The Effects of Tax Changes at the Zero Lower Bound: Evidence from Japan*

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Abstract

We use the narrative approach to identify tax changes unrelated to current economic conditions and to estimate the effect of these changes on macroeconomic variables during and outside of the zero lower bound period in Japan. There is little difference in reaction of output across the two periods.

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1 Introduction

How effective fiscal policy is when monetary policy is constrained by the zero lower bound? The recent global financial crisis brought this question to the center of the policy debate when central banks around the world faced the effective zero lower bound on policy rates. While there is some evidence (Miyamoto *et al.*, 2016; Ramey and Zubairy, 2016) that government spending changes are more expansionary in the ZLB than in normal periods, the recent papers that estimated macroeconomic effects of tax changes have not differentiated between periods with different monetary policy regimes (Romer and Romer, 2010; Mertens and Ravn, 2012, 2013; Cloyne, 2013)

In this paper, we attempt to fill this gap by estimating the macroeconomic effects of tax changes during ZLB and normal periods. We focus our analysis on Japan as it experienced a particularly long ZLB period: the nominal interest rate in Japan has been near zero since 1995Q4.

We construct a new data set of tax changes in Japan based on narrative records. Using these records, we are able to identify tax changes that are not designed to offset business cycles shocks, which we call "exogenous" shocks. This allows to interpret our results with more confidence. We find no convincing evidence that output responds differently to tax changes in the normal and ZLB periods. However, there is evidence that components of GDP respond differently.

2 Data and Specification

Data description. We collect a new data set for tax changes in Japan between 1967Q1 and 2016Q3. We use the reports published by the Ministry of Finance ("KaiseiZeihou no Subete") as our primary data source.[1] These reports document projected revenue changes of discretionary tax changes, their announcement and implementation dates, macroeconomic conditions during the policy changes, and motivations behind each change made by the Tax Committee or the Prime Minister. In addition, we use the interviews of the Ministry of Finance staff members documented in the history of fiscal management volumes *Shouwa Zaiseishi* and *Heisei Zaiseishi* to cross-check the motivation behind tax changes from our primary source.[2] From the narrative records, we identified about 1574

[1]The description of the reports can be found in http://www.zaikyo.or.jp/publishing/books/007407.shtml (in Japanese).
We not only focus on fiscal consolidations as was done in Guajardo *et al.* (2014) but also consider other tax changes that can potentially be classified as exogenous.

[2]The description of the volumes can be found in http://www.mof.go.jp/pri/publication/policy_history/index.htm (in Japanese).

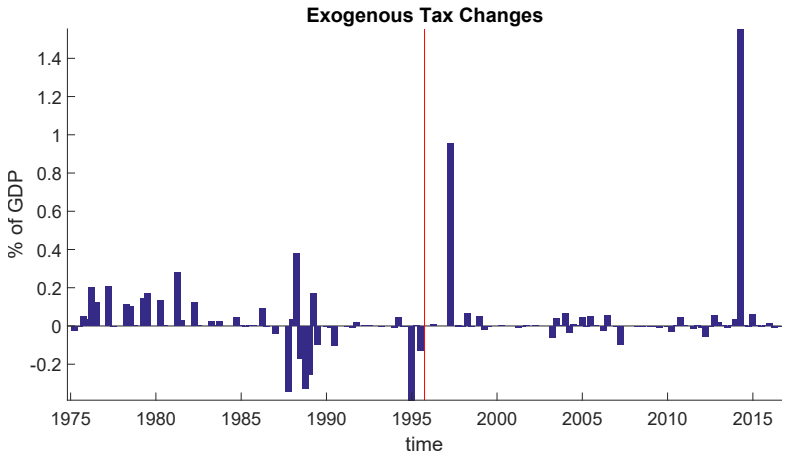

Figure 1: Exogenous tax changes in Japan 1975Q1-2016Q3. The vertical line corresponds to the start of the the ZLB period.

tax changes during our sample period. These tax changes include income, corporate, and income taxes, as well as national and local policy changes that have a national impact.[3]

We follow Cloyne (2013), who uses the modification of narrative classification of Romer and Romer (2010), and classify every tax change into "endogenous" (i.e., designed to offset macroeconomic shocks) and "exogenous" (i.e., those that are not endogenous). We classify 657 tax changes as exogenous in our sample period.

We next create a quarterly series of exogenous tax changes following Romer and Romer (2010). We date every tax change by its implementation date (we employ a convention in which tax changes implemented in the second half of the quarter are assigned to the following quarter), sum up projected tax revenues associated with tax changes within a quarter, and normalize it by annualized GDP. The resulting series τ_t for the the period of 1975Q1-2016Q3 is represented in Figure 1. One immediately notices that the ZLB period is dominated by two big spikes in the tax changes that correspond to increase in consumption taxes. We will verify below that the ZLB results are mainly driven by consumption taxes.

Specification. We use the local projection method to measure the effect of exogenous tax changes (Jorda, 2005; Stock and Watson, 2007). We estimate the following specification

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

where x_t is a variable of interest (detrended log of real per capital output, consumption, or investment), τ_t is a tax change, y_{t-1} is a vector of controls that include detrended log of

[3] An example of local policy change that has a national impact is a country-wide consumption tax change with region-specific magnitudes.

real per capital GDP, consumption, investment, exogenous tax changes, α_h^x is a constant term, $\psi_h^x(L)$ are lag polynomials of the order 4, and t is time. The impulse response function is a collection $\{\beta_h^x\}$ for different horizons h. The data are quadratically detrended. We use heteroskedasticity and autocorrelation consistent (HAC) standard errors that are robust to both arbitrary heteroskedasticity and autocorrelation. We choose automatic bandwidth selection in the estimation. We present our results by showing 68% and 90%.

In the baseline, we define the normal period as 1975Q1 to 1995Q3 and the ZLB period as 1995Q4 to 2016Q3, when the short-term nominal interest rate falls to 0.25 percent and stays under 0.6 percent. Although the earliest period for our data is 1967Q1, we choose the start of the normal period as 1975Q1: Japanese monetary policy was in the fixed nominal exchange rate regime before 1973, which can influence the tax policy effects. In addition, there was a large oil price shock in 1973 that could have lasting effects leading us to choose 1975Q1 as a starting quarter. There are 1277 overall tax changes and 553 "exogenous" tax changes in the period that starts in 1975Q1. 325 out of 480 exogenous tax changes occurred in the ZLB period. To estimate the impulse response function in both subperiods, we allow for a break in all coefficients in equation (1).

3 Results

We start by presenting the results of our estimation for the whole 1975Q1-2016Q3 sample without differentiating between the ZLB and normal periods. Figure 2 contains the impulse response functions of four variables that we used on the left-hand side of equation (1). An exogenous tax cut mechanically reduces the series of exogenous taxes on impact and quickly reverts to zero. Output increases significantly during the first three quarters and the on-impact point estimate is 1.2 percent. Investment and consumption also go up significantly on-impact and the effect persists for a few quarters. The on-impact increase in investment is 3.0 percent and consumption is 2.1 percent.

Figure 3 presents the main result of the paper. It shows the impulse response function of output, investment, and consimption after a tax cut of one percent of GDP in the normal and ZLB periods. The confidence intervals are one-standard-deviation error bands. The on-impact point estimate of the output response in the normal period is 0.6 percent, and it stays generally positive after that. In the ZLB period, the on-imact response of output is 1.8 percent, but it becomes close to zero after first quarter. The difference between the two impulse responses is significant at five percent confidence level on-impact. However, it becomes non-significant after that with the exception of horizon 5. These results suggest that there is limited evidence for a difference in the response of output in the ZLB and normal periods.

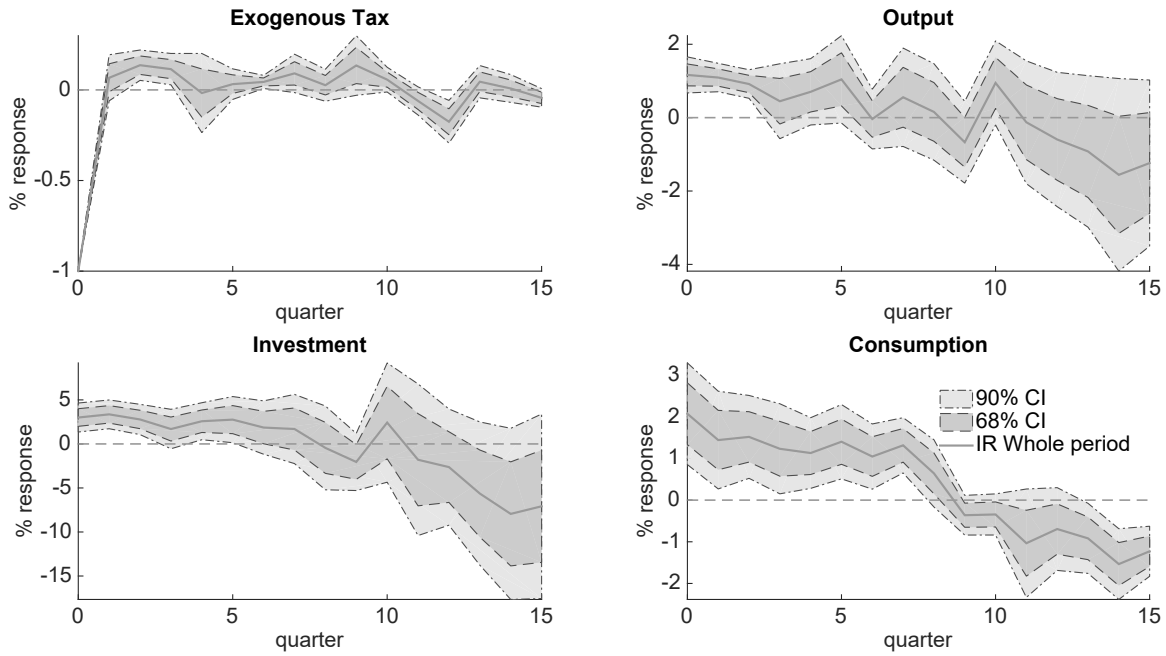

Figure 2: Impulse responses of exogenous taxes, output, investment, and consumption to an exogenous tax cut of one percent of GDP. The sample period is 1975Q1-2016Q1. The confidence intervals are one standard and 90% error bands.

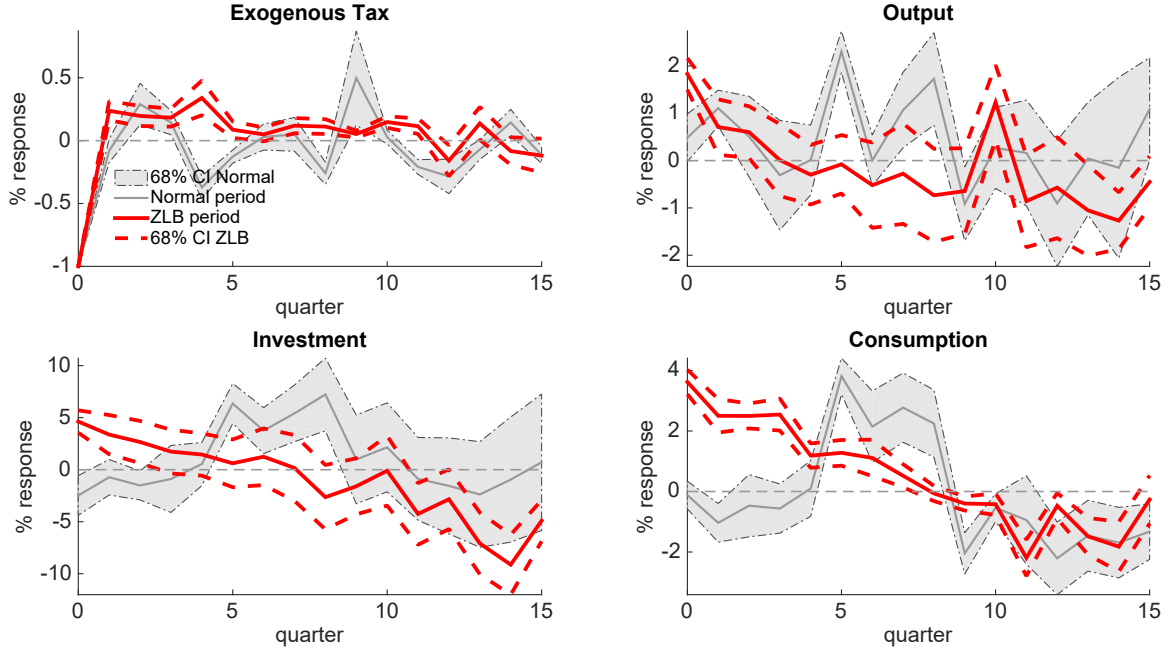

Figure 3: The responses of output, investment, and consumption to a tax cut of one percent of GDP. The confidence intervals are one standard deviation error bands.

A similar behavior of output response in the two periods can mask a difference in the behavior of components of output. The on-impact point estimate of investment is 4.5 percent in the ZLB period while it is -2.0 percent in the normal period. The difference between investment responses in the two periods is significant at ten percent level during the first three quarters. The consumption response is very close to zero and imprecisely estimated in the normal period during the first four quarters, but it becomes significantly positive during the following four quarters. In the ZLB period, consumption responds positively and statistically significant at five percent level on impact. The point estimate is 3.7 percent. This response remains elevated for eight quarters before it drops below zero. The difference between consumption responses in the two periods is significant at five percent level during the first four quarters.

3.1 Nature of Tax Changes

The tax series that we used so far pulls together different types of taxes. The advantage of this approach is that it increases statistical power if the effects of different types of taxes are similar. However, different types of taxes can have different effects on the economy. To investigate this possibility, we estimate the responses of output in the ZLB and normal periods to various types of tax changes, which comes at a cost of losing statistical power.

Consumption, corporate, and income taxes. We first estimate the reaction of output to three types of tax changes: consumption, corporate, and income (both capital and labor) taxes.[4] These three types of taxes constitute 80 percent of national tax revenues. We obtain these responses by estimating the following specification

$$x_{t+h} = \alpha_h^x + \sum_{i=1}^{3} \beta_h^{x,i} \tau_t^i + \psi_h^x (L)\, y_{t-1} + \epsilon_{t+h}^x, \; h = 0, 1, 2, \ldots, \tag{2}$$

where $\{\tau_t^i\}_{i=1}^3$ are three types of exogenous taxes that we consider: consumption, corporate, and income taxes, controls y_{t-1} include detrended log of real per capital GDP, consumption, investment, and the three types of exogenous taxes. Including all three types of tax changes in one regression, allows us to control for potential correlation between them.

Figure 4 shows the response of output, consumption and investment to a consumption tax cut of one percent of GDP.[5] A one percent consumption tax cut increases GDP in the

[4]The following link contains the description of types of taxes we use https://www.nta.go.jp/foreign_language/index.htm.

[5]In the interest of space, we do not show the responses to other types of taxes. The results are available from the authors on request.

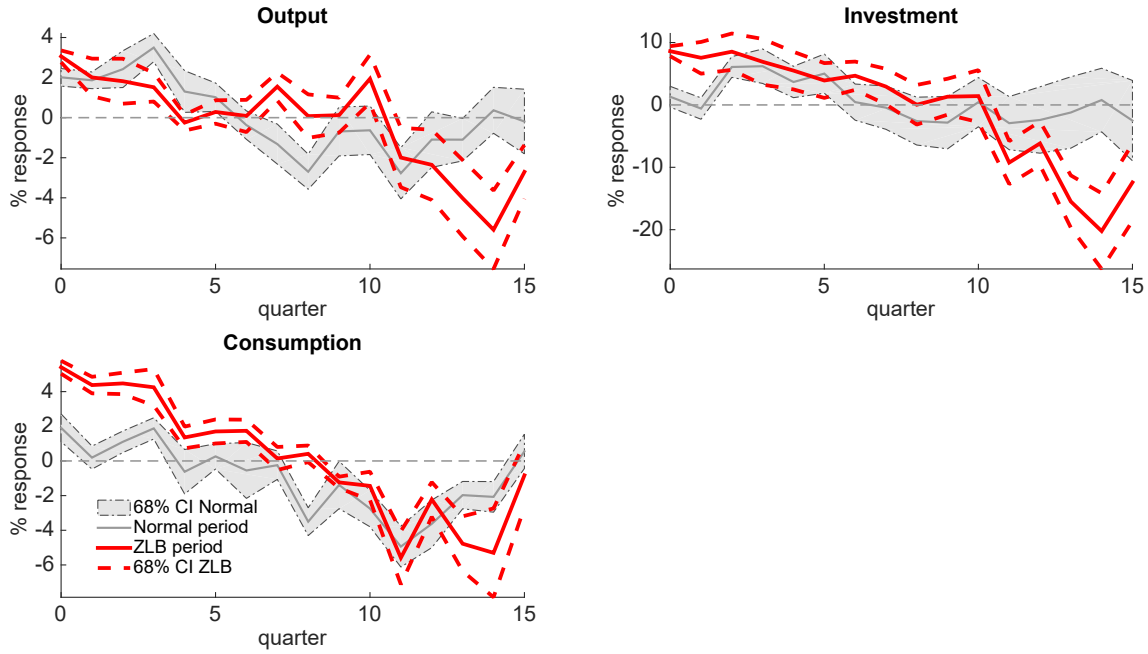

Figure 4: GDP, consumption and investment response to a consumption tax cuts of one percent of GDP. The confidence intervals are one standard deviation error bands.

normal and ZLB periods on impact. The responses are statically significant at five percent confidence level. In the following quarters, the responses becomes smaller before turning negative. The difference in the two responses is statistically significant at ten percent level only on impact. Investment and consumption respond significantly more in the ZLB than in the normal period.

Comparison of Figures 3 and 4 reveals that the responses of output, consumption, and investment to consumption tax changes in the ZLB period are qualitatively similar to the responses of these variables in the same period to all exogenous taxes. At the same time, the normal period responses are different in these two figures. This suggests that the results in the ZLB period can be mostly driven by the consumption tax changes, while the responses in the normal period are affected by consumption as well as other tax changes.

Anticipated vs. non-anticipated taxes. It is potentially important to distinguish between taxes that are anticipated and those that come as a surprise because forward-looking agents can start reacting before the actual tax change occurs. To do this, we follow Romer and Romer (2010) and control for announced but not yet implemented tax changes. Specifically, we estimate

$$x_{t+h} = \alpha_h^x + \beta_h^x \tau_t + \gamma_h^x \tau_t^{news} + \psi_h^x(L)\, y_{t-1} + \epsilon_{t+h}^x,\ h = 0, 1, 2, \ldots, \tag{3}$$

where τ_t^{news} is the news about future changes in taxes, y_{t-1} includes output, consumption, investment, and exogenous taxes.

The impulse response of GDP, consumption and investment to actual changes in taxes, i.e., $\{\beta_h^x\}$, is very close to those observed in Figure 3 (not shown here). This suggests that the economy primarily reacts to implementation of tax changes. And hence all the differences or similarities in responses between ZLB and normal periods come primarily from implementation of taxes.

4 Discussion

How are our results related to macroeconomic models predictions? To answer this question, we focus on a simple real business cycle (Baxter and King, 1993) and a simple New Keynesian models that emphasize nominal price flexibility and stickiness respectively. The former predicts that macroeconomic effects of tax changes should be unrelated to the stance of monetary policy. The letter implies that macroeconomic effects of tax changes depends on whether monetary policy is constraint by the ZLB. However, this dependence is different for different types of taxes.

Eggertsson (2011) argues that a temporary reduction in labor income and capital taxes are contractionary, while a temporary reduction in sales taxes and implementation of investment tax credit are strongly expansionary at the ZLB in a simple New Keynesian model. At the same time, all of these taxes are expansionary in the normal period. The intuition behind these results is a follows. First, a temporary reduction in labor income increases "aggregate supply" and decreases marginal costs of production. This allows firms to reduce prices for their products and leads to deflationary pressure that, if not offset by monetary policy, increases real interest rate and depresses output through "aggregate demand channel." Second, a temporary reduction in capital taxes increases "aggregate supply" reducing output through aforementioned channel and reduces "aggregate demand" through increasing incentives to save, reducing aggregate output even more. Third, a temporary reduction in sales taxes stimulates "aggregate demand" and hence increases output by more at the ZLB than in the normal period because monetary policy does not offset an expansionary effect of these taxes at the ZLB. Fourth, an implementation of investment tax credit increases "aggregate demand" (firms buy more capital goods) increasing output and stimulates aggregate supply reducing output. In his calibration, Eggertsson (2011) shows that the first effect dominates. What is more, Mertens and Ravn (2014) demonstrated that the effect of tax changes crucially depends on the duration of tax changes.

Even if the composition of taxes changes does not evolve over time in Japan in our

sample, it is possible that the composition is such that the overall effect of taxes does not change at the ZLB. For example, if there are only labor income and sales taxes in the economy, the labor income tax cuts become contractionary while sales tax cuts become even more expansionary. These two effects can potentially offset each other. However, as presented in Section 3.1, we do not find convincing evidence of the difference in responses to different types of taxes between the ZLB and normal periods.

5 Conclusion

We estimated the response of GDP to exogenous tax changes and did not find convincing evidence that the response differs across monetary policy regimes. While there are some arguments that during the ZLB period, tax cuts can be contractionary, we found that tax cuts can stimulate the economy, potentially as much as government spending. Our estimates, however, are not precise enough to distinguish between different macroeconomic models.

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