the short-term nominal interest rate is close to the zero lower bound, and "non-ZLB" indicates the outside of the ZLB period.

Table 2d. Results of response functions (Effects on male labor gap, GI, lag of the control variables (except $Gshock_t$) of Equation (1) =4)

	On impact (Horizon 0)	**Horizon 4**	**Horizon 8**		**On impact (Horizon 0)**	**Horizon 4**	**Horizon 8**
Hokkaido				**Chugoku**			
Non-ZLB	-0.047	-0.106	0.058	Non-ZLB	0.099	0.125	-0.162 *
ZLB	-0.047	0.016	-0.058	**ZLB**	-0.101	-0.192 *	0.075
Tohoku				**Shikoku**			
Non-ZLB	-0.060	-0.055	0.041	Non-ZLB	-0.321 *	-0.232 *	0.070
ZLB	0.085	0.098	-0.024	**ZLB**	0.248	0.148	-0.183
Southern Kanto				**Kyushu**			
Non-ZLB	-0.015	0.068	0.043	Non-ZLB	0.100	0.068	0.020
ZLB	0.048	0.037	-0.020	**ZLB**	-0.099	-0.048	-0.032
Northern Kanto							
Non-ZLB	-0.011	0.025	0.154				
ZLB	0.020	-0.096	-0.173				
Hokuriku							
Non-ZLB	0.212 *	0.123	0.026				
ZLB	-0.227 *	-0.086	-0.018				
Tokai							
Non-ZLB	0.031	0.042	0.081				
ZLB	-0.046	-0.038	-0.056				
Kansai							
Non-ZLB	-0.032	0.160	0.063				
ZLB	0.092	-0.075	-0.065				

Note: "PI" means public investment. A^* indicates that 0 is outside the region between the 90% confidence intervals. "ZLB" refers to the period during which the short-term nominal interest rate is close to the zero lower bound, and "non-ZLB" indicates the outside of the ZLB period.

Table A1. Data for FAVAR estimation

Data Number	Data name
Slow moving variables	
1	Industrial Production Index (Mining and Manufacturing, 2015 = 100)
2	Industrial Production Index (Construction Goods, 2015 = 100)
3	Industrial Production Index (Capital Goods, 2015 = 100)
4	Industrial Production Index (Durable Consumer Goods, 2015 = 100)
5	Industrial Production Index (Nondurable Consumer Goods, 2015 = 100)
6	Industrial Production Index (Consumer Goods, 2015 = 100)
7	Industrial Production Index (Final Demand Goods, 2015 = 100)
8	Industrial Production Index (Investment Goods, 2015 = 100)
9	Industrial Production Index (Producer Goods, 2015 = 100)
10	Producer's Shipment Index (Mining and Manufacturing, 2015 = 100)
11	Producer's Shipment Index (Construction Goods, 2015 = 100)
12	Producer's Shipment Index (Capital Goods, 2015 = 100)
13	Producer's Shipment Index (Durable Consumer Goods, 2015 = 100)
14	Producer's Shipment Index (Nondurable Consumer Goods, 2015 = 100)
15	Producer's Shipment Index (Consumer Goods, 2015 = 100)
16	Producer's Shipment Index (Final Demand Goods, 2015 = 100)
17	Producer's Shipment Index (Investment Goods, 2015 = 100)
18	Producer's Shipment Index (Producer Goods, 2015 = 100)
19	Capacity Utilization Index (Machinery, 2015 = 100)
20	Capacity Utilization Index (Chemicals, 2015 = 100)
21	Capacity Utilization Index (Ceramics, Clay and Stone Products, 2015 = 100)
22	Capacity Utilization Index (Electrical Machinery, 2015 = 100)
23	Capacity Utilization Index (Fabricated Metals, 2015 = 100)
24	Capacity Utilization Index (General Machinery, 2015 = 100)
25	Capacity Utilization Index (Manufacturing, 2015 = 100)
26	Capacity Utilization Index (Nonferrous Metals, 2015 = 100)
27	Capacity Utilization Index (Pulp, Paper and Paper Products, 2015 = 100)
28	Capacity Utilization Index (Transport Equipment, 2015 = 100)
29	Capacity Utilization Index (Textiles, 2015 = 100)
30	Department Store Sales (per Square Meter, 10,000 yen)
31	Department Store Sales (per Worker, 10,000 yen)
32	Large-Scale Retail Store Sales (billion yen)
33	Index of Wholesale Price in Small and Medium Sized Enterprises (2015 = 100)
34	Index of Total Worked Hours (All Industries, 30 or More Persons, 2015 = 100)
35	Household Disposable Income (billion yen)
36	New Job Offers (person)
37	New Job Offers (Part-Time, person)
38	Consumption Expenditure (yen)
39	Consumption Expenditure (Food, yen)
40	Employment Index of Regular Workers (All Industries, 30 Employees or more, 2015 = 100)

Table A1 (continued)

Data Number	Data name
41	Unemployment Rate (%)
42	Consumer Price Index (Clothes and Footwear)
43	Consumer Price Index (Food)
44	Consumer Price Index (Fuel Light and Water Charges)
45	Consumer Price Index (General)
46	Consumer Price Index (General, Exclude Fresh Food)
47	Consumer Price Index (General, Exclude Imputed Rent)
48	Consumer Price Index (Furniture and Household Utensils)
49	Consumer Price Index (Miscellaneous)
50	Consumer Price Index (Reading and Recreation)
51	Consumer Price Index (Transportation and Communication)
52	Corporate Goods Price Index (Manufacturing Industry Products)
53	Corporate Goods Price Index (Mineral Produce)
54	Corporate Goods Price Index (All Commodities)
55	Real Wage Index (Contractual Cash Earnings in All Industries, 2015 = 100)
56	Real Wage Index (Contractual Cash Earnings in Manufacturing, 2015 = 100)
57	Wage Index (Contractual Cash Earnings in Manufacturing, 2015 = 100)
58	Wage Index (Contractual Cash Earnings in All Industries, 2015 = 100)
59	Import Volume Index (Total)
60	Export Volume Index (Total)
61	Value of Exports, Customs Clearance Basis (billion yen)
Fast moving variables	
62	Total Floor Area of Building Construction Started (Grand Total, 1000 ㎡)
63	Total Floor Area of New Housing Construction Started (Built for Sale, 1000 ㎡)
64	Total Floor Area of New Housing Construction Started (Owned, 1000 ㎡)
65	Total Floor Area of New Housing Construction Started (Total, 1000 ㎡)
66	Total Number of New Housing Construction Started (Built for sale)
67	Total Number of New Housing Construction Started (Owned)
68	Total Number of New Housing Construction Started (Rented)
69	Total Number of New Housing Construction Started (Total)
70	Amount of Clearing (Value: billion yen)
71	Amount of Clearing (Number: thousand bills)
72	Nikkei Stock Average 225 Selected Stocks (Average of Month, yen)
73	Nikkei Stock Average 500 Selected Stocks (Average of Month, yen)
74	Arithmetic Stock Price Average (First Section of the Tokyo Stock Exchange)
75	Tokyo Stock Price Index (TOPIX)
76	Foreign Exchange Rate (Yen per US Dollar)
77	Foreign Effective Exchange Rate (Nominal, 2015 = 100)
78	Money Stock (MI, Average, billion yen)
79	Money Stock (M2, Average, billion yen)
80	Monetary Base (Average, billion yen)

Table A1 (continued)

Data Number	Data name
81	Bank of Japan Accounts, Assets, Loans (billion yen)
82	Banking Accounts, City Banks, Assets. Cash and Due from Banks (billion yen)
83	Banking Accounts, Regional Banks, Assets, Cash and Due from Banks (billion yen)
84	Banking Accounts, City Banks, Assets, Call Loans (billion yen)
85	Banking Accounts, Regional Banks, Assets, Call Loans (billion yen)
86	Banking Accounts, City Banks, Assets, Loans and Bills Discounted (billion yen)
87	Banking Accounts, Regional Banks, Assets, Loans and Bills Discounted (billion yen)
88	Banking Accounts, City Banks, Assets, Investment Securities (billion yen)
89	Banking Accounts, Regional Banks, Assets, Investment Securities (billion yen)
90	Banking Accounts, City Banks, Liabilities, Borrowed Money (billion yen)
91	Banking Accounts, Regional Banks, Liabilities, Borrowed Money (billion yen)
92	Banking Accounts, City Banks, Liabilities, Call Money (billion yen)
93	Banking Accounts, City Banks, Liabilities, Deposits (billion yen)
94	Banking Accounts, City Banks, Liabilities, Negotiable Certificates of Deposits (billion yen)
95	Banking Accounts, Regional Banks, Liabilities, Negotiable Certificates of Deposits (billion yen)
96	Banking Accounts, Regional Banks, Liabilities, Deposits (billion yen)
97	Index of Industrial Inventories (Mining and Manufacturing, 2015 = 100)
98	Index of Industrial Inventories (Construction Goods, 2015 = 100)
99	Index of Industrial Inventories (Capital Goods, 2015 = 100)
100	Index of Industrial Inventories (Durable Consumer Goods, 2015 = 100)
101	Index of Industrial Inventories (Nondurable Consumer Goods, 2015 = 100)
102	Index of Industrial Inventories (Consumer Goods, 2015 = 100)
103	Index of Industrial Inventories (Final Demand Goods, 2015 = 100)
104	Index of Industrial Inventories (Investment Goods, 2015 = 100)
105	Index of Industrial Inventories (Producer Goods, 2015 = 100)
106	The Basic Discount Rate and Basic Loan Rate (%)
107	Yield of Interest-Bearing Government Bonds (10 years, %)
108	Yield of Government Guaranteed Bonds (10 years, %)
109	Yield of Government Bonds (10 years, %)
110	Tokyo Interbank Offered Rate (TIBOR) (3 months, %)
111	Deposit Rates of Postal Savings, Ordinary Savings (%)
112	Spread between Long and short term interest rates (%)
113	Call Rate (Collateralized Overnight, Month Average, %)
114	Government Fixed Capital Formation (billion yen)
115	GDP (billion yen)
116	Real Tax Revenue (billion yen)
117	Real Effective Exchange Rate Index (2015 = 100)
118	Real Long-term Interest Rates
119	Real Short-term Interest Rates
120	Public Debt(billion yen)
121	Government Consumption (billion yen)

The selected series basically follows Fujii et al. (2013).