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An Expansionary Effect of QE Not via the Signaling Channel

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Abstract

In recent years, central banks have engaged in massive purchases of long-term government bonds once their policy rate is stuck at zero. The standard view is that such a policy influences economic activities by sending the public a signal about the future path of nominal interest rates. I demonstrate that, with an appropriate institutional arrangement between the central bank and the fiscal authority in place, such a policy has an expansionary effect without the signaling channel. The arrangement consists of the two following ingredients. First, the fiscal authority commits to covering possible losses on the central bank's balance sheet. Second, the fiscal authority commits to a certain sequence of primary surpluses. In this setup, the consolidated government's budget must incur losses at a time of liftoff from the zero lower bound. This results in an increase in inflation via the mechanism highlighted by the fiscal theory of the price level.

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1. Introduction

In recent years, central banks in developed countries have faced low levels of economic activity and inflation rates. To stimulate the macroeconomy, they have set their policy interest rates to zero. In addition, after the short-term nominal interest rate reached zero lower bound (ZLB), they have engaged in quantitative easing (QE) that involves long-term government bond purchases by issuing excess reserves (e.g., the Federal Reserve's Large-Scale Asset Purchase Programs and the Bank of Japan's Quantitative and Qualitative Monetary Easing (QQE)).

However, the mechanism through which QE affects the macroeconomy when the ZLB binds remains unclear. Eggertsson and Woodford (2003) establish the well-known "neutrality proposition for open market operations" by extending the seminal work of Wallace (1981) to a New Keynesian model with the ZLB. They demonstrate that any changes in the size and composition of a central bank's balance sheet should have no macroeconomic effect unless they lead to changes in expectations about future policy conduct. Indeed, QE, which itself should have no effect, was introduced in the hope that it would lead to changes in expectations about the future conduct of monetary policy. A well-known possible channel through which QE may influence the economy at the ZLB is via a signal about the future path of nominal interest rates, reducing long-term interest rates (e.g., Woodford, 2012; Bernanke, 2020).

This note shows that when the ZLB binds, QE can increase output, even without any changes in expected future nominal interest rates. This possibility is worth exploring because the signaling channel might be unreliable. The management of expectations at the ZLB has presented a serious challenge for central banks. Whether the signaling channel operates well essentially depends on how the public interprets a central bank's future policy intentions. One example is the recent experience in Japan. The Bank of Japan has engaged in large-scale purchases of long-term government bonds since 2013, but Japanese inflation has been below its 2% target until 2021.[1]

To show this result, we focus on the fact that QE exposes the central bank to the risk of losses on its balance sheet due to an unexpected decline in the price of long-term bonds. Specifically, we make two key assumptions about the institutional arrangement between the fiscal authority and the central bank. The first assumption is that the fiscal authority commits to covering possible future losses on the central bank's balance sheet. Under this assumption, losses on the central bank's balance sheet directly translate into liabilities of the consolidated government. The second assumption is that fiscal-monetary policy is in a non-Ricardian regime, as in the fiscal theory of the price level, in which the fiscal authority pre-commits to a certain sequence of fiscal primary, and the central bank follows a simple interest-rate rule. Given these policy rules, under a non-Ricardian regime, endogenous variables must be determined so as to maintain government solvency.

The reason why under the above two assumptions, QE, which exposes the central bank to the risk of losses on its balance sheet, can affect the economy at the ZLB is as follows. Suppose that when the economy falls into the ZLB, the central bank engages in QE, exposing its balance sheet to the risk of losses. When the nominal interest rate is increased, the central bank incurs losses on its balance sheet, which expands total government liabilities. As the fiscal authority does not make fiscal adjustments, this leads to an increase in inflation so as to reduce the real value of government bonds. Thus, when the ZLB binds, QE leads the private sector to expect

[1] For example, Kuroda (2016) stated that "In order to overcome deflation that has lasted for 15 years and achieve the 2 percent price stability target, the Bank of Japan has conducted large-scale monetary easing by introducing '"Quantitative and Qualitative Monetary Easing (QQE)"' in April 2013 and '"QQE with a Negative Interest Rate"' in January 2016. […] On the price front, a measure of underlying inflation -- the year-on-year rate of change in the consumer price index (CPI) for all items less fresh food and energy -- has remained positive for almost three years. Japan's economy is no longer in deflation, which is commonly defined as a sustained decline in prices. However, the price stability target of 2 percent has not been achieved."

higher future inflation, which reduces the real interest rate and increases output.

Our study contributes to the literature on monetary policy at the ZLB following the seminal work of Eggertsson and Woodford (2003). They show that even when the nominal interest rate is stuck at the ZLB, the central bank can mitigate current deflation and a recession by committing to keeping the nominal interest rate at zero for a while, even after the economy recovers in the future. However, as well-known, this optimal policy at the ZLB involves a time-inconsistent commitment to the future conduct of monetary policy.[2] While this type of forward guidance is regarded as an effective policy tool at the ZLB, there are no clear solutions to this time-inconsistency problem. Our result implies that when the economy falls into the ZLB again in a next recession, the central banks can influence the macroeconomy without struggling to communicate their future policy intentions to the public. In light of the current fiscal situation in developed countries, QE can be an effective tool for central banks during a next deep recession. Central banks must make appropriate agreements with their fiscal authorities regarding possible future losses before QE.

This paper is also related to the recent studies that consider effects of QE from the perspective of fiscal and monetary policy interactions. Bhattarai et al. (2022) and Berriel and Mendes (2015) show that QE can prevent deflation and a recession when the ZLB binds because it serves as a commitment device that mitigates the time-inconsistency problem of forward guidance. Most closely related to our work is Benigno and Nisticò (2020). They show that, in a non-Ricardian regime, QE at the ZLB changes the optimal conduct of monetary policy after the ZLB no longer binds and thus influences the current state of the economy. The contribution of our work is to show that QE can influence the macroeconomy when the ZLB binds even without the signaling channel. The effectiveness of the purchases of long-term bonds in our model is not brought about by a change in expected future nominal interest rates.

Before closing this section, a remark is in order. Some readers may consider that the assumption that the fiscal authority covers losses on the central bank's balance sheet is not necessarily realistic. However, we believe that the financial arrangement between the two authorities considered in this study is relevant for policies in the real world, at least when focusing on a situation in which a central bank introduces QE to mitigate a severe recession owing to an economic crisis. For example, in November 2012, Her Majesty's Treasury explicitly agreed to cover possible losses on the Bank of England's balance sheet resulting from the Asset Purchase Facility (see, e.g., McLaren and Smith, 2013). This case is not unique. Although the Japanese government and the Bank of Japan have not made a clear agreement on how to share possible losses on the Bank of Japan's balance sheet after exiting the QQE, it is not unnecessarily realistic to assume that the government will provide financial supports for the Bank of Japan that incurs losses on its balance sheet in some ways. For example, at the Monetary Policy Meeting held in April 2013, at which the Bank of Japan formally decided to introduce the QEE, a policy board member commented that "it might be worthwhile to examine the feasibility of an arrangement in which the Bank's losses would be covered by the government."[3] Even in the United States, the government must exempt the Federal Reserve from making remittances when it incurs losses on its balance sheet. More specifically, by law, when the Federal Reserve incurrs losses on its balance sheet, it can make zero remittances and record deferred assets as negative liabilities on its balance sheet that can be repaid by future profits.

The remainder of this paper is organized as follows. Section 2 presents the model. Section

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[2] Indeed, central bankers regard this time-inconsistency as a relevant concern when considering the effectiveness of forward guidance in reality (see, e.g., Williams, 2012; Bullard, 2013).

[3] Bank of Japan (2013), "Minutes of the Monetary Policy Meeting on April 3 and 4, 2013" https://www.boj.or.jp/en/mopo/mpmsche_minu/minu_2013/g130404.pd

3 presents a numerical example of how QE affects the macroeconomy at the ZLB. Finally, Section 4 concludes.

2. Model

We consider an infinite-horizontal model with sticky prices along the lines of Leeper and Zhou (2021). The economy starts in period 0, and is populated by a representative household, a continuum of firms in the unit interval, the fiscal authority, and the central bank. The household consumes and supplies labor, as in the standard new Keynesian model. Differently from the standard New Keynesian model, for simplicity, we assume that prices become flexible from some period onward; from period 0 to $t_f - 1$, firms face adjustment costs in changing their prices so that prices are rigid, where $t_f \geq 2$, and from period t_F onward, firms can change their prices at no costs so that prices are flexible. The fiscal authority issues one-period and long-term bonds. The fiscal authority pre-commits to a certain path of primary surpluses in period 0. In addition, the fiscal authority commits to covering possible losses on the central bank's balance sheet so that the balance sheets of the two authorities are consolidated. The central bank controls the nominal interest rate following a simple interest-rate rule.

2.1 Households

The representative household has the following utility function:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t [\log(C_t) - N_t]\xi_t \tag{1}$$

where C_t is an aggregate of consumption, N_t is labor supplied, ξ_t is a demand shock, $\mathbb{E}_0$ is the conditional expectation operator, and $\beta \in (0,1)$ is the discount factor.

The aggregate consumption C_t is defined as $C_t \equiv \left[\int_0^1 c_t(j)^{\frac{\theta-1}{\theta}} dj\right]^{\frac{\theta}{\theta-1}}$, where $c_t(j)$ denotes the quantity of goods $j \in [0,1]$ consumed by the household and $\theta > 1$ parameterizes the elasticity of substitution across goods. The aggregate price index is defined as $P_t \equiv \left[\int_0^1 p_t(j)^{1-\theta} dj\right]^{\frac{1}{1-\theta}}$, where $p_t(j)$ is the price of goods j.

The household earns labor income $N_t W_t$, where W_t is the nominal wage, receives profits $Z_t(j)$ from firm j, and pays lump-sum taxes T_t to the fiscal authority. The budget constraint of the household is given by

$$P_t C_t + \frac{B_t}{1+i_t} + Q_t D_t \leq B_{t-1} + (1+\rho Q_t) D_{t-1} + W_t N_t + \int_0^1 Z_t(i) di - P_t T_t, \tag{2}$$

where B_t is a one-period government bond, i_t is the short-term nominal interest rate, D_t is a long-term bond portfolio with price Q_t. Long-term bonds are assumed to be perpetuities. Specifically, a bond issued in period t pays ρ^j in nominal terms at time $t+j+1$, as in Woodford (2001), for $j \geq 1$ and $\rho \in [0,1]$. The duration of this bond is $(1-\beta\rho)^{-1}$.

The household maximizes its expected utility (1) subject to the budget constraints (2), which yields the following first-order conditions:

$$\frac{1}{1+i_t} = \beta \mathbb{E}_t \left[\frac{C_t}{C_{t+1}} \Pi_{t+1}^{-1} \frac{\xi_{t+1}}{\xi_t}\right], \tag{3}$$

$$\frac{W_t}{P_t} = C_t \tag{4}$$

$$Q_t = \mathbb{E}_t \frac{1}{1+i_t}(1+\rho Q_t), \tag{5}$$

where $\Pi_t \equiv P_t / P_{t-1}$ denotes the gross inflation rate.

2.2 Firms

There is a continuum of monopolistically competitive firms indexed by $j \in [0,1]$. Firm j produces goods using the production technology:

$$y_t(j) = n_t(j), \tag{6}$$

where $n_t(j)$ is the labor hired. Firm j faces a downward-sloping demand curve given by $y_t(j) = (p_t(j)/P_t)^{-\theta} Y_t$, where $Y_t \equiv \left[\int_0^1 y_t(j)^{\frac{\theta-1}{\theta}} dj\right]^{\frac{\theta}{\theta-1}}$ denotes aggregate output.

From period 0 to $t_F - 1$, firms face adjustment costs in changing their prices. Following Rotemberg (1982), firm j is assumed to face price adjustment costs:

$$\frac{\gamma}{2}\left(\frac{p_t(j)}{p_{t-1}(j)} - 1\right)^2 Y_t \text{ for } t = 0,\ 1, \dots,\ t_F - 1. \tag{7}$$

The profits of firm j from period 0 to t_F are expressed as

$$Z_t(j) = \left[(1+\tau)p_t(j)y_t(j) - W_t y_t(j) - P_t \frac{\gamma}{2}\left(\frac{p_t(j)}{p_{t-1}(j)} - 1\right)^2 Y_t\right] \tag{8}$$
$$\text{for } t = 0,\ 1, \dots,\ t_F - 1,$$

where $\tau \equiv (\theta - 1)^{-1}$ is a production subsidy which offsets distortion from monopolistic competition. As from period t_F onward, there are no price adjustment costs, profits can be expressed as

$$\max_{p_t(j)} \left[Z_t(j) + \beta\left(\frac{C_t}{C_{t+1}}\Pi_t^{-1}\frac{\xi_{t+1}}{\xi_t}\right) Z_{t+1}(j)\right] \quad \text{for} \quad t = 0,1,\cdots,t_F - 2. \tag{9}$$

Firm j sets its price at each time $p_t(j)$ by solving the following problems:

$$\max_{p_t(j)} Z_t(j) \quad \text{for} \quad t \geq t_F - 1. \tag{10}$$

Deriving the first-order conditions for $p_t(j)$ and focusing on a symmetric equilibrium in which $p_t(j) = P_t$, the following conditions are obtained:

$$\gamma\Pi_t(\Pi_t - 1) = \theta(C_t - 1) + \beta\gamma\mathbb{E}_t\left[\frac{\xi_{t+1}}{\xi_t}\frac{C_t}{C_{t+1}}\frac{Y_{t+1}}{Y_t}\Pi_{t+1}(\Pi_{t+1} - 1)\right], \tag{11}$$
$$\text{for } t = 0,1,\cdots,t_F - 2,$$

$$\gamma\Pi_{t_F-1}\left(\Pi_{t_F-1} - 1\right) = \theta\left(C_{t_F-1} - 1\right), \tag{12}$$

$$C_t = 1 \quad \text{for} \quad t \geq t_F \tag{13}$$

2.3 Market clearing

Clearing in the goods market implies that

$$\gamma\left[1 - \frac{\gamma}{2}(\Pi_t - 1)^2\right] Y_t = C_t \text{for } t = 0,1,\cdots,t_F - 1, \tag{14}$$

$$Y_t = C_t \ \text{ for } \ t \geq t_F, \tag{15}$$

2.4 Government

The fiscal authority imposes lump-sum taxes on the household and pays the production subsidy to firms. The real primary surplus is given by

$$S_t = T_t - \tau Y_t \tag{16}$$

For simplicity, we abstract from government consumption.

We assume that in period 0, the fiscal authority pre-commits to a certain sequence of primary surpluses as follows:

$$S_t = \bar{S} > 0 \quad \text{for } \ t \geq 0. \tag{17}$$

The central bank also controls the nominal interest rate according to the following rule with no regard for government solvency

$$i_t = \max(0, r_t^n). \tag{18}$$

where $r_t^n \equiv (\beta \mathbb{E}_t \xi_{t+1})^{-1} \xi_t - 1$ is the natural interest rate.[4] The central bank tracks the natural interest rate as long as it is positive, and sets the short-term nominal interest rate to zero when the natural interest rate is negative. For simplicity, the inflation target is assumed to be zero.

Assuming that the one-period bond is in zero net supply, the flow budget constraint of the consolidated government in the real term is given by

$$(1 + \rho Q_t) \frac{d_{t-1}}{\Pi_t} = Q_t d_t + \bar{S}. \tag{19}$$

Iterating this forward and imposing a transversality condition gives the solvency condition of the consolidated government:

$$(1 + \rho Q_t) \frac{d_{t-1}}{\Pi_t} = \mathbb{E}_t \sum_{\tau=t}^{\infty} R_{t,\tau} \bar{S} \tag{20}$$

where $R_{t,\tau} \equiv \beta^{\tau-t}[(\xi_\tau C_t)/(\xi_t C_\tau)]$ is the stochastic discount factor. Because the nominal bond price Q_t, depends on the expected future path of nominal interest rates, the solvency condition of the government can be rewritten as[5]

$$\left[1 + \sum_{\tau=t}^{\infty} \frac{\rho^\tau}{\prod_{k=0}^{\tau}(1 + i_{t+k})}\right] \frac{d_{t-1}}{\Pi_t} = \mathbb{E}_t \sum_{\tau=t}^{\infty} R_{t,\tau} \bar{S} \tag{21}$$

Note that to determine the equilibrium price level using the solvency condition of the consolidated government (21), the present discounted value of primary surpluses, the right-hand side on the condition (21), should be positive. As emphasized by Cochrane (2023), this assumption is not unnecessarily realistic when focusing on the United States. After World War II, although surplus has been negative owing to interest payments on government bonds for almost all years, the United States has run small primary surpluses on a regular basis.[6]

3. Numerical Analysis

3.1 Assumptions

This section presents a numerical example of how QE influences the macroeconomy at the ZLB. Following Eggertsson and Woodford (2003), the ZLB becomes temporarily binding due to an exogenous negative shock to the natural interest rate r_t^n. It follows a two-state Markov process with an absorbing state: when $r_t^n = \beta^{-1} - 1$, the natural interest rate is positive and when $r_t^n = r_{ZLB}$, it takes a negative value, $r_{ZLB} < 0$. We assume that in period 0, a negative shock initially hits the economy.

The central bank, which follows the simple interest-rate rule (18), sets the nominal interest rate zero in period 0 and raises it as soon as the natural interest rate returns to positive territory. In the numerical analysis below, we focus on a scenario in which the nominal interest rate is increased in period $t_E \geq 3$.

When a shock to the natural interest rate hits the economy, the central bank also conducts QE. To consider its macroeconomic effects, following Bhattarai et al. (2022), we perform comparative statics to examine how a reduction in ρ affects the response of the macroeconomy to a shock. This analysis is motivated by the fact that central bank purchases

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[4] To guarantee the uniqueness of the equilibrium, we assume that the central bank controls the nominal interest rate following a passive policy rule in the terminology of Leeper (1991). Further, we consider the simplest case in which the central bank does not completely react to inflation.

[5] See Leeper and Zhou (2021) for the derivation of this condition.

[6] This is not the case in Japan, which has stably run primary deficits since the 1960s. To reconcile the fiscal theory of the price level with this experience of Japan, Brunnermeier et al. (2020) incorporate government bonds bubbles into the solvency condition of the consolidated government. It would be interesting to extend their model to investigate a relationship between QE and bubbles. We leave this for future research.

of long-term bonds by issuing reserves shorten the maturity structure of the total government liabilities held by the public. More specifically, we compare the following two cases: (i) the duration of long-term bonds is ten years ($\rho \approx 0.984$) and (ii) the duration of long-term bonds is five years ($\rho \approx 0.959$).

The remaining parameterization for the numerical analysis is as follows. We take the model's frequency to be quarterly and adopt $\beta = 0.99$. we choose $\theta = 10$ and $\gamma = 100$, implying that the slope of the Phillips curve from period 0 to t_F, which is given by θ/γ, is equal to 0.1. It is assumed that the natural interest rate when the economy falls into the ZLB, $r_{ZLB} = -0.04$, and the probability that the economy remains at the ZLB, $\mu = 0.85$. The steady-state debt level is set to 2.4 (debt equal to 60 percent of a year's GDP). We choose $t_E = 2$ and $t_F = 3$ for illustrative purposes.

3.2 Result

Figure 1 shows the response of output and inflation to a negative shock to the natural interest rate. In period 0, a negative shock hits the economy. We consider the three values of ρ are considered. A lower value of ρ means that the central bank engages in more massive purchases of long-term bonds.

The figure indicates that more massive operations increase output during the periods of the ZLB. A more massive operation expands total government liabilities at a time of liftoff from the ZLB. This weakens public confidence in government liabilities, as the fiscal authority does not adjust primary surpluses, increasing the demand for goods. This results in higher inflation at the time of liftoff from the ZLB. When the private sector expects higher future inflation when the ZLB binds, it mitigates a recession owing to the negative shock to the natural interest rate.

Note that the expansionary effect of QE is because of price stickiness and is thus temporary. During the periods of price stickiness, to satisfy the government solvency condition (21), not only inflation but also consumption should adjust. This is why QE affects real activity in our model. Indeed, when prices become flexible in period 3, output jumps to the steady-state value 1.

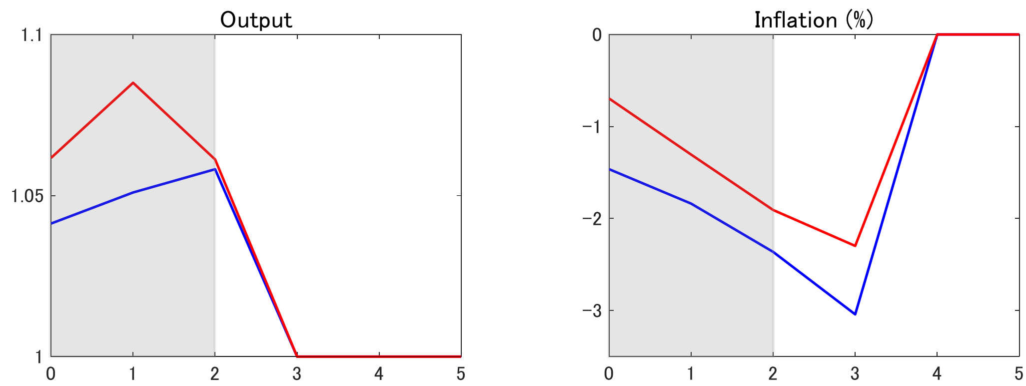

Figure 1. Responses of output and inflation to a negative shock to the natural interest rate. Blue lines: the duration is 10 years. Red lines: the duration is 5 years.

4 Conclusion

The paper showed that QE can increase output at the ZLB, even without any changes in expectations about the future path of short-term nominal interest rates. We considered a model in which the fiscal authority commits to a certain sequence of primary surpluses, and the central bank commits to tracking the natural interest rate. In this setup, QE at the ZLB leads to an expansion in nominal government liabilities in the future, which increases expected inflation today. Commitment by the fiscal authority to covering possible future losses on the central bank's balance sheet plays a central role.

While the literature on optimal monetary policy at the ZLB emphasizes the importance of commitment, the management of expectations at the ZLB has been a serious challenge for central banks. The results imply that, in light of the current fiscal situations in developed countries, QE can be an effective alternative tool by which central banks can influence the macroeconomy during a next deep recession. Central banks make an appropriate agreement with their fiscal authorities regarding possible future losses before introducing QE.

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