American Economic Journal: Macroeconomics 2018, 10(3): 247–277
https://doi.org/10.1257/mac.20170131

Government Spending Multipliers under the Zero Lower Bound: Evidence from Japan[†]

By Wataru Miyamoto, Thuy Lan Nguyen, and Dmitriy Sergeyev*

Using a rich dataset on government spending forecasts in Japan, we provide new evidence on the effects of unexpected changes in government spending when the nominal interest rate is near the zero lower bound (ZLB). The on-impact output multiplier is 1.5 in the ZLB period and 0.6 outside of it. We estimate that government spending shocks increase both private consumption and investment during the ZLB period, but crowd them out in the normal period. There is evidence that expected inflation increases more in the ZLB period than in the normal period. (*JEL* E21, E22, E23, E31, E43, E52, E62)

To compute the impulse responses of various variables, we use the following two-step estimation procedure. First, we identify the unexpected innovations in government spending by estimating the following specification:

$$\Delta \ln G_t = \alpha + \gamma F_{t-1} \Delta \ln G_t + \psi(L) y_{t-1} + \epsilon_t, \tag{1}$$

where $\Delta \ln G_t$ is the log difference of government spending, $F_{t-1} \Delta \ln G_t$ is the one-period-ahead forecast of $\Delta \ln G_t$, y_{t-1} is a vector of controls, and $\psi(L)$ is a lag operator. All variables are in real per capita terms. The estimated residuals, $\hat{\epsilon}_t$, are the unexpected government spending changes orthogonal to the expected component of government spending and information in the control variables, so $\hat{\epsilon}_t$ is our government spending shocks. If forecast $F_{t-1} \Delta \ln G_t$ incorporates all of the information available to agents, there is no need to add controls $\psi(L) y_{t-1}$ as additional regressors in equation (1). However, to account for the possibility that households' information set may be different from that of forecasters due to the timing of our forecast data as we discuss below, we include a vector of controls in the estimation.[5]

Additionally, we note that forecast data for government spending do not correspond exactly to our "adjusted" government spending as explained in Section II, so we include forecast data on the right-hand side in the estimation instead of using forecast errors or assuming $\gamma = 1$. In what follows, we define "the standard controls" to be the growth rate of government spending, the growth rate of tax revenue, the growth rate of output, and the unemployment rate. We include the unemployment rate in the standard controls following Barro (1981) and Barro and Redlick (2011), who find that the unemployment rate contains important information about the state of the business cycle relative to output data. We add four lags of the control variables in the regressions.

In the second step, we estimate a series of regressions at each horizon h:

$$x_{t+h} = \alpha_h^x + \beta_h^x \cdot shock_t + \psi_h^x(L)\, y_{t-1} + \epsilon_{t+h}^x, \quad h = 0, 1, 2, \ldots, \tag{2}$$

where x_t is a variable of interest; $shock_t$ is the series of government spending shocks, proxied by the estimated $\hat{\epsilon}_t$ in equation (1); and $\psi_h^x(L)$ is a lag operator. Then, β_h^x is the response of x at horizon h to an unexpected government spending shock. When we estimate equation (2) for output, $\psi_h^x(L)\, y_{t-1}$ are lags of the standard controls. For all other variables of interest, $\psi_h^x(L)\, y_{t-1}$ are lags of the standard controls as well as lags of the variable of interest. We specify separately when we include additional controls.[6] Note that regression (2) uses the generated regressor $shock_t$. In the online Appendix, we show that correcting for the generated regressors problem does not change our results significantly. In a related environment, Coibion and Gorodnichenko (2012) also demonstrated that correcting for the generated regressors problem has no significant effect on their results.

To compute multipliers, we estimate the following regression for each horizon h:

$$\sum_{j=0}^{h} x_{t+j} = \alpha_h^x + M_h^x \sum_{j=0}^{h} \frac{G_{t+j} - G_{t-1}}{Y_{t-1}} + \psi_h^x(L)\, y_{t-1} + \epsilon_{t+h}^x, \tag{3}$$

where we instrument $\sum_{j=0}^{h}(G_{t+j} - G_{t-1})/Y_{t-1}$ with $\hat{\epsilon}_t$ obtained in (1). In equa-

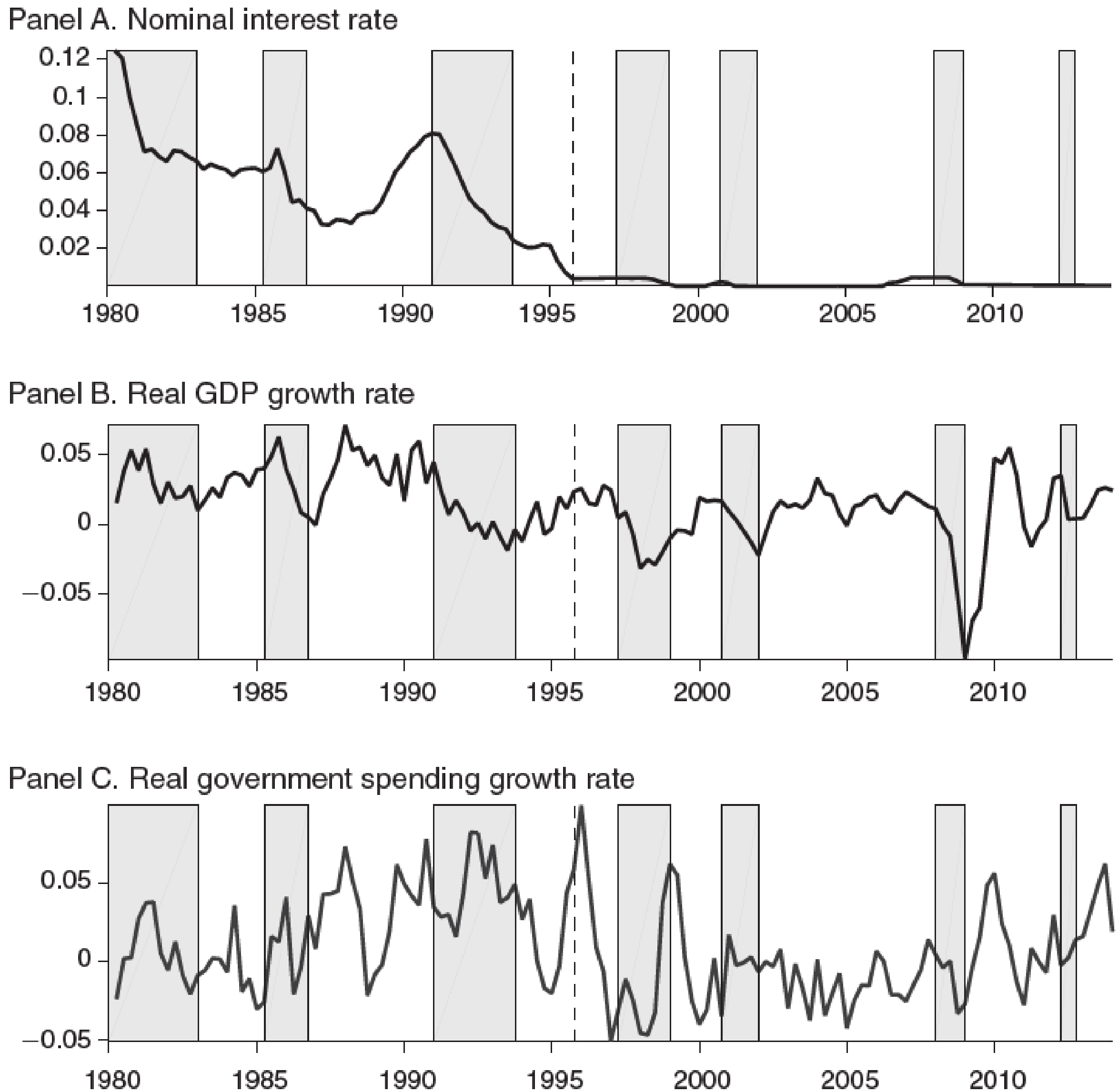

Figure 1. Nominal Interest Rate, Real GDP, and Government Spending Growth Rates in Japan

Note: The shaded areas are Cabinet Office recession dates.

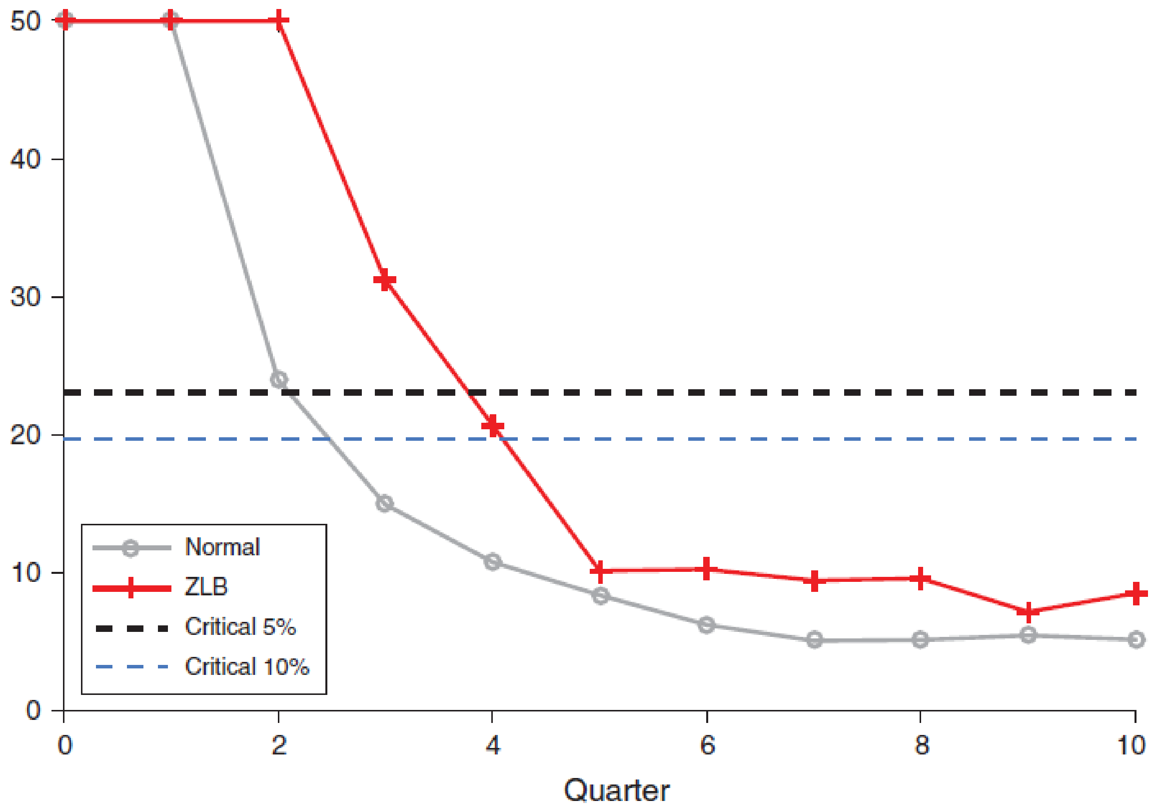

Figure 4. Test of Weak Instrument

Notes: The graph reports the *F*-statistics, capped at 50, testing the weak instrument $\hat{\varepsilon}_t$ in the first-stage estimation for equation (3). The threshold is 23.1 for one instrument for the 5 percent critical value for testing the null hypothesis that the two-stage least squares bias exceeds 10 percent of the OLS bias, and 19.7 for 10 percent critical value. All statistics are robust to heteroskedasticity and serial correlation.

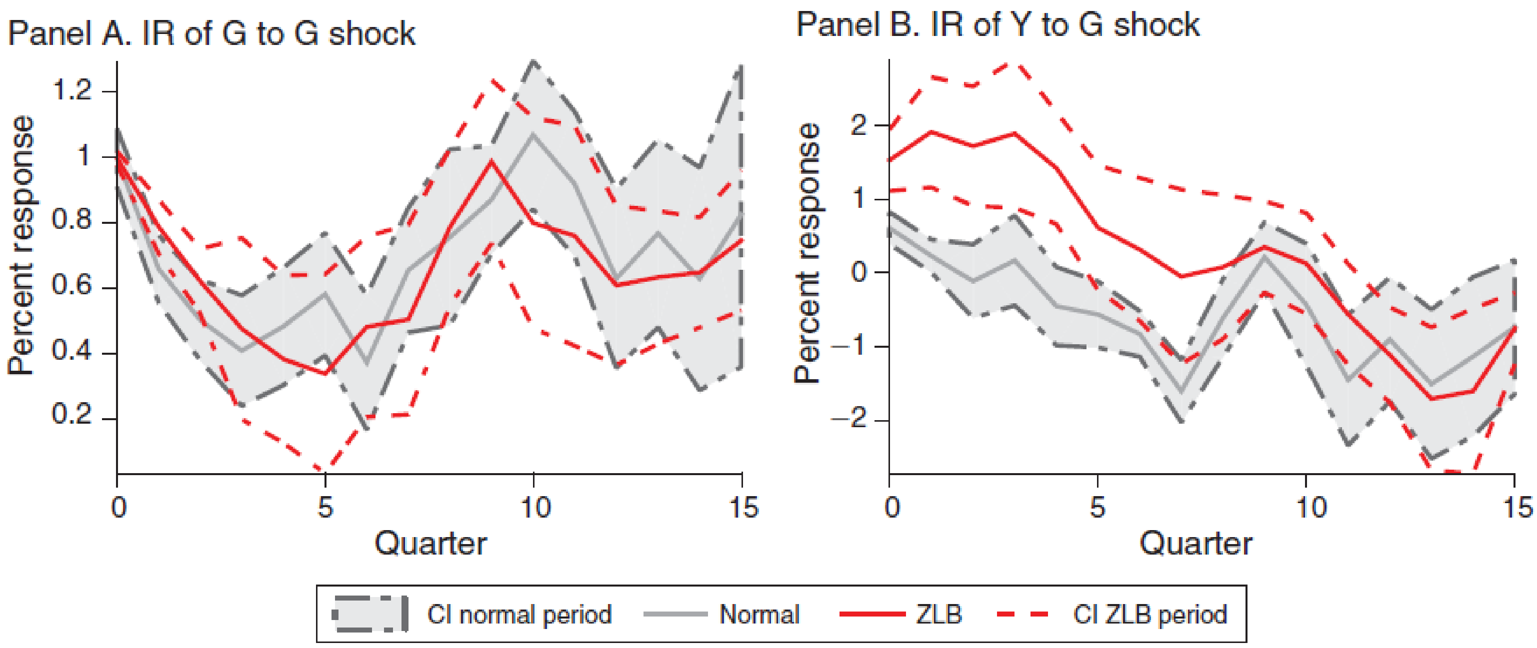

Figure 5. Impulse Responses of Output and Government Spending

Note: Impulse responses of output and government spending to an unexpected increase in government spending by 1 percent of output during normal and ZLB periods together with one standard deviation error bands.

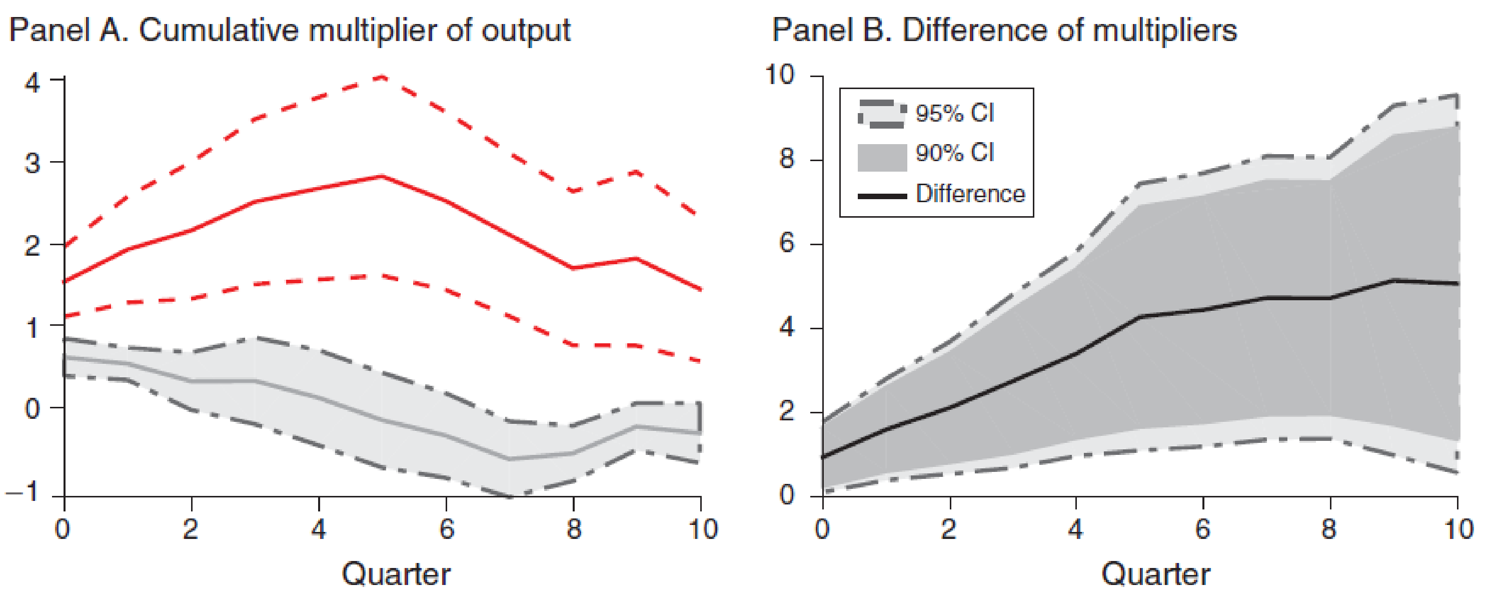

FIGURE 6. OUTPUT MULTIPLIERS AND THE DIFFERENCE IN THE MULTIPLIERS

Notes: Output multipliers during normal and ZLB periods (panel A), and their difference (panel B). The borders around point estimates on panel A are one standard deviation error bounds.

Table 1—Output Multipliers

	Normal	ZLB	p-value
On impact	0.61	1.54	HAC: 0.02
	(0.23)	(0.43)	AR: 0.09
1 quarter	0.53	1.93	HAC: 0.01
	(0.20)	(0.65)	AR: 0.06
4 quarter	0.12	2.67	HAC: 0.00
	(0.58)	(1.11)	AR: 0.06
8 quarter	–0.56	1.70	HAC: 0.00
	(0.34)	(0.94)	AR: 0.08

Notes: The table reports the estimated cumulative output multipliers at different horizons in the normal and in the ZLB periods. The HAC robust and Anderson-Rubin p-values of the difference between the multiplier in the normal period and that in the ZLB period are reported in the last column. Numbers in parentheses are the HAC standard errors.