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Keywords

fiscal multiplier, effective lower bound, government spending, liquidity trap

JEL Classification

E32, E52, E62

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Should the fiscal authority avoid implementation lag?*

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January 12, 2024

Abstract

Implementation lags are a concern of policymakers as they may reduce the efficacy of fiscal policy. Using a standard New Keynesian model with an effective lower bound on the nominal interest rate, we compare the impacts of fiscal stimulus on output across various lengths of implementation lag. We show that despite concerns among policymakers, implementation lags may enhance the efficacy of government purchases on output when the economy is caught in a liquidity trap.

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1 Introduction

A broad consensus on discretionary fiscal policy is that it involves long implementation lags. The seminal work by Friedman (1953) highlighted the potential ineffectiveness or destabilizing effects of fiscal policies with implementation lags. This concern about implementation lags persists among policymakers and economists, even in recent years, when developed countries have faced an effective lower bound (ELB) on nominal interest rates and increased their reliance on fiscal policy. For example, Blanchard et al. (2009) and Blanchard, Dell'ariccia, and Mauro (2010) acknowledge the risks associated with the long implementation lags of fiscal policy. Christiano, Eichenbaum, and Rebelo (2011) also argue that long implementation lags in discretionary fiscal policy can decrease the fiscal multiplier, emphasizing the importance of avoiding implementation lags. Therefore, the fiscal authority should avoid implementation lags.

This note shows that a fiscal authority may not need to avoid implementation lags. Using a standard New Keynesian model with an ELB, we examine the efficacy of fiscal policy over various lengths of implementation lags. We find that implementation lags can enhance the efficacy of fiscal stimulus when the ELB is binding. Thus, a certain length of implementation lag may be desirable for the efficacy of fiscal stimulus. However, we also show that implementation lags do not always enhance the efficacy of fiscal stimulus if they are too long. Fiscal stimulus may even reduce output if implemented when the ELB is no longer binding. In this case, the concerns of policymakers remain valid and the fiscal authority should avoid implementation lags. Therefore, the desirability of implementation lags critically depends on in which state of the economy the government implements fiscal stimulus.[1]

Implementation lags in the fiscal authority can be interpreted as a variant of fiscal policy's

[1] Our study is related to the vast literature on state-dependent fiscal multipliers. A seminal work is Auerbach and Gorodnichenko (2012), who argue that fiscal multipliers vary between expansions and recessions. More recently, Ghassibe and Zanetti (2022) provide a theory and related evidence that fiscal multipliers depend on the source of economic fluctuations, namely, on what types of shocks generate expansions and recessions.

forward guidance and compared with that of monetary policy.[2] Fiscal policy with implementation lags leads to changes in future real interest rates through anticipation of policy, similar to monetary policy's forward guidance. Our findings regarding the desirability of implementation lags imply that fiscal policy's forward guidance is effective only when it is possible to lower future real interest rates under a binding ELB. This contrasts sharply with monetary policy's forward guidance, which becomes effective by lowering future real interest rates under a nonbinding ELB (i.e., real interest rates after the economy recovers from a liquidity trap).

2 The model

The model we consider here is a standard closed-economy New Keynesian model with an ELB. The model shares various features discussed in Galí (2015), consisting of the consumption Euler equation, the New Keynesian Phillips curve (NKPC), and the Taylor rule with an ELB. Here, we explicitly introduce fiscal policy with implementation lags into this standard model. For simplicity, we consider the deterministic version of the model because we focus only on the impulse response functions to the steady state. In what follows, we describe the key linearized equations of the model and leave the details to the not-for-publication Appendix A.

The consumption Euler equation in the representative agent model is given by

$$c_t = c_{t+1} - (r_t - \pi_{t+1} - \varrho_t) \, , \tag{1}$$

where c_t denotes the log-deviation of consumption from the steady state, r_t is the deviation of the net nominal interest rate from the steady state, and π_t is inflation. Here, we assume zero inflation in the steady state and an intertemporal elasticity of substitution of one.

[2] For monetary policy's forward guidance, see Eggertsson and Woodford (2003) and Jung, Teranishi, and Watanabe (2005), among others.

Following Krugman (1998), Eggertsson and Woodford (2003), and Jung, Teranishi, and Watanabe (2005), we introduce a deterministic preference "shock" ϱ_t into the consumption Euler equation to generate a liquidity trap in which the nominal interest rate hits the ELB.

The NKPC takes the following form:

$$\pi_t = \kappa \left(c_t + \frac{\alpha + \psi}{1 - \alpha} y_t \right) + \beta \pi_{t+1}, \tag{2}$$

where y_t is the log-deviation of output from the steady state, $\psi > 0$ denotes (the inverse of) the Frisch elasticity of labor supply, and $\beta \in (0, 1)$ is the subjective discount factor of households. We assume the firm's production function with decreasing returns in labor, where $1 - \alpha$ is the returns to labor.[3] Also, $\kappa \equiv [(1 - \theta)(1 - \beta\theta)/\theta)][(1 - \alpha)/(1 - \alpha + \varepsilon\alpha)]$ represents the slope of the NKPC, where θ is the probability that firms cannot reset their prices in each period and ε is the elasticity of substitution across differentiated goods. In (2), $c_t + [(\alpha + \psi)/(1 - \alpha)]y_t$ represents the log-deviation of the average real marginal cost.[4]

The monetary authority sets the nominal interest rate according to a simple Taylor rule where r_t responds only to inflation: $r_t = \alpha_\pi \pi_t$ with $\alpha_\pi > 1$. Together with the ELB, the nominal interest rate is given by

$$r_t = \max\left(\alpha_\pi \pi_t, \ln \beta\right). \tag{3}$$

Recall that r_t is the deviation of the nominal interest rate. The steady-state nominal interest rate equals $\ln(1/\beta)$. Thus, the nominal interest rate becomes zero if and only if r_t decreases to $-\ln(1/\beta) = \ln \beta$.

We are interested in the impact of a fiscal policy shock on the economy. Following Galí, López-Salido, and Vallés (2007) and Galí (2020), denote g_t as the deviation of government

[3]Following Galí (2015), we assume that intermediate good producers produce differentiated goods using the production function $Y_t(i) = N_t(i)^{1-\alpha}$, where $Y_t(i)$ and $N_t(i)$ are the output of firm i and labor demand for firm i, respectively.

[4]Here, $c_t + \psi/(1 - \alpha)y_t$ is the log-deviation of real wages expressed by the marginal rate of substitution between consumption and labor, and $\alpha/(1 - \alpha)y_t$ is the log-deviation of aggregate labor productivity.

purchases from the steady-state value expressed as a fraction of steady-state output (i.e., $g_t = (G_t - G)/Y$ where G_t, G, and Y are government purchases in period t, steady-state government purchases, and steady-state output, respectively). We also assume that government purchases are financed by the lump-sum tax. Thus, Ricardian equivalence holds and the equilibrium allocation is independent of the timing of taxation.

The goods market satisfies the following market-clearing condition:

$$y_t = (1-\gamma)c_t + g_t, \tag{4}$$

where γ is the steady-state government purchases to output ratio G/Y. As discussed in the next section, g_t is exogenously determined.

3 Policy experiments of implementation lags

3.1 Simulations

Our simulations aim to compare the effects of government purchases on output across various lengths of implementation lag. In simulations, the government makes an announcement at $t = 0$ that government purchases are to increase by one percent of steady-state output relative to steady-state government purchases. The increase in government purchases takes place in period $h \geq 0$, where h represents the length of the implementation lag. Government purchases g_t take the following values:

$$g_t = \begin{cases} 0 & \text{for } t < h, \\ \delta^{t-h} g_h & \text{for } t \geq h, \end{cases} \tag{5}$$

where $\delta \in [0, 1)$ measures the persistence of g_t because $g_{t+1} = \delta g_t$ for $t > h$. Throughout this paper, we consider fiscal stimulus, meaning that the government purchases in period h are always positive: $g_h > 0$.

We measure the overall effect of fiscal stimulus with implementation lag h on output by

$$\varphi_h = \frac{\sum_{t=0}^{\infty} \beta^t (Y_t - Y_t^R)}{\sum_{t=h}^{\infty} \beta^t (G_t - G)}. \tag{6}$$

The numerator represents the cumulative changes in output from its reference level Y_t^R, which we define later. It measures output responses from the periods of announcement (i.e., from period 0 to $h-1$) as well as the periods after implementation (i.e., from period h to ∞). The denominator is the cumulative changes in government purchases relative to the steady state. This measures changes in government purchases from the periods of implementation (i.e., from period h to ∞). Both the numerator and the denominator are expressed as the present value.[5] Thus, φ_h assesses how the cumulative effect of an anticipated shock to government purchases varies as the implementation lag h increases.

As we proceed, it is useful to specify Y_t^R in (6) for our two experiments. The first experiment (experiment I) investigates the impact of government purchases on the economy in a normal time in which the ELB is not binding. In particular, we assume that $\varrho_t = 0$ for all $t \geq 0$, and thus the economy is initially in the steady state, where the nominal interest rate is greater than zero (i.e., $r_t > \ln \beta$). In this sense, the economy is in the normal time. Because the initial state of the economy is in the steady state, this experiment specifies the reference level of output as $Y_t^R = Y$ for all t.

The next experiment (experiment II) considers the economy under a liquidity trap in which the nominal interest rate temporarily hits the ELB. In particular, we assume that a negative preference shock unexpectedly occurs in period 0 and continues to be negative for the next three years. After three years, the negative shock disappears. More specifically, ϱ_t is fixed at a negative value for $t = 0, 1, 2, ..., 11$ and $\varrho_t = 0$ for $t \geq 12$. In response to the declines in aggregate demand, the government announces the fiscal stimulus in period 0 (the period when the negative preference shock hits the economy) and implements its

[5] We approximate (6) by $\sum_{t=0}^{60} \beta^t (Y_t - Y_t^R) / [\sum_{t=h}^{60} \beta^t (G_h - G)]$. The approximation is valid as long as h is small relative to the truncation value.

policy in period h. We define the reference level of output Y_t^R in this experiment as the equilibrium output where the preference shock disturbs the economy without fiscal stimulus. More specifically, Y_t^R is the equilibrium output arising from fluctuations in ϱ_t while keeping G_t at G for all t.

Throughout the paper, we parameterize the size of the preference shock to ensure that the weakened aggregate demand generates the liquidity trap for two years.[6] By fixing the duration of a liquidity trap, we can clarify the role of the timing of implementation. In particular, as long as the duration is fixed, we can identify whether the ELB is binding or no longer binding when fiscal stimulus is implemented with lag h.

The remaining parameterization for the simulations follows Galí (2015) or Galí (2020) unless otherwise noted. We set β at 0.995, which implies a steady-state annualized real interest rate of two percent under zero steady-state inflation. The elasticity of substitution across differentiated goods ε is set to nine. The Frisch elasticity of labor supply is 1/5 so that $\psi = 5$ and the return to labor in the production function $1 - \alpha$ is 3/4. In addition, we set θ such that the average duration of price changes is four quarters (i.e., $\theta = 3/4$). Following Galí, López-Salido, and Vallés (2007), we set γ at 0.2. The persistence of government spending δ is set to 0.5. Finally, we set α_π to 1.50.

3.2 Results

3.2.1 Experiment I: The economy in normal times

Figure 1 reports the simulation results of experiment I. The left panel plots φ_h against h to compare the overall effect of fiscal stimulus on output across various lengths of the implementation lag h. The right panel chooses the cases of $h = 0$ and 4 and shows how output responses to fiscal stimulus differ between the two cases.

[6] In our benchmark parameterization, we set the size of a negative shock to -0.3 percent (i.e., ϱ_t for $t = 0, 1, ..., 11$ to -0.003). We change this value across robustness checks to ensure the liquidity trap for two years.

[Figure 1 about here.]

As shown in the left panel, implementation lags are not desirable in terms of the overall effect of a fiscal stimulus on output because φ_h reaches its maximum value when $h = 0$. We confirm that $h = 0$ continues to achieve the (global) maximum value of φ_h even if we allow for a large h sufficiently beyond the value of h shown in the figure. This result suggests that fiscal stimulus without implementation lags performs best in terms of the overall effect on output. One important message in experiment I is that the fiscal authority should avoid any implementation lags when the economy is in normal times. Quantitatively, the decrease in efficacy is nonnegligible in that if a policymaker postpones the implementation of government purchases by one year after the announcement, the efficacy of the fiscal stimulus falls by about 83 percent, from $\varphi_0 = 0.70$ to $\varphi_4 = 0.12$. This fall in efficacy results from substantial initial declines in output between the announcement and the implementation (see the solid line with circles for the case of $h = 4$ in the right panel).

Intuitively, the consumption-smoothing motive gives rise to this undesirability of implementation lags. Government purchases with an h-period implementation lag raise the real interest rate in period h. An increase in the real interest rate decreases consumption in the same period (i.e., $c_h < 0$). Put differently, government purchases g_h crowd out consumption c_h as in the standard New Keynesian model. In period 0, households realize that government purchases with an h-period implementation lag reduce their consumption in period h. The h-period implementation lags provide forward-looking households with opportunities to mitigate a large fluctuation in consumption at the time of the implementation of fiscal stimulus. Namely, they can smooth out their consumption over the periods before h. This consumption smoothing results in declines in c_t over $0 \leq t \leq h - 1$. As the implementation lag lengthens, households have more opportunities to reduce consumption. Thus, implementation lags weaken the overall effect of fiscal stimulus on output.

3.2.2 Experiment II: The economy in a liquidity trap

We next turn to experiment II. Figure 2 again plots φ_h against h in the left panel and depicts output responses for the cases of $h = 0$ and 4 in the right panel.

[Figure 2 about here.]

In contrast to the result of experiment I, the left panel of the figure suggests that a certain length of implementation lag is desirable because φ_h exhibits a hump shape that peaks at $h = 5$. This shape suggests that a fiscal stimulus with no implementation lag does not necessarily perform best in terms of the efficacy on output. An important message in experiment II is that the fiscal authority does not always need to avoid implementation lags when the ELB is binding. Furthermore, the increment in efficacy is substantial. For example, if a policymaker postpones the fiscal stimulus by one year after the announcement, the efficacy of the fiscal stimulus will increase by approximately 2.5 times, from $\varphi_0 = 1.26$ to $\varphi_4 = 3.19$. This surge in efficacy can be confirmed from output responses in the right panel. This panel shows output responses for $h = 0$ and $h = 4$ as well as the responses without government intervention (i.e., the reference level of output y_t^R). Because of the negative preference shock ϱ_t, output drops in all periods after $t = 0$. In period 0, the government announces the fiscal stimulus to mitigate the decreases in output. The fiscal stimulus is much more effective with implementation lags of one year ($h = 4$) than without them ($h = 0$).

Our finding on the desirability of implementation lags sharply contrasts with the broad consensus among policymakers. Since Friedman (1953), lags in implementing fiscal policies have long been a concern for policymakers. Even in recent studies, this concern remains. For example, Blanchard et al. (2009) argue for fiscal stimulus during a financial crisis, but also recognize that implementation lags remain a risk for fiscal stimulus. In contrast to these previous studies, we point out the *desirability* of implementation lags when the ELB is binding.

We note that the overall effect of fiscal stimulus on output φ_h is hump-shaped rather than monotonically increasing in h, as shown in the left panel of Figure 2. Thus, a longer implementation lag does not always enhance the efficacy of fiscal stimulus even if the ELB is binding at the time of announcement. Indeed, φ_h is even negative for $h \geq 9$. In the next section, we explain in detail the mechanism behind the hump shape in Figure 2, based on model responses to shocks.

3.3 Model dynamics of the economy in a liquidity trap

Figure 3 presents the model dynamics of output, consumption, the nominal interest rate, and the real interest rate in experiment II. These variables are shown in terms of the responses to an anticipated increase in government purchases. The nominal and real interest rates are multiplied by four to express them at an annual rate. Here, negative preference shocks lasting for three years weaken aggregate demand such that the nominal interest rate hits the ELB during $0 \leq t \leq 7$. Given a decline in inflation from weakened aggregate demand, the real interest rate increases strongly when the nominal interest rate hits the ELB.

[Figure 3 about here.]

We are now ready to discuss the effects of fiscal stimulus with implementation lags. Figure 3 selects two values for the implementation lags: $h = 4$ (the solid line with circles) and $h = 12$ (the solid line with diamonds). The vertical lines in each panel represent the period of implementation of the fiscal stimulus. Note that an implementation lag of one year means that the government implements the fiscal stimulus during a liquidity trap (see the lower-left panel of Figure 3). By contrast, an implementation lag of three years implies that the government implements the fiscal stimulus when the ELB is no longer binding. Recall that, as indicated in the left panel of Figure 2, φ_h almost peaks in $h = 4$ ($\varphi_4 = 3.19$), but is considerably smaller when $h = 12$ ($\varphi_{12} = -3.39$).

Let us first discuss the effect of a fiscal stimulus on output when implemented during a liquidity trap ($h = 4$). The solid line with circles in Figure 3 details the model responses to both an increase in g_t and a decrease in ϱ_t. In the upper-left panel, the solid line with circles (y_t) is located uniformly above the dashed line (y_t^R), especially several quarters after the announcement of a fiscal stimulus in period 0. That is, government purchases with an implementation lag of one year raise output relative to the reference level.

To obtain the intuition behind the positive effect on output, define the *relative* consumption Euler equation as

$$\tilde{c}_t = \tilde{c}_{t+1} - \left(\tilde{r}_t - \tilde{\pi}_{t+1}\right), \tag{7}$$

where the variable with a tilde denotes the variable relative to the reference level (i.e., $\tilde{c}_t = c_t - c_t^R$, $\tilde{r}_t = r_t - r_t^R$, and $\tilde{\pi}_t = \pi_t - \pi_t^R$). Equation (7) compares two consumption Euler equations by taking the difference from the reference level. The preference shock ϱ_t disappears in (7) because ϱ_t is common to the two consumption Euler equations and thus, they cancel each other out.

Government purchases with $h = 4$ increase inflation without affecting the nominal interest rate because the economy is caught in a liquidity trap (see the solid line with circles for $0 \leq t \leq 7$ in the lower-left panel). Higher (anticipated) inflation caused by the implementation of the fiscal stimulus then lowers the real interest rate relative to the reference level, as shown in the lower-right panel of Figure 3. This low relative real interest rate, in turn, stimulates relative consumption in the same period (see the upper-right panel in period $t = h$). Put differently, government purchases increase relative consumption because of the crowding-in effect of government purchases. In terms of (7), g_h leads to $\tilde{c}_h > 0$ through a lower real interest rate $\tilde{r}_h - \tilde{\pi}_{h+1} < 0$. This crowding-in effect is well known in the literature (Woodford (2011) and Christiano, Eichenbaum, and Rebelo (2011)).

The consumption-smoothing motive makes implementation lags desirable. In period 0, households realize that government purchases with an h-period implementation lag crowd in their consumption in period h through the low real interest rate. The h-period implementation lags provide forward-looking households with opportunities to smooth out their consumption over the periods before h. This consumption smoothing leads to increases in $\tilde{c}_t$

over $0 \leq t \leq h-1$. As the implementation lag lengthens, households have more opportunities to increase consumption before the implementation of the fiscal stimulus. Thus, a long implementation lag strengthens the overall effect of the fiscal stimulus on output.

We next turn to the case where the fiscal stimulus is implemented after a liquidity trap ($h = 12$). In contrast to the case of $h = 4$, government purchases decrease relative consumption because of the crowding-out effect of government purchases. Higher (anticipated) inflation caused by the implementation of the fiscal stimulus ($g_{12} > 0$) raises the real interest rate relative to the reference level, as the ELB is no longer binding in period $t = h = 12$. From (7), this high relative real interest rate ($\tilde{r}_h - \tilde{\pi}_{h+1} > 0$) implies low relative consumption in the same period ($\tilde{c}_h < 0$).

When the fiscal stimulus is implemented after a liquidity trap, the implementation lag is no longer desirable. Not surprisingly, the intuition in experiment I is applicable to this result because of the crowding-out effect on consumption. Because of the consumption-smoothing motive, relative consumption decreases from the time of the announcement ($t = 0$). As the implementation lag lengthens, households have more opportunities to decrease relative consumption before the implementation of the fiscal stimulus. As a result, φ_h tends to decline with the implementation lag. Moreover, more frequent declines in relative consumption make φ_h become increasingly negative.

Before closing this section, three remarks are in order. First, the mechanism behind the desirability of implementation lags is similar to that behind forward guidance on monetary policy. In the case of monetary policy's forward guidance, the central bank can lower future real interest rates by decreasing nominal interest rates after the ELB does not become binding. Thus, forward guidance in monetary policy becomes effective by announcing that the accommodative policy will be implemented after the economy has recovered. Conversely, in the case of fiscal policy's forward guidance, fiscal authorities can lower future real interest rates by increasing inflation when the ELB is binding. As a result, forward guidance in fiscal policy becomes effective by announcing that the fiscal stimulus will be implemented before the economy recovers. In other words, fiscal policy's forward guidance can enhance the efficacy of fiscal policy, but needs to be implemented in a timely manner.

Second, our result is related to the finding of Farhi and Werning (2016). They analytically demonstrate that longer duration of fiscal stimulus always leads to a stronger crowding-in effect on consumption.[7] Their finding suggests that a long implementation lag always enhances the efficacy of fiscal policy, which appears inconsistent with our finding. This difference comes from the fact that they assume constant nominal interest rates to represent a liquidity trap. Thus, in Farhi and Werning (2016), the fiscal stimulus is always implemented during a liquidity trap and its efficacy always increases monotonically. In our model, we assume the endogenous nominal interest rate. The fiscal stimulus is not necessarily implemented during a liquidity trap (e.g., a large h) and its efficacy is hump-shaped.

Third, Christiano, Eichenbaum, and Rebelo (2011) argues against implementation lags, which again appears inconsistent with our finding. They emphasize that the fiscal multiplier drops substantially when government spending increases only after a liquidity trap. Their argument corresponds to our case for $h = 12$ in Figure 3. Both models have the same implication for fiscal policy in that the fiscal stimulus should be implemented in a timely manner. Namely, the fiscal authority should avoid very long implementation lags. However, our paper goes a step further than theirs: The fiscal authority may not need to avoid implementation lags if they are not too long.

3.4 Robustness

Our finding on the desirability of implementation lags is robust to a variety of changes in our model's assumptions and parameters.

Discounting in the consumption Euler equation and the Phillips curve The first robustness analysis replaces the consumption Euler equation (1) and the NKPC (2) with

[7] See their Proposition 1 in Farhi and Werning (2016, p. 2433).

those with discounting. The behavioral New Keynesian model of Gabaix (2020) introduces cognitive discounting in the consumption Euler equation and the NKPC. He argues that the forward guidance puzzle in monetary policy disappears because cognitive discounting weakens the forward-looking property of the consumption Euler equation and the NKPC.[8] Given that our finding arises from the mechanism of forward guidance, the discounting makes the forward guidance puzzle less pronounced and may reverse the desirability of implementation lags when the economy is in a liquidity trap. Based on Gabaix (2020), we replace (1) and (2) with $c_t = \bar{m}c_{t+1} - (r_t - \pi_{t+1} - \varrho_t)$ and $\pi_t = \kappa\{c_t + [(\alpha+\psi)/(1-\alpha)]y_t\} + \beta M^f \pi_{t+1}$, respectively. Here $\bar{m} = 0.85$ and $M^f = \bar{m}[\theta + (1-\theta)(1-\beta\theta)/(1-\beta\theta\bar{m})] = 0.80$ in the parameterization of Gabaix (2020).

Panel (a) of Figure 4 reports φ_h for experiment II under the model with discounting. The dashed line corresponds to the case where both the consumption Euler equation and the NKPC are "discounted" as in Gabaix (2020) (i.e., $\bar{m} = 0.85$ and $M^f = 0.80$). It indicates that φ_h remains hump-shaped, suggesting the desirability of implementation lags (e.g., $\varphi_4 = 2.36$, larger than $\varphi_0 = 1.19$). The dotted line plots φ_h when $\bar{m} = 0.85$ but $M^f = 1.0$. In this case, we intentionally isolate the effect of discounting in the consumption Euler equation on φ_h from the model. The dotted line shows that φ_h is again hump-shaped. The isolated effect of discounting in the consumption Euler equation is substantial because the dotted line roughly keeps track of the dashed line for the case of $\bar{m} < 0$ and $M^f < 1$.

[Figure 4 about here.]

Monetary policy rule Parameters in the monetary policy rule may influence our results because they directly affect aggregate demand through the nominal interest rate r_t in the consumption Euler equation (1). Panel (b) of Figure 4 indicates how φ_h for experiment II changes across three values of $\alpha_\pi = \{1.25, 1.50, 1.75\}$. In all cases, φ_h is hump-shaped

[8] See McKay, Nakamura, and Steinsson (2016) and Del Negro, Giannoni, and Patterson (2023) for the forward guidance puzzle. McKay, Nakamura, and Steinsson (2017) propose a simple (nonbehavioral) New Keynesian model in which discounting appears only in the consumption Euler equation.

against h.[9]

Monetary policy inertia may also affect our results. As argued by Hills and Nakata (2018), monetary policy inertia is consistent with the statement by the Federal Open Market Committee and could generate history dependence in r_t akin to that of the optimal commitment policy (Hills and Nakata, 2018, p. 157). Thus, we replace (3) with $r_t = \max(r_t^*, \ln\beta)$, where r_t^* is the shadow policy rate. We then consider two alternative specifications for r_t^*: (i) $r_t^* = \rho_r r_{t-1}^* + (1-\rho_r)\alpha_\pi \pi_t$; (ii) $r_t^* = \rho_r r_{t-1} + (1-\rho_r)\alpha_\pi \pi_t$. The former assumes that the shadow policy rate depends on its lagged value, and the latter assumes that it depends on the actual value. In both specifications, we borrow $\rho_r = 0.7$ from the posterior mean estimated by Gust et al. (2017).

Our results are robust when we introduce inertia into the monetary policy rule. Panel (c) of Figure 4 plots φ_h for two specifications (i) and (ii) along with φ_h for the benchmark case denoted as "no policy inertia." The dashed line represents φ_h in specification (i). It indicates that the desirability of implementation lags is weaker than the benchmark case shown in the solid line because φ_h is flatter over h than the benchmark case. In the dotted line corresponding to specification (ii), φ_h is more strongly hump-shaped than that in the benchmark case. While desirability differs between specifications (i) and (ii), φ_h remains hump-shaped at least under the plausible value of ρ_r.

Robustness to miscellaneous model parameters We conduct robustness analysis of miscellaneous model parameters. In particular, we implement robustness analysis for the persistence of government purchases (δ), the slope of the NKPC (κ), the inverse of the Frish elasticity of labor supply (ψ), the returns to labor in the production function ($1-\alpha$), and the steady-state government purchases to output ratio (γ). In all cases, we observe a hump

[9] Recall that the consumption smoothing motive with the crowding-out effect of fiscal stimulus generates a negative φ_h for a large h. As α_π becomes larger, the crowding-out effect is stronger because of the higher sensitivity of the nominal interest rate to inflation. For this reason, φ_h for a large h is the lowest under $\alpha_\pi = 1.75$.

shape of φ_h, confirming the desirability of implementation lags in a liquidity trap.[10]

Here, we report the robustness to δ in Panel (d) of Figure 4. Again, φ_h is hump-shaped, though the hump shape becomes weaker for larger δ. Interestingly, φ_h under $\delta = 0.8$ is largest among the three parameter values when h is low (e.g., $h = 0$), but it now becomes the lowest when h is large. Namely, φ_h is not monotonic in δ. This finding is consistent with Ngo (2021), who shows that the fiscal multiplier is not monotonic in the persistence of government purchases when the ELB is binding.

We can interpret the nonmonotonicity in δ from the perspective of implementation lags. When h is low (e.g., $h = 0$), increases in government purchases become negligible after a liquidity trap unless δ is extremely large. An increase in δ when h is low implies that fiscal stimulus implemented during a liquidity trap occurs persistently. Thus, the increase in δ enhances the overall effect of fiscal stimulus on output.

When h is high (e.g., $h = 8$), however, increases in government purchases are substantial even after a liquidity trap, regardless of the value of δ. This case corresponds to a fiscal stimulus implemented after a liquidity trap. An increase in δ when h is high means that a fiscal stimulus implemented after a liquidity trap occurs persistently. Therefore, a larger δ lowers the overall effect of fiscal stimulus on output.

Two-agent New Keynesian models It is well known that the standard New Keynesian model predicts the crowding-out effect of fiscal stimulus in normal times, but many previous empirical studies have argued that the prediction is inconsistent with the data.[11] It is not clear whether the same qualitative results are obtained even in models that can explain the crowding-in effect of fiscal stimulus in normal times. These studies also argue that real wages increase slowly in response to an increase in government purchases.

To address the external validity of the model, we conduct the same experiments in a two-

[10] The not-for-publication Appendix B reports the results of these robustness checks (except for δ, for which we discuss its robustness in the main text).

[11] Examples of these studies include: Blanchard and Perotti (2002), Perotti (2007), and Galí, López-Salido, and Vallés (2007), among others.

agent New Keynesian model with nominal wage rigidity.[12] This class of models can generate a crowding-in effect of fiscal stimulus because of the presence of the liquidity-constrained non-Ricardian households. As shown in the not-for-publication Appendix C, our finding is robust even in this model: In experiment I (i.e., fiscal stimulus in normal times), φ_h reaches its maximum value when $h = 0$, but, in experiment II (i.e., fiscal stimulus during a liquidity trap), φ_h is hump-shaped against h.

4 Conclusion

Since Friedman (1953), implementation lags have been a concern of policymakers because they may reduce the efficacy of fiscal policies. Even recent studies support the conventional view that the fiscal authority should avoid implementation lags. We showed that implementation lags could enhance the efficacy of fiscal stimulus on output when the ELB is binding. In this case, the efficacy exhibits a hump shape against the length of implementation lag, thereby suggesting that the desirability of implementation lags depends critically on whether the ELB is binding.

We are not arguing that the fiscal authority should control implementation lags. The literature often argues for the automatic built-in stabilizer or fiscal policy rules to avoid implementation lags.[13] Our analysis implies that attempts to shorten implementation lags may not necessarily maximize the efficacy of fiscal policy when the ELB is binding.

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[12] See the not-for-publication Appendix C for details of the model. The model is similar to those of Colciago (2011) and Ascari, Colciago, and Rossi (2017).

[13] See Blanchard, Dell'ariccia, and Mauro (2010), for example.

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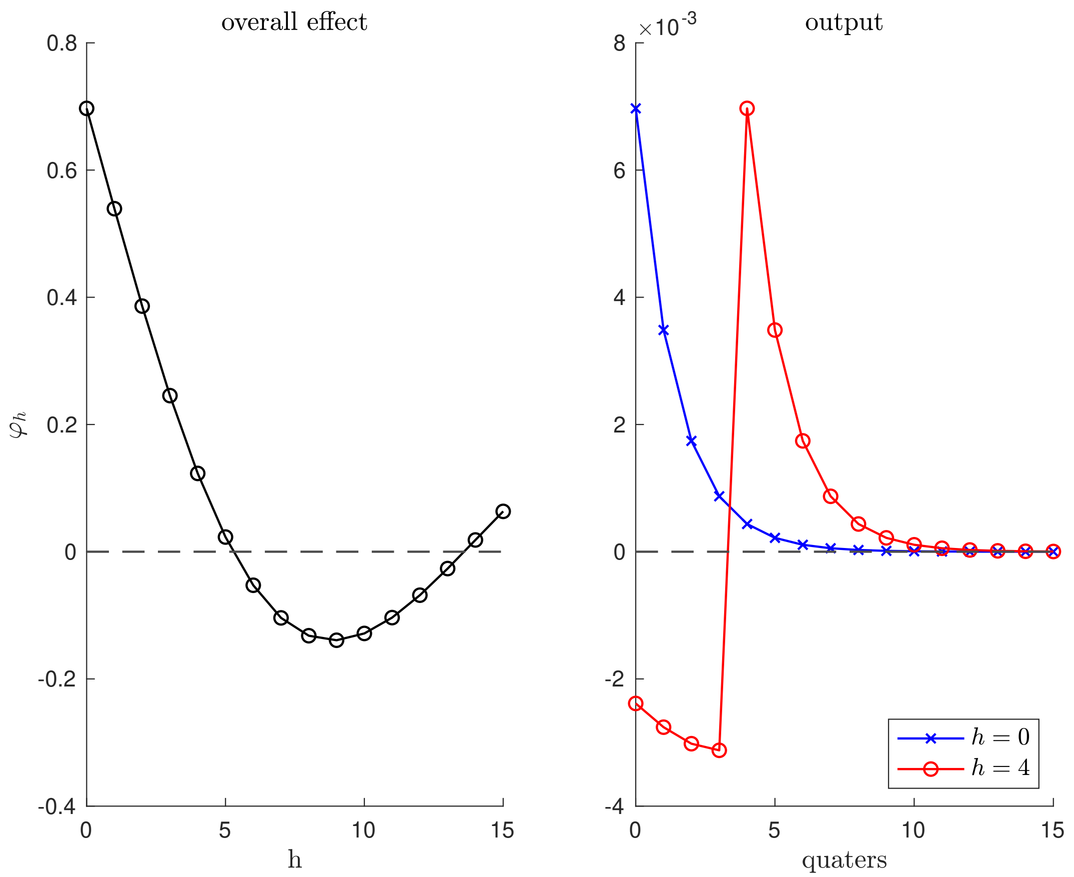

Figure 1: The effect of fiscal stimulus on output in normal times

Note: The left panel shows the overall effect of fiscal stimulus on output and the right panel shows the impulse response of output to a fiscal stimulus. A fiscal stimulus is represented by an increase in government purchases announced in period 0 and implemented in period h. The increase in government purchases is normalized to one percent of the steady-state output. At the time of announcement, the economy is in the steady state. The unit of time is one quarter.

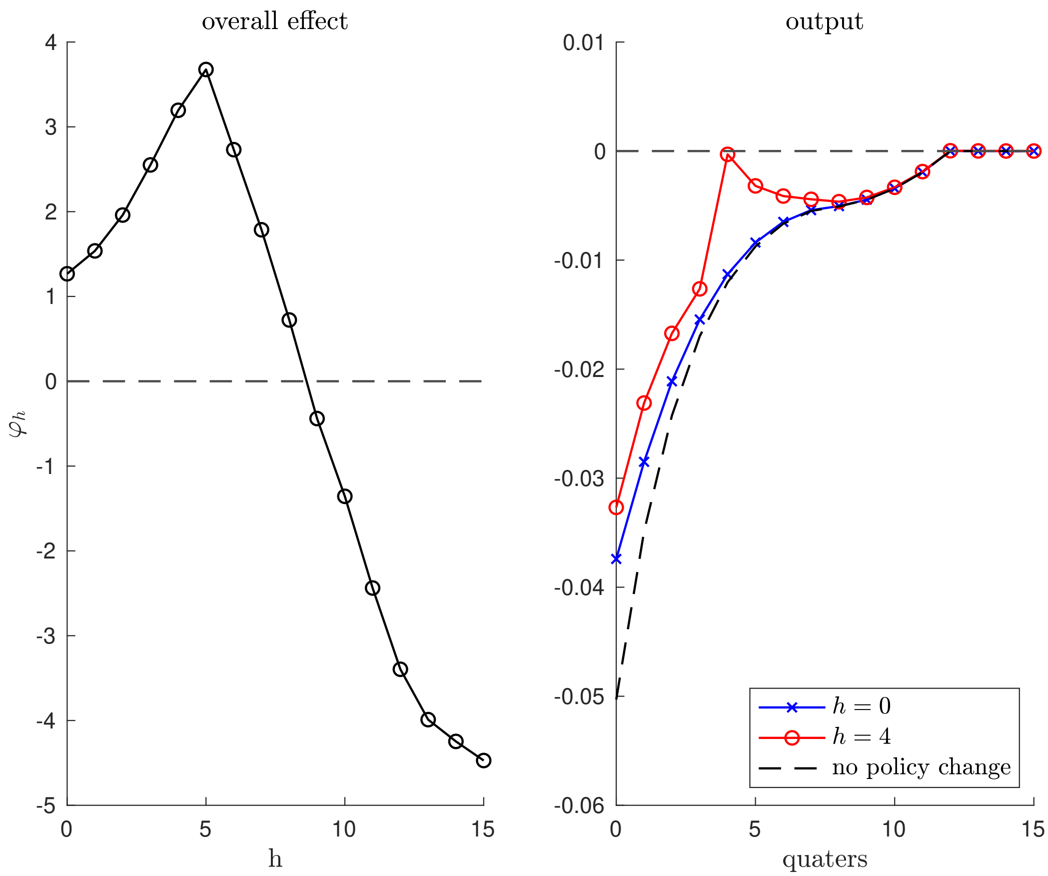

Figure 2: The effect of fiscal stimulus on output in a liquidity trap

Note: The left panel shows the overall effect of fiscal stimulus on output and the right panel shows the impulse response of output to a fiscal stimulus. At the time of announcement, the economy is caught in a liquidity trap. The dashed line in the right panel represents the equilibrium responses without government intervention (denoted by "no policy change"). For more details, see the footnote of Figure 1.

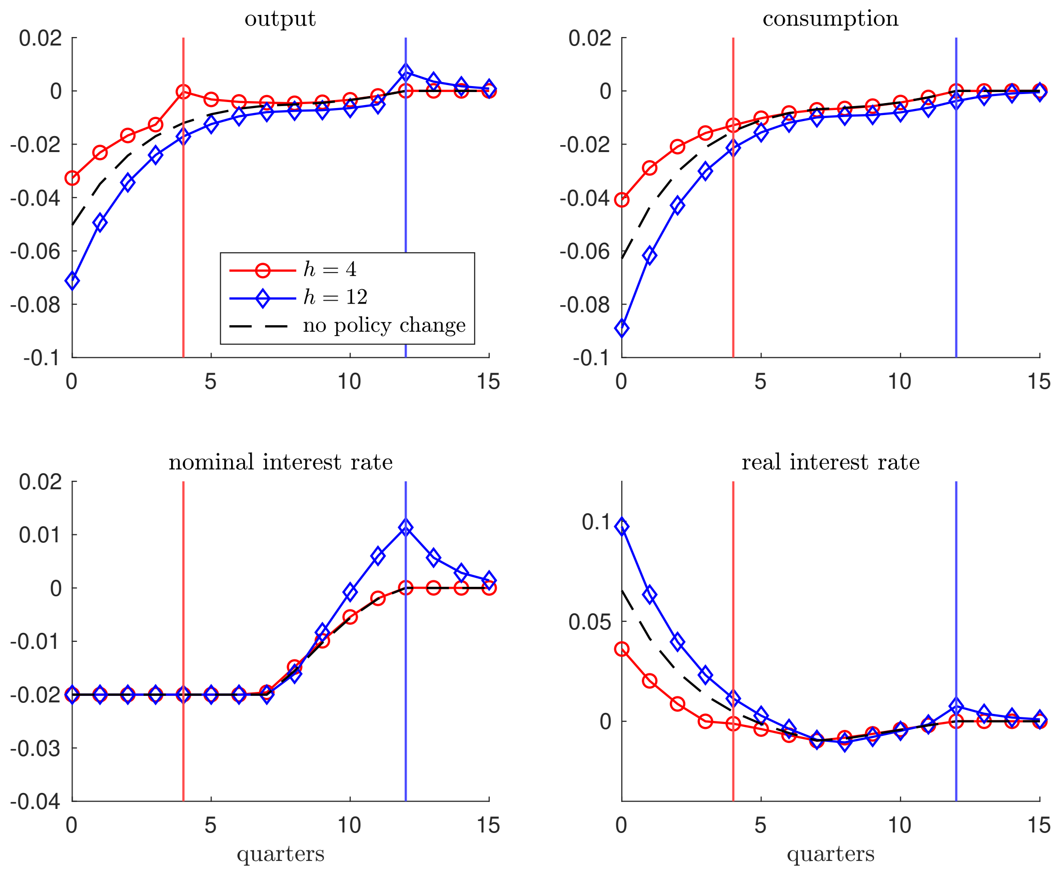

Figure 3: Responses of variables to changes in ϱ_t and g_t

Note: Each panel of the figure compares the model responses to ϱ_t and g_t for an implementation lag of between one and three years ($h = 4$ and $h = 12$), along with the reference level of the corresponding variables. The upper-left and upper-right panels refer to output and consumption, respectively. The lower-left and lower-right panels present the nominal interest rate and the real interest rate, respectively. The dashed line in each panel represents the equilibrium responses without government intervention (denoted by "no policy change"). The solid lines in each panel refer to the model response to decreases in the preference shock and increases in government purchases. The solid line with circles indicates model responses under $h = 4$, and the solid line with diamonds indicates model responses under $h = 12$. The horizontal axis is the quarters after the preference shocks. The vertical lines in each panel represent the timing of the implementation of the fiscal stimulus. In the figure, $\varphi_h = 3.19$ at $h = 4$ and $\varphi_h = -3.39$ at $h = 12$.

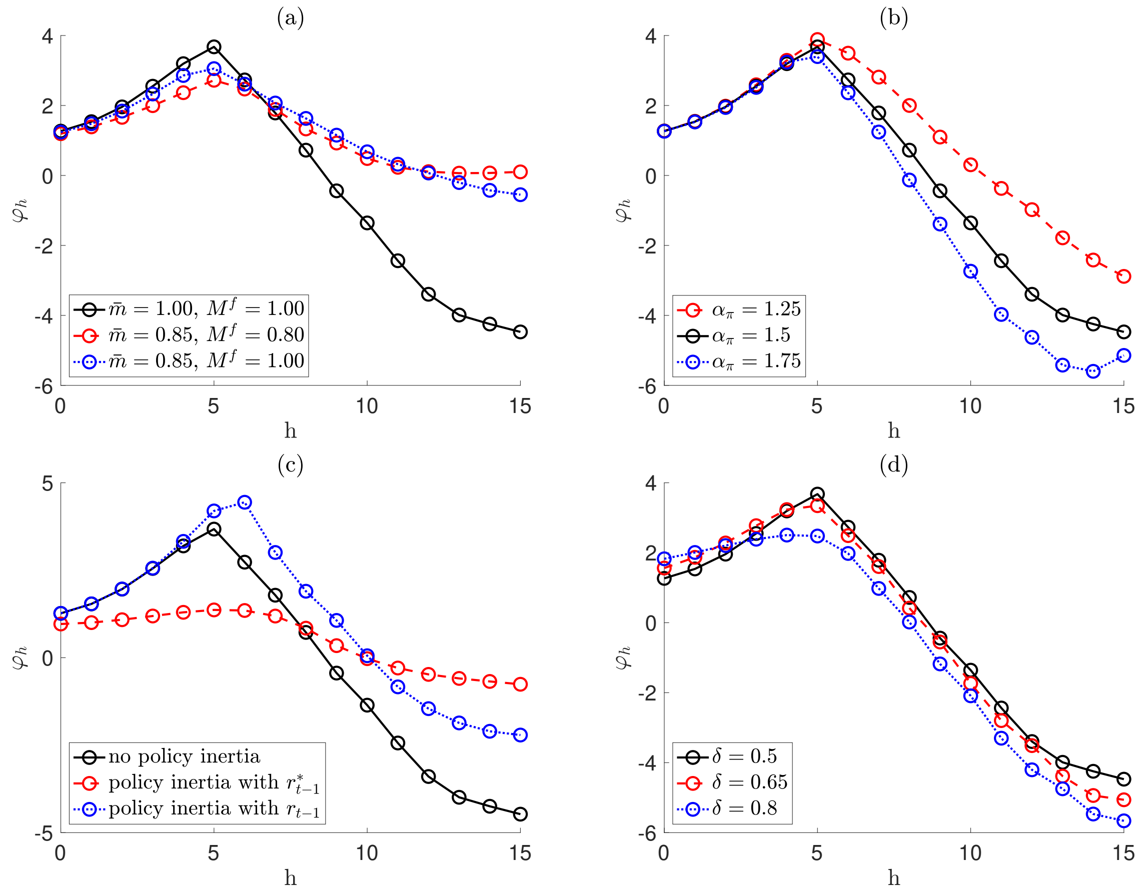

Figure 4: Robustness checks: Overall effect of fiscal stimulus on output in a liquidity trap

Note: Panel (a) plots φ_h against h under the model with discounting in the consumption Euler equation and the NKPC. Panel (b) compares φ_h across three values of α_π in the monetary policy. Panel (c) compares φ_h across three monetary policy rules under the ELB. The dashed line represents φ_h when the monetary policy rule depends on the lagged shadow policy rate. The dotted line shows φ_h when the monetary policy rule depends on the lagged actual policy rate. Panel (d) compares φ_h across three values of δ in government purchases. In all panels, the solid line corresponds to the benchmark case replicating φ_h shown in the left panel of Figure 2 for comparison.