

Money-Financed Fiscal Programs: A Cautionary Tale*

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Abstract

Some economists have argued that money-financed fiscal programs, sometimes called “helicopter money,” may be desirable in economies facing persistent economic weakness and low inflation. We use a DSGE model to show that such programs could in principle provide significant stimulus (as in Gali 2020). However, we also show that these programs imply a radical shift in the central bank’s reaction function, and that the near-term stimulus to output and inflation may be fairly small in the realistic case in which the public does not initially regard the policy shift as credible, expectations are not very forward looking, and monetary policy is constrained by the effective lower bound. We argue that monetary-fiscal cooperation that involves a less dramatic shift in monetary policy – but more fiscal expansion – is likely to be more effective under these circumstances because it would be more credible. Fiscal expansion makes monetary policy more potent by boosting the equilibrium real interest rate path and giving monetary policy more room to lower near-term yields, and monetary policy makes fiscal policy more potent by keeping interest rates low and so limiting crowding out. We conclude by discussing a number of historical examples of monetary-fiscal cooperation in light of our model.

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1. Introduction

A number of economists and policymakers (e.g., Buiter, 2014; Turner, 2015; and Bartsch et al, 2019) have suggested that in a sufficiently challenging economic situation, money-financed fiscal programs – sometimes referred to as “helicopter money” – could be used to provide stimulus beyond what can be accomplished with standard monetary policy alone. Such programs involve an increase in government spending or a reduction in taxation, with the fiscal policy financed by money creation by the central bank.¹ This possibility has garnered additional attention as the coronavirus pandemic has caused massive economic dislocations that have required historic monetary and fiscal policy responses. It is argued that these policies could be effective in stimulating economies where inflation is persistently very low (or negative) and output that is far below potential, even if monetary policy is constrained by the effective lower bound on interest rates and fiscal policy is constrained by high levels of government debt.²

Our paper uses a New Keynesian model to examine the possible effects of money-financed fiscal programs and coordinated monetary and fiscal policies more broadly. We begin by considering a “textbook” money-financed fiscal program that involves an increase in government spending funded by an equal-sized permanent expansion in the stock of currency.³ A critical feature of such a program is that the central bank commits not to reverse the increase in currency in the future through monetary policy actions, so that the fiscal expansion is financed entirely by seigniorage. In our benchmark model, in which agents fully understand this commitment and regard it as credible, a money-financed program is a powerful tool for boosting output and inflation. The government

¹ The term “money-financed fiscal program” is from Bernanke (2016). While these programs are sometimes referred to as “helicopter drops” of money, we think it is useful to bear in mind that the policies involve a mix of traditional fiscal and monetary policy actions. For recent discussion of such programs, see Turner (2015), Buiter (2014), and Gali (2020a). For a critical perspective, see Borio et al (2016) and Cecchetti and Schoenholtz (2016). See Friedman (1969) for the original discussion of “helicopter money.”

² The titles of some of these contributions suggest the nature of the discussion: “Helicopter money: The time is now” (Gali, 2020b), “Funding pandemic relief: Monetise now” (Gurkaynak and Lucas, 2020). For a differing view, see Blanchard and Pisani-Ferry (2020).

³ Since we assume that the central bank can pay interest on reserves, currency is the only non-interest-bearing liability of the central bank.

spending multiplier is around 10 *even outside of a liquidity trap*, so that only a small fiscal expansion is required to push a weak economy out of recession and boost inflation to the central bank's target, while also achieving a sizable reduction in the government debt-to-GDP ratio. Moreover, because higher expected inflation tends to raise the policy rate, the effective lower bound is not a constraint on implementation. These results are closely aligned with those reported by Gali (2020a), which are derived in a similar framework.

What accounts for these powerful expansionary effects? To answer this question, it is helpful to express the monetary policy rule – which links growth in the money supply (which consists entirely of currency in our model) to fiscal spending – as a reaction function in terms of the policy rate. We show that the reaction function under a money-financed program can be interpreted as a form of flexible price level targeting in which the central bank's policy rate responds to real activity (consumption in our model), as well as to the gap between the price level and its target level. The key new feature is that the targeted price level path shifts upward in response to the rise in government spending, with the magnitude of the shift depending on the size and persistence of the government spending hike. Most of the substantial output stimulus from the money-financed program in the baseline model arises from this upward shift in the price level target path, as agents immediately grasp that boosting the price level to its new target will require the central bank to keep real interest rates persistently low.⁴ The associated rise in nominal currency demand, in turn, generates enough seigniorage to finance the fiscal expansion. Conversely, under a constant price level target (but still assuming flexible price level targeting), the fiscal expansion would be debt-financed and imply a peak multiplier of less than unity, so that a large fiscal expansion would be required to blunt the effects of a recession.

⁴ The long-run effects on the price level are determined by the familiar relationship linking real seigniorage revenue to currency growth scaled by the ratio of currency to GDP (see Fischer, 1982). Because currency is a small share of GDP, a fiscal expansion causes a large rise in the price level. While this implication is likely to be robust, we find that the contour of the inflation response – as well as of those of output and debt – depend on the particular features of model.

Because a money-financed program involves a dramatic shift in the central bank’s reaction function, achieving near-term output stimulus from such a program is contingent on the public rapidly understanding the new strategy and regarding it as credible. However, it seems likely that it would be difficult in practice to communicate the new strategy to the public because the resulting period of high inflation would likely be seen as at variance with the objective of low and stable inflation shared by almost all central banks. Moreover, because raising revenue through seigniorage depends on the base of the inflation tax, the magnitude of the effects on inflation would depend the specific features of the currency demand function, and thus be hard to predict.

Given these considerations, our sense is that it would be difficult in most circumstances for a central bank to convince the public that it was changing its reaction function in such a substantial way. While a central bank could initially finance the acquisition of government debt by printing money and even promise to hold new debt in perpetuity, the public would likely view the monetary expansion as transient, and expect that the central bank would soon revert to its usual reaction function. In practice, this reversion could be achieved by the central bank eventually paying interest on reserves.⁵ The economic effects in this case would be similar to those under debt-financed fiscal stimulus.⁶

Based on these considerations, we modify our model to allow for the possibility that agents only gradually come to believe that there has been a shift in the central bank’s reaction function following the announcement of a money-financed fiscal program. Specifically, we adopt a Kalman filtering framework in which agents are uncertain whether the increases in the money supply associated with an announced money financed program are temporary – and thus will be reversed – or reflect permanent increases in money, as called for by the program. We show that if the learning process

⁵ Ireland (2014) shows that with the payment of interest on reserves, the central bank can choose the level of reserve balances essentially independently of its monetary policy stance.

⁶ Some authors (e.g., Cecchetti and Schoenholtz, 2016; and Borio et al, 2016) have interpreted a money-financed program more narrowly along these lines.

is gradual, the boost to output and inflation may be small or negligible in the near-term, and only become substantial at longer horizons. Thus, a money-financed program may be much less effective in providing near-term stimulus in a recession than implied by the baseline model. In a similar vein, we also consider an augmented model in which inflation and aggregate demand are much less forward-looking than in the baseline model, in the spirit of the recent literature on the forward guidance puzzle (McKay, Nakamura, and Steinsson, 2014; Gertler, 2017; Gabaix, 2020). As in our model with learning, the near-term stimulus to output and inflation from a money-financed program in this case is much smaller than in the baseline, especially if the effective lower bound is binding.

Our simulations – which take account of limited credibility and limited forward-looking behavior – underscore that a key practical shortcoming of money-financed programs is that they would likely require a high degree of monetary policy accommodation to operationalize. This seems particularly consequential in the current environment in which many central banks are constrained by the effective lower bound well out the maturity spectrum.

Accordingly, we see money-financed programs as placing too much reliance on monetary policy to deliver stimulus, and argue instead in favor of monetary and fiscal cooperation that puts more emphasis on fiscal policy as a crucial ingredient in the policy mix. In particular, we show how a strategy combining a modest shift in the monetary policy reaction function in concert with substantial fiscal stimulus can be more effective than either policy alone in boosting output and inflation in a deep liquidity trap. Concretely, the shift in the central bank reaction function might call for the price level to rise several percent above baseline, or for inflation to run modestly above target for some time. While the shift in the monetary reaction function may of itself provide little stimulus because of the constraint caused by the effective lower bound (ELB) on the policy rate, fiscal spending boosts the equilibrium real interest rate path, allowing the change in the monetary

policy reaction function to be visible and effective somewhat sooner. And the (conditional) promise of greater monetary accommodation in turn enhances the fiscal multiplier and mitigates the runup in government debt.⁷

Such a combination has some of the flavor of a money-financed fiscal program, but implies a different monetary/fiscal mix that is likely to be more credible and easier to communicate to the public.⁸ The monetary-fiscal cooperation can be structured in a way consistent with central bank mandates to keep long-run inflation expectations well-anchored at a moderate level (e.g., 2 percent), and thus pose much less risk to long-run price stability than "helicopter money." The central bank's commitment to a more accommodative reaction function would in turn encourage fiscal policymakers to act given the expectation of a high fiscal multiplier and diminished upward pressures on the debt-to-GDP ratio.⁹ Especially in difficult economic circumstances in which the central bank cannot signal a change in the reaction function by lowering the policy rate, cooperative monetary and fiscal actions could boost the public's confidence in policymakers' ability to achieve their objectives.¹⁰

Our paper then considers some historical case study evidence on the use of money-financed fiscal programs to see if the evidence is broadly consistent with the implications of our model. One well-understood lesson is that monetary financing of the large runups in government expenditure that accompany major wars can generate a large rise in the price level. In such circumstances, the public presumably regards a major shift in the monetary-policy reaction function as credible – indeed, perhaps as inevitable – and the expectation that the new regime will involve significant

⁷ For a discussion of the possible effectiveness of such forward guidance see Reifschneider and Wilcox (2020) and the discussion of recent Japanese policy below.

⁸ Nominal GDP targeting may have broadly similar implications. For a discussion of the possible benefits of nominal GDP targeting coordinated with expansionary fiscal policy, see the comments by Woodford in Reichlin, Turner, and Woodford (2013).

⁹ As the price level only increases modestly, only a small fraction of the fiscal expansion is ultimately financed directly by seigniorage. However, the easier monetary policy, by significantly reducing real interest rates and boosting tax revenue for a time, leads to a larger reduction in the debt-to-GDP ratio.

¹⁰ It bears emphasizing that even these more limited forms of monetary-fiscal coordination may pose important risks, including to central bank independence (as discussed below). Accordingly, central banks may well opt to provide additional monetary stimulus without explicit coordination with the fiscal authority.

debt monetization can boost both prices and output. We examine the French experience during and after the First World War in this light, noting that France managed the fiscal challenges posed by the war effort in part through money creation; the result was a period of high inflation, but also of relatively robust growth in GDP during the 1920s. Similarly, we argue that a deep economic depression may help to make a formal change in the monetary policy reaction function easier to communicate and make credible, thereby contributing to the effectiveness of the change. We illustrate this outcome by briefly reviewing the policies followed in Japan in the early 1930s, which appeared to help that nation recover from the Great Depression. By contrast, a central bank that has built a reputation for low and stable inflation may find it difficult to generate even a temporary rise in inflation above target, much less rely on a money-financed program. We see the challenges that the Bank of Japan has faced in recent decades along these lines, with progressively more central banks facing similar issues. Finally, we discuss the possibility that ongoing monetary-fiscal cooperation could move inflation expectations permanently higher, rather than raising them only temporarily. Such outcomes would be more likely if the central bank lacked independence, and so was subject to short-term political pressures to accommodate ongoing deficit spending. We discuss economic developments in the U.K. during the 1960s as an illustration of such a risk.

This paper is organized as follows: Section 2 presents the benchmark model and calibration, while Section 3 discusses our simulation results. Section 4 considers monetary-fiscal cooperation from a historical perspective, while Section 5 concludes.

2. Benchmark Model

Our benchmark model builds on the workhorse New Keynesian model by incorporating a demand function for money (which consists exclusively of currency). In the next section, we show how a rule for setting currency growth to yield a given amount of seigniorage can be reinterpreted in terms of

an instrument rule for the policy rate.

2.1. Households

Households derive utility from consumption, c_t , and from their holdings of real currency balances, m_t , but experience disutility from the hours they spend working, n_t . The period utility function of households is assumed to take the separable form:

$$u(c_t, n_t, m_t) = \frac{[c_t + \nu_0 \xi_t]^{1 - \frac{1}{\sigma}} - 1}{1 - \frac{1}{\sigma}} - \chi_0 \frac{n_t^{1+\chi}}{1+\chi} - \frac{\mu_0}{1+\mu} [\max\{v_t^* - \frac{m_t}{c_t^a}, 0\}]^{1+\mu} \quad (1)$$

with $\sigma \geq 0$, $\chi \geq 0$, $\chi_0 > 0$, $\mu_0 > 0$, and $\mu > 0$. The consumption taste shock ξ_t is an exogenous AR(1) process with a persistence parameter of ρ_ξ . The final term of equation (1) assumes that real balances – expressed as a ratio to aggregate consumption – are valued at the margin until reaching a stochastic bliss point of v_t^* . For simplicity, we assume that the scaling factor is aggregate consumption, c_t^a , which is taken as given by the household; this formulation implies that the consumption Euler equation doesn't depend on the level of real balances, consistent with most empirical analysis.¹¹

Households face a budget constraint at time t that may be expressed in real terms as:

$$b_t + m_t + c_t(1 + \tau_{st}) = (1 - \tau_l)w_t n_t + r_{Kt}k + \frac{1}{1 + \pi_t}((1 + i_{t-1})b_{t-1} + m_{t-1}) + \mathfrak{d}_t - \tau_t \quad (2)$$

The household's income consists of after-tax labor income $(1 - \tau_l)w_t n_t$ (where w_t denotes the real wage, and τ_l a fixed tax on labor income), capital income $r_{Kt}k$ (where r_{Kt} is the real rental price of capital and k is the fixed amount of capital owned by each household), dividends, \mathfrak{d}_t , from the ownership of firms, minus the lump-sum taxes, τ_t , paid to the government. The household uses this income to purchase consumption goods, where τ_{st} is a sales tax; purchase real bonds, $b_t = \frac{B_t}{P_t}$ (nominal holdings B_t divided by the price level P_t); and accumulate real balances, $m_t = \frac{M_t}{P_t}$. The

¹¹ Note that we are leaving aside the fact that much of U.S. currency is held abroad (Judson, 2017). Of course, foreign holdings imply that a portion of the inflation tax falls on foreigners, making the benefits from monetization larger.

gross real return on bonds is $\frac{1+i_{t-1}}{1+\pi_t}$, where i_{t-1} is the nominal interest rate and $\pi_t = \frac{P_t}{P_{t-1}} - 1$ is the inflation rate; the gross real return on money is simply $(1 + \pi_t)^{-1}$.

The household's problem consists of choosing its consumption, labor hours, real balances, and bond holdings to maximize its discounted utility $E_0 \sum_{t=0}^{\infty} \beta^t U(c_t, n_t, m_t)$, where the discount factor $\beta \in (0, 1)$, and the maximization is subject to the budget constraint given by equation (2) in each period. The first order conditions imply the usual consumption Euler equation and household labor supply decision, respectively:

$$\lambda_t = \beta E_t \left\{ \frac{1 + i_t}{1 + \pi_{t+1}} \lambda_{t+1} \right\} \quad (3)$$

$$-\frac{u_{n_t}}{\lambda_t} = w_t(1 - \tau_l), \quad (4)$$

where λ_t is the marginal utility of consumption. Household money demand can be expressed as:

$$\mu_0 \left(v_t^* - \frac{m_t}{c_t} \right)^\mu = \lambda_t c_t \left(1 - \frac{1}{1 + i_t} \right), \quad \text{if } i_t > 0 \quad (5)$$

Given the opportunity cost of holding money balances when the (net) interest rate is positive, real money demand (expressed relative to consumption) is less than its satiation level v_t^* . As in Eggertsson and Woodford (2003), the money demand function is continuous at $i_t = 0$ with $\frac{m_t}{c_t} \geq v_t^*$ if $i_t = 0$. This formulation is useful because it allows us substantial flexibility to calibrate the interest semi-elasticity of money demand, as can be seen from the log-linearized form that we work with below:

$$\tilde{m}_t = \tilde{c}_t - \phi_c (\tilde{\lambda}_t + \tilde{c}_t) - \phi_i \tilde{i}_t + \left(\frac{v^*}{v} \right) \tilde{v}_t^*, \quad \text{if } i_t > 0 \quad (6)$$

where $\phi_c = \frac{v^* - 1}{\mu}$, $\phi_i = \frac{v^* - 1}{\mu} \frac{1}{i(1+i)}$, $v = \frac{m}{c}$, variables without time subscripts are steady-state values, and tildes denote log deviations from steady-state values. Assuming log utility over consumption, real money balances vary directly with consumption with a unit coefficient (since $\tilde{\lambda}_t = -\tilde{c}_t$ in this case) and the interest semi-elasticity of money demand varies directly with $\frac{v^* - 1}{\mu}$.

2.2. Firms and Price-Setting

We assume that there is a single final domestic output good, Y_t , that is produced from a continuum of differentiated intermediate goods, $Y_t(f)$, according to the Dixit-Stiglitz technology $Y_t = \left[\int_0^1 Y_t(f)^{\frac{1}{1+\theta_p}} df \right]^{1+\theta_p}$ where $\theta_p > 0$. Firms that produce the final output good are perfectly competitive in both product and factor markets, purchasing intermediate goods, $Y_t(f)$, at prices $P_t(f)$ to minimize the cost of producing Y_t . The demand schedule for each intermediate good derived from this cost-minimization problem is of the form:

$$Y_t(f) = \left(\frac{P_t(f)}{P_t} \right)^{\frac{-(1+\theta_p)}{\theta_p}} Y_t. \quad (7)$$

where P_t is the aggregate price index (i.e., $P_t = \left[\int_0^1 P_t(f)^{\frac{1}{\theta_p}} df \right]^{-\theta_p}$).

Intermediate good f is produced by a monopolistically competitive firm according to a Cobb-Douglas production function:

$$Y_t(f) = K_t(f)^\alpha (Z_t L_t(f))^{1-\alpha}, \quad (8)$$

where Z_t denotes a stationary shock to the aggregate level of productivity. The intermediate goods producers face perfectly competitive factor markets for hiring capital, $K(f)$ at the real rental price of r_{Kt} and labor, $L_t(f)$ at a real wage of w_t . The first-order conditions for the cost-minimizing input choices imply that all intermediate producers have an identical real marginal cost per unit of output of $\frac{MC_t}{P_t}$. Real marginal cost can be expressed as the ratio of the real wage to the marginal product of labor:

$$\frac{MC_t}{P_t} = \frac{w_t}{MPL_t} = \frac{w_t}{(1-\alpha)} L_t^\alpha K^{-\alpha} \quad (9)$$

noting that the aggregate ratio of labor to capital appears in (9) because all firms choose the same factor proportions, and the aggregate capital stock is assumed fixed.

Intermediate-goods-producing firms set prices according to Calvo-style staggered contracts, with firm f facing a constant probability, $1 - \xi_p$, of being able to re-optimize its price, $P_t(f)$. Each firm

that is allowed to reoptimize chooses its price ($P_t^{opt}(f)$) to maximize:

$$\max_{P_t^{opt}(f)} E_t \sum_{j=0}^{\infty} \xi_p^j \psi_{t,t+j} \left[P_t^{opt}(i) - MC_{t+j} \right] Y_{t+j}(i), \quad (10)$$

subject to its demand curve (7), where $\psi_{t,t+j}$ is the stochastic discount factor (i.e. $\beta^j E_t \frac{\lambda_{t+j}}{\lambda_t}$). The first order condition (together with the identity for the evolution of the aggregate price index) yields the standard New Keynesian Phillips Curve.

2.3. Fiscal Policy

It is convenient to consider the fiscal authority (Treasury) and central bank as a single consolidated entity (the “government”). The government finances its purchases of real goods and services, g_t , through taxation, real seignorage revenue, or by issuing debt. Accordingly, the government’s flow budget constraint, which determines the evolution of government debt, b_t , is:

$$b_t = \frac{1 + i_{t-1}}{1 + \pi_t} b_{t-1} + g_t - \tau_t - \tau_{s,t} c_t - \tau_l w_t l_t - s_t, \quad (11)$$

where s_t is real seignorage revenue, and recalling that τ_t is a lump-sum tax on households, $\tau_{s,t}$ the sales tax rate, and τ_l the labor tax rate. Real seignorage revenue in turn is equal to the new nominal monetary liabilities issued by the government divided by the price level (i.e., the purchasing power of newly issued money):

$$s_t = \frac{M_t - M_{t-1}}{P_t} = m_t - \frac{m_{t-1}}{1 + \pi_t} \quad (12)$$

We assume that government spending follows an exogenous AR(1) process of the form:

$$g_t = \rho_g g + (1 - \rho_g) g_{t-1} + \varepsilon_{gt}, \quad (13)$$

where g is the steady-state value of government spending. We also assume that the sales tax, $\tau_{s,t}$, is constant. Thus, lump-sum taxes adjust to satisfy the government budget constraint (11).

2.4. Market Clearing

The aggregate production function is given by:

$$y_t = \tilde{a}_t k^\alpha n_t^{1-\alpha} \quad (14)$$

where \tilde{a}_t denotes the level of technology scaled by price dispersion (see Woodford, 2003), and aggregate labor and capital are $n_t = \int_0^1 L_t(f)df$ and $k = \int_0^1 K_t(f)df$, respectively. The aggregate resource constraint is:

$$y_t = c_t + g_t \quad (15)$$

2.5. Monetary Policy

Our benchmark assumption is that monetary policy sets seigniorage revenue to be proportional to the deviation of government spending from its steady state level.

$$s_t = \frac{M_t - M_{t-1}}{P_t} = \frac{M_t - M_{t-1}}{M_{t-1}} \frac{M_{t-1}}{P_t} = (g_t - g)^\phi \quad (16)$$

We devote considerable attention to the case in which any shock to government spending is fully financed by seigniorage (i.e., $\phi = 1$). However, we also consider cases in which government spending is only partially financed by seigniorage. As we will discuss, this money-based rule can be recast in terms of a reaction function for the policy rate that makes it easier to interpret.

2.6. Log-Linearized Equations

The log-linearized equation characterizing price-setting takes the familiar form of the New Keynesian Phillips curve:

$$\tilde{\pi}_t = \beta \tilde{\pi}_{t+1|t} + \kappa_{mc} \tilde{x}_t, \quad (17)$$

where \tilde{x}_t is the output gap – the deviation of output from its potential level under flexible prices.

The parameter κ_{mc} denotes the contemporaneous sensitivity of inflation to real marginal cost, and

varies inversely with the mean duration of price contracts. The New Keynesian IS curve is given by:

$$\tilde{x}_t = \tilde{x}_{t+1|t} - \sigma(i_t - \pi_{t+1|t} - r_t^*), \quad (18)$$

where r_t^* is the potential or “natural” real rate of interest that would prevail under fully flexible prices. The model is complete with the specification of the (log-linearized) money policy reaction function that we describe below.

2.7. Calibration

We calibrate our model at a quarterly frequency using fairly standard parameter values. The discount factor of $\beta = 0.995$ at a quarterly frequency implies a steady state real interest rate of 2 percent (at an annualized rate). With a steady state inflation rate of 0 percent (i.e., $\pi = 0$), the steady state nominal interest rate is also 2 percent. We set the intertemporal elasticity of substitution $\sigma = 0.5$, so that the interest elasticity of aggregate demand is somewhat lower than under log utility.¹² The Frisch elasticity of labor supply of $\frac{1}{\chi} = 0.5$ and capital share of $\alpha = 0.3$ are in the typical range specified in the literature.

The government share of steady state output is set to 20 percent ($g_y = 0.2$), which is close to the average federal government spending share in U.S. GDP. The steady state sales tax rate is set to 10 percent, i.e., $\tau_s = 0.10$. Given that lump-sum taxes are assumed to be zero in the steady state – so that the labor tax covers all government expenditure not covered by the sales tax or seigniorage – the implied value of the labor tax $\tau_l = 0.21$.

The responsiveness of inflation to marginal cost plays a key role in determining how monetary policy actions affect output and inflation. We assume $\xi_p = 0.95$, so that the mean duration of price contracts is 20 quarters – implying a very flat Phillips Curve slope that seems consistent

¹² The scale parameter on the consumption taste shock ν is set to 0.001 (this parameter is set to have a negligible impact on the slope of the IS curve).

with empirical evidence for the United States, at least in recent years (e.g., Blanchard, 2016). The specification of money demand implies a unitary long-run elasticity with respect to consumption. We impose a short-run interest rate semi-elasticity of money demand equal to 2.5 (when expressed at an annual rate). Given that real balances are assumed to be 40 percent of steady state consumption, a 1 percentage point rise in the (annualized) nominal interest rate would reduce the share of currency to GDP by 1 percentage point.¹³ We discuss the monetary policy rule in more detail below.

Finally, we solve the log-linearized model using the AIM algorithm.

3. Effects of a Money-Financed Fiscal Program

We begin by using our model to show how a fairly small money-financed fiscal program could – at least in principle – provide a large boost to output while also reducing the government debt to GDP ratio. Thus, as seen in Figure 1, we consider a rise in government spending that equals only 0.4 percent of GDP in the initial quarter, and which cumulates to 1 percent of annual GDP; the persistence of the shock is 0.9. Both the design of the scenario and our results are close to those reported in Gali (2020a).

The red dashed lines show the effects of the government spending hike under the assumption that monetary policy follows the Taylor (1993) rule:

$$i_t = 1.5\pi_t + 0.5x_t, \tag{19}$$

where the assumed target inflation rate is zero.

Although output and inflation both rise, the government spending multiplier (not shown) is well below unity, reflecting that the central bank raises both nominal and real interest rates, which crowds out private demand.¹⁴ The spending hike is almost exclusively debt-financed. The ratio

¹³ The 0.4 figure reflects quarterly consumption. Currency is roughly 10 percent of annual consumption spending.

¹⁴ We also experimented with incorporating habit persistence in consumption, which can account for a more

of government debt to GDP rises because the higher government spending generates persistent primary deficits, and because the higher real interest rates raise the cost of financing existing debt. Seigniorage actually falls in the short-run as higher nominal interest rates reduce real money demand, though the eventual rise in the price level translates into a small amount of seigniorage at longer horizons.

Policies that boost debt may be regarded as undesirable or unsustainable, especially in economies with high levels of public debt. Accordingly, our second scenario considers a money-financed fiscal program. In this simulation we assume the same fiscal expansion as before, but also assume a radical shift in monetary policy, under which the central bank commits to raising the demand for nominal currency permanently by the amount required to finance the increase in government spending.¹⁵ In order to boost currency demand by the required amount, the price level must eventually rise by enough that the public voluntarily demands this additional nominal currency. This change in monetary policy is assumed to be fully understood by the public and completely credible – an assumption to which we will return below.

The blue solid lines in Figure 1 show the results of this money-financed fiscal program in our model. The money-financed program generates a large and persistent rise in the inflation rate. The inflation rate rises by roughly 3 percentage points above baseline, and eventually causes the price level to rise by 10 percent. The large rise in the price level in response to this fairly small increase in government spending reflects the fact that the inflation tax base – the ratio of money balances to nominal GDP – is small, so that the money stock must rise by a substantial amount in percentage

empirically-realistic multiplier (i.e., in the range of 0.8 in the first year following the shock, consistent with evidence in Ramey and Zubairy, 2018). However, given our focus on the massive disparity between the response under a Taylor rule and under a monetary-financed program – which also prevails under habit – we opted for the somewhat simpler specification.

¹⁵ Note that our definition of monetization differs from that in Gali (2020a). Gali defines monetization to mean that the central bank chooses inflation that is sufficient to keep the level of real government debt constant. Since that policy reduces the level of the real interest rate, monetization under Gali's definition will not yield seigniorage sufficient to finance the fiscal action. As we show below, with our definition, the level of real government debt actually declines. We prefer our definition since it is consistent with the intuitive idea of the central bank printing currency to pay for a fiscal action.

terms. Because real interest rates decline markedly, GDP expands by nearly 4 percent relative to baseline, consistent with an implied spending multiplier of around 10. The money-financed program elicits a large fall in the debt-to-GDP ratio of more than 15 percentage points after a decade. While seigniorage revenue rises by the size of the government spending hike by design, most of the improvement in the debt-to-GDP ratio reflects a rise in tax revenues due to the output expansion, and also the depressing effects of low real interest rates on interest expenses and hence outstanding debt.¹⁶

Results along these lines have led a number of economists to conclude that central bank-Treasury cooperation to monetize fiscal spending could be a potent tool to confront cyclical downturns: Only a small dose of fiscal spending is required to provide a powerful boost to GDP and inflation, and such a program would have the collateral benefit of reducing the government debt burden. Support for including monetization in the arsenal of central bank tools has undoubtedly been fueled by the long period in which many central banks were constrained by the ELB after the financial crisis and the need for additional tools to provide support to economies hard hit by the coronavirus. An attractive feature of a money-financed fiscal program in a liquidity trap is that the rise in inflation expectations and aggregate demand it engenders tends to boost the nominal interest rate, and hence can help “lift” central banks off the ELB more quickly.

We demonstrate these results in Figure 2, which shows the effects of the same (small) rise in government spending against the backdrop of a deep recession that would pin the policy rate at zero for three years absent the fiscal stimulus. In contrast to our previous results in Figure 1, which are reported in deviations from the steady state baseline, Figure 2 shows the responses in levels, with the baseline generated by a transitory preference shock that increases desired savings. The boost

¹⁶ The path of government debt also depends on the steady state government debt share (which we set to 75 percent of GDP). In our simulations, lump-sum taxes are assumed to adjust endogenously to government debt (falling as debt declines), but with an extremely low sensitivity. Hence, their evolution plays a minimal role in influencing debt dynamics.

to output and inflation from fiscal stimulus under a standard monetary policy reaction function – the promise to continue following the Taylor rule after liftoff from the ELB – is barely noticeable. The spending multiplier is considerably larger than in normal times because real interest rates fall, which crowds in private demand (c.f., Christiano, Eichenbaum, and Rebelo, 2011; and Woodford, 2011); even so, a much larger fiscal program would be required to close output and inflation gaps.¹⁷ By contrast, the money-financed program quickly erases most of the output gap, moves inflation above target within two years, and induces some decline in government debt relative to GDP (rather than a sizeable runup). Notably, the nominal interest rate rises from the ELB shortly after the shock, and attains its long-run value within a couple of years.

3.1. Re-interpreting the central bank’s reaction function

While the central bank’s reaction function under a money-financed program is typically thought of as a money supply rule, it is helpful to express the rule in a more familiar form in terms of the policy rate. In general, the policy reaction function implied by monetary financing depends on the currency demand function. Under the reasonable assumptions about currency demand in our model—that real currency demand varies directly with activity, and inversely with the policy rate—the central bank’s reaction function under a money-financed fiscal program can be interpreted as a form of “flexible price-level targeting,” in which the policy rate varies with the gap between the price level and its target path, and also with real activity (output or consumption). The crucial twist is that the target price level path varies with the size and persistence of the fiscal expansion, rather than remaining constant or growing at fixed rate (e.g., 2 percent per year).

In this vein, the interest rate reaction function can be derived by noting that the log-linearized

¹⁷ Note that Figure 2 shows the output gap (to keep all responses in levels). The output response is somewhat larger given that higher government spending boosts potential GDP.

form of the monetary policy rule in equation (16) can be expressed as:

$$m_y(\Delta\tilde{m}_t + \tilde{\pi}_t) = g_y\tilde{g}_t \quad (20)$$

where m_y is the ratio of steady-state real balances to steady-state output, g_y is the steady-state government expenditure share of output, and we have assumed that $\phi = 1$. Thus, a money-financed increase in government spending requires some combination of an expansion in real money demand ($\Delta\tilde{m}_t$) and higher inflation. Substituting the log-linearized money demand function (6) into equation (20) and solving for the policy rate yields:

$$\Delta\tilde{i}_t = \frac{1}{\phi_i}\left(\tilde{\pi}_t - \frac{g_y}{m_y}\tilde{g}_t + \Delta\tilde{c}_t + \left(\frac{v^*}{v}\right)\Delta v_t^*\right), \text{ if } i_t > 0 \quad (21)$$

where we have assumed log utility for expositional simplicity. This “super-inertial” reaction function can be written alternatively in terms of the level of the policy rate as:

$$\tilde{i}_t = \frac{1}{\phi_i}\left(\tilde{p}_t - \tilde{p}_t^* + c_t + \left(\frac{v^*}{v}\right)v_t^*\right), \text{ if } i_t > 0 \quad (22)$$

where the price level target, \tilde{p}_t^* , evolves according to:

$$\tilde{p}_t^* = \tilde{p}_{t-1}^* + \frac{g_y}{m_y}\tilde{g}_t \quad (23)$$

Abstracting from \tilde{p}_t^* , the interest rate reaction function (22) can be interpreted as consistent with a form of flexible price level targeting, with consumption rather than output the relevant activity measure.¹⁸ The key difference is that a money-financed fiscal expansion raises \tilde{p}_t^* , which can be regarded as a time-varying price level target that varies with the size and persistence of the government spending expansion.

This framework provides a useful way to help understand why a money-financed fiscal expansion generates a much larger rise in output and inflation than under the Taylor rule. Figure 3 provides

¹⁸ This result is consistent with Woodford (2003, p. 109), who shows that an exogenous money supply process and log-linear money demand yield an implicit interest rate rule that depends on output and the price level. See also Taylor (1999, pp. 322-23). In our model, real consumption is the appropriate measure of activity because currency demand is a function of consumption and not government spending. If all types of activity contributed proportionally to currency demand, then output would be the appropriate measure of activity.

a decomposition along these lines. In particular, this figure reports exactly the same responses to a government spending shock as in Figure 1 under both the Taylor rule (dashed red lines) and money-financed program (solid blue lines). However, Figure 3 also shows the effects of the government spending hike in the case where the central bank adopts flexible price-level targeting – consistent with the reaction function in equation (22) – but leaving the price level target path \tilde{p}_t^* unchanged (the green dash-dotted lines). As shown in the figure, the shift to flexible price level targeting alone induces only a slightly bigger output response (the multiplier in the first year is only about 10 percent larger). Thus, the vastly larger multiplier under the money-financed program occurs because agents regard it as implying a large upward shift in the price level target path over time (the black dotted line in the upper right panel shows the target path, \tilde{p}_t^*).

Given that agents immediately recognize this shift in the target price level path, it is unsurprising that there are large expansionary effects on output. The central bank must lower the trajectory for the real interest rate in order to raise output by enough to boost the price level toward this new target path, and hence generate the seigniorage needed to finance the fiscal expansion. Figure 3 illustrates how most of the decline in the real interest rate under a money-financed program is due to the upward shift in the price-level target path (the difference between the solid blue and green dash-dotted lines in the middle left panel). The strong expansion of output and inflation causes the nominal interest rate to rise (as was seen in Figure 2).

3.1.1. Role of Money Demand

Equation (22) underscores how the effects on output of a money-financed fiscal expansion depend critically on the specific features of money demand. The price level target path would rise more than in Figure 3 if real money demand was smaller relative to output because the base for the inflation tax would be smaller. Conversely, the price level would rise less if money demand was

larger. Thus, as seen in Figure 4, while our baseline calibration of money demand implies that the price level rises about 10 percent relative to baseline under the benchmark scenario, the price level would rise 20 percent under a calibration in which money demand were only half as large, and the effects on output and interest rates would be commensurately larger.

3.1.2. Monetary Financing and the Phillips Curve Slope

The slope of the Phillips Curve plays an important role in determining how the rise in nominal money demand associated with a money-financed fiscal program is distributed between output and inflation. Under our benchmark calibration with a low Phillips Curve slope, a large and relatively persistent output expansion is required in order to boost the price level to its new target path. However, if inflation was more responsive to output, a smaller and more transient output expansion could achieve the same rise in nominal demand, so that a given-sized money-financed fiscal expansion would imply less GDP stimulus. The red dashed lines in Figure 5 illustrate the implications of the same rise in government spending under a steeper Phillips Curve slope corresponding to a Calvo parameter of $\xi_p = 0.8$, rather than $\xi_p = 0.95$ as in our benchmark calibration. Output peaks less than 4 percent above baseline under this alternative calibration and falls back more rapidly, while the peak rise in inflation is more than half again as large. The shorter duration of the output expansion translates into a less persistent improvement in the primary budget balance, and, accordingly, the government debt-to-GDP ratio declines by considerably less.

As we will discuss more below, when considering historical episodes, a relatively muted inflation response to a money-financed program is more likely when the central bank is perceived as allowing a one-time shift in its price level target, perhaps in response to extraordinary circumstances such as a major war or depression. Conversely, repeated efforts to monetize fiscal deficits would seem likely to engender a much larger inflation response – and correspondingly, less persistent effects on

real interest rates and GDP – as agents would likely react by re-setting prices more frequently, and possibly by adjusting upward their views about longer-term inflation.

3.2. The Effects of Imperfect Credibility

We next consider two forms of departure from the baseline model that have the effect of damping the substantial near-term stimulus that arises from the perceived shift in the target price level path under monetary financing. In this subsection, we assume that agents must learn about the new reaction function, and in particular, about the shift in the target price level path. Indeed, given that monetary financing involves a dramatic shift in the policy reaction function, it seems likely that the private sector would either fail to understand what the new policy regime entailed, or regard the central bank’s commitment to the new regime as somewhat tenuous. We try to capture this uncertainty in our model by assuming that agents must solve a signal extraction problem: They see the central bank increasing currency, but must decide whether the increase presages monetization of the new government spending, or ultimately will be reversed.¹⁹

To set up the signal extraction problem formally, we begin by noting that under full monetary financing, money growth is given approximately by:

$$\frac{\Delta M_t}{M_{t-1}} = \frac{g_y}{m_y} \tilde{g}_t \quad (24)$$

where \tilde{g}_t is the log deviation of government spending from its steady-state level. (For simplicity we have assumed here that the nominal growth rate of the economy is zero – that is, there is no real growth or inflation in steady state.)

We now consider the possibility that only some component of the new government spending \tilde{g}_t^{mf} is financed by money creation, while the remainder is financed by issuing debt \tilde{g}_t^{df} (thus,

¹⁹ In our simple model, a reversal would require the central bank to scale back currency in circulation and substitute interest-bearing debt. In practice the central bank could finance the fiscal expansion initially by expanding currency – and thus depart temporarily from its normal reaction function – but later raise the interest rate paid on reserves to reduce currency again (consistent with a return to its usual reaction function) without selling any of the government debt.

$\tilde{g}_t = \tilde{g}_t^{mf} + \tilde{g}_t^{df}$). Moreover, we assume that the money stock may also be buffeted by other shocks, so that money growth is given by:

$$\frac{\Delta M_t}{M_{t-1}} = \frac{g_y}{m_y} (\tilde{g}_t^{mf} + \Delta e_{Tt}) \quad (25)$$

The money-financed component \tilde{g}_t^{mf} is itself linked to an underlying shock e_{gt} via the linear relation $\tilde{g}_t^{mf} = \psi u_{gt}$ where u_{gt} has the same persistence as the actual government spending shock g_t :

$$u_{gt} = (1 - \rho_G)u_{gt-1} + e_{gt} \quad (26)$$

where the innovations e_{gt} and e_{Tt} are assumed to be $N(0,1)$, and uncorrelated with the innovation to government spending ε_{gt} in expression (13).

This framework provides a stylized way of analyzing how a money-financed program might play out under different assumptions about the information available to agents. Broadly speaking, agents would typically expect fiscal spending to be debt-financed: This is captured by our assumptions that the money-finance innovation e_{gt} is uncorrelated with the fiscal innovation, ε_{gt} , and that the scaling parameter ψ is very small. Hence if the authorities did opt to finance the higher government spending by printing money, this would be reflected in an extremely large rise in u_{gt} (given that ψ is small). Under full information, agents would observe the shock u_{gt} directly, and accordingly, immediately change their views about the long-run money stock and price level, recognizing that the money shock would have to rise enough to finance the new government spending. By contrast, under imperfect information, we assume that agents only see the actual money stock, M_t , but cannot distinguish the money-financed component, u_{gt} , from random variation in the money stock that is captured by e_{Tt} . Hence, they must solve a signal extraction problem to infer these components based on their incoming observations about M_t . Specifically, they use the Kalman filter with the

observation equation given by:

$$\log M_t = H'z_t = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} \log M_t \\ u_{gt} \\ e_{Tt} \end{bmatrix}, \quad (27)$$

and where the underlying state vector z_t in turn is perceived to follow a first-order vector autoregression:

$$\begin{bmatrix} \log M_t \\ u_{gt} \\ e_{Tt} \end{bmatrix} = \begin{bmatrix} 1 & \psi(1 - \rho_G) & -1 \\ 0 & 1 - \rho_G & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} \log M_{t-1} \\ u_{gt-1} \\ e_{Tt-1} \end{bmatrix} + \begin{bmatrix} \psi & 1 \\ 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} e_{gt} \\ e_{Tt} \end{bmatrix} \quad (28)$$

Figure 6 shows the implications of imperfect credibility for output, inflation, and government debt. While agents are assumed to have a complete understanding of how government spending will evolve (it is the same shock as in Figure 1), they believe initially that it will be largely debt-financed. The speed at which agents update their views about the state – and critically, about the persistent shock u_{gt} that determines the extent of monetary financing – depends on the Kalman gain, which in turn depends on the size of the parameter ψ .²⁰ Specifically, the parameters of the Kalman filter are set so that agents initially believe that only a small fraction of the increase in spending will be monetized, and accordingly, initially expect most of the rise in money to be reversed. However, as agents are surprised by ongoing increases in currency (middle right panel), they come to expect that more of the government spending hike will be monetized.

Output and inflation rise much more gradually in this simulation than in Figure 1, with the peak impact on output and inflation occurring about 6 years after the policy is implemented. Thus, to the extent that the policy aims to support the economy in a recession, the stimulus is less well-timed than under the extreme assumption of full information.

²⁰ Because the government spending shock is assumed to be completely independent of the two types of monetary shocks in the signal extraction problem, the parameters of the government shock process play no role in determining the Kalman gain or in the dynamics. Intuitively, fiscal shocks are not systematically associated with shocks to the monetary policy rule, so that fact that it occurs in this case comes as a surprise.

3.3. Less-Forward-Looking Behavior

A recent literature – including McKay, Nakamura, and Steinsson (2014), Gabaix (2020), and Gertler (2017) – has highlighted how the standard New Keynesian model implies that monetary policy actions expected to be taken in the distant future can have extremely powerful near-term effects – in fact, even larger than if the same actions were taken today. This potent effect of future policy changes has been dubbed the “forward guidance puzzle,” and reflects the highly forward-looking behavior of both output and inflation in the baseline New Keynesian model. In this section, we consider the effects of introducing less-forward-looking behavior into both the aggregate demand and price-setting equations in the spirit of Gabaix (2020). In this context, when aggregate demand and inflation are less forward-looking, we show that money-financed programs tend to generate much less *near-term* stimulus, much like in models in which agents follow the sort of learning mechanism we described above. While it is helpful, for analytical reasons, to treat learning and less-forward-looking behavior as distinct mechanisms – as we do here – it is worth emphasizing that both features would likely play an important role in affecting how a money-financed program would play out in practice.

As in Gabaix (2020), the general form of our augmented model is very similar to the baseline New Keynesian model, with the key difference being a diminished effect of the future evolution of economic variables in both the Phillips curve and IS equation. Thus, relative to expressions (17) and (18), the Phillips curve becomes:

$$\tilde{\pi}_t = \beta\delta_\pi\tilde{\pi}_{t+1|t} + \kappa_{mc}\tilde{x}_t \quad (29)$$

while the IS curve is now:

$$\tilde{x}_t = \delta_x\tilde{x}_{t+1|t} - \sigma(i_t - \pi_{t+1|t} - r_{\delta_t}^*), \quad (30)$$

where the new parameters δ_π and δ_x represent the discount factors (or attention parameters) for

price-setters and households, respectively.²¹ The baseline New Keynesian model is a special case when $\delta_\pi = \delta_x = 1$. At the opposite extreme, assuming that $\delta_\pi = \delta_x = 0$ eliminates any effect that forward guidance regarding the future path of nominal interest rates may have on current output and inflation.

We now illustrate how the monetary stimulus from a money-financed fiscal program has a much weaker effect in this case than in the baseline model. To do so, we adopt a calibration in which we set $\delta_x = 0.9$ and $\delta_\pi = 0.25$.²² This parameterization gives monetary policy much less scope to affect current inflation and output by influencing inflation expectations. This latter feature seems consistent with research indicating that even relatively large-scale fiscal interventions, such as the U.S. ARRA program of 2009, had small effects on inflation expectations (Dupor and Li, 2014), as well as with the recent experience of a number of industrial economies. In particular, these economies – most notably, Japan – have experienced very low inflation despite the expectation that employment would remain at a historically high level for some time.

Figure 7 shows the effects of a money-financed fiscal program in this model variant with less-forward-looking behavior. The money financed program still provides considerable stimulus over time, but much less stimulus initially than in the baseline model. Moreover, the nominal interest rate must fall progressively – and by a very large amount – to elicit these expansionary effects. Because inflation doesn't respond much to the expectation of persistently strong future demand, the low real rates required to boost the price level to its higher target path, \tilde{p}_t^* must be achieved by keeping the nominal rate very low. In the presence of a binding ELB, the near-term boost to output and inflation is even more muted – an issue to which we next turn.

²¹ Note that the natural real interest rate – here denoted $r_{\delta t}^*$ – differs slightly from the original in expression (18) given that future shocks are discounted by $0 < \delta_x < 1$.

²² The value for δ_π is low relative to the value suggested by Gabaix (2020). However, we use this value to show clearly the effects of having less-forward-looking agents in the economy.

3.4. Monetary-Fiscal Cooperation with More Fiscal in the Mix

The foregoing simulations, which allow for limited credibility and less forward-looking behavior, suggest a number of key shortcomings of money-financed programs. First, they may be slow to deliver stimulus in the near-term when it is needed most. Second, they are likely to face significant implementation challenges given the need to cut interest rates; indeed, many central banks now appear constrained well out the maturity spectrum. And third, they may have very large and unpredictable effects on inflation and inflation expectations that may make their adoption inconsistent with central bank mandates.

From a broader perspective, money-financed programs appear to put too heavy a reliance on monetary policy to deliver stimulus. A program involving monetary-fiscal cooperation – allowing for some shift in the central bank’s reaction function, but adding much more fiscal support to the mix – may have a much better chance of achieving central bank objectives, especially when monetary policy is constrained by the ELB.

To explore this, we next consider in more detail how a shift in a central bank’s reaction function may produce relatively little stimulus of itself when the effective lower bound is binding, but can have much more traction when coupled with fiscal support that boosts the equilibrium real interest rate path.²³ In this vein, Figure 8 shows the effects of a shock to the target price level path \tilde{p}_t^* alone in order to focus on the effects of a purely monetary action (stripping out the government spending increase of the money-financed program). The simulation is in the version of the model with limited forward-looking behavior, and against the backdrop of a severe recession that would pin the policy rate at zero for over two years absent monetary stimulus.²⁴ The program is scaled

²³ The possibility that fiscal policy can create space for more effective monetary policy by raising r^* is discussed in Corsetti et al (2019). See also Bartsch et al (2020).

²⁴ The upper panels show the recession baseline (black solid line) as well as the effects of monetary easing against this backdrop (the dashed red lines), with the variables reported in levels to highlight the role of the ELB constraint. The bottom panels show the partial effects of monetary easing (the difference between the responses in the upper panels).

so that the target price level path rises 5 percent in the long-run.

As shown by the red dashed lines in the upper panels, this shift in \tilde{p}_t^* would deliver some stimulus after a couple of years: forward guidance gains more traction as the economy recovers (and policy rates would start to rise absent this shift in policy, which provides space for the policy action to operate). However, the stimulus from the policy shift is much smaller in the near-term than if policy rates were unconstrained: this can be seen in the bottom panels, which show the partial effect of the rise in \tilde{p}_t^* in the case in which the zero bound binds (the dashed red lines) with the partial effect if the lower bound didn't bind (the solid black lines). In the first few quarters after the monetary policy shift, the stimulus when the zero lower bound binds is only about one-third as large. As might be expected, the shift in \tilde{p}_t^* would have even smaller effects if the liquidity trap were longer-lived.

We next consider how coupling the monetary policy shift with a pronounced fiscal expansion can give the former much more traction to boost activity, and come close to delivering the same stimulus as under the unconstrained policy. For concreteness, we consider the effects of a large temporary sales tax cut τ_{st} , though other fiscal instruments could elicit similar effects.²⁵ As shown in Figure 9, the fiscal expansion boosts the path of the equilibrium real interest rate, and would move policy rates much more quickly above the zero lower bound if the monetary policy reaction function were unchanged (see the dashed pink line in the upper right panel, which shows the effects in the absence of a shift in \tilde{p}_t^*). This greater policy space in turn makes the shift in \tilde{p}_t^* more effective, with the partial effect of the monetary easing on output (the blue dashed lines in the lower left panel) now almost as large as in normal times without a binding ELB.

These results illustrate how monetary and fiscal policy can interact to elicit larger effects than either policy in isolation. Without fiscal stimulus, additional monetary stimulus provides relatively

²⁵ We employ a tax cut here because the result is an increase in consumption, which is the scale variable for money demand. Thus a tax cut boosts money demand and interest rates, while an increase in government spending would not.

little benefit given the binding ELB constraint; and without monetary stimulus – here in the form of a shift in the reaction function – the fiscal multiplier would be smaller because the fiscal action would engender a faster removal of policy accommodation.

Taken together, our analysis suggest why money-financed programs may "work" in certain environments, and hence seem appealing, but also why this success likely wouldn't extend to other settings. In particular, in circumstances in which expectations of a major shift in the monetary regime appear credible, money financed programs can provide large stimulus to aggregate demand. Conversely, a monetary-fiscal program that placed much more weight on fiscal support would appear better suited to provide stimulus in an environment in which central banks face a prolonged ELB constraint, expectations are not heavily forward-looking, and agents are likely to doubt the credibility of a substantial change in the monetary policy framework.

4. Monetary-Fiscal Cooperation: Some Historical Examples

In this section, we review some prominent examples of monetary-fiscal cooperation to see if the outcomes experienced are consistent with those our model would suggest. We start with the case of France during and after World War I, which shows that money-financed government spending can be effective in boosting prices and output.²⁶ Wars and war-related expenditures may be so large that the authorities are essentially forced to monetize a portion of the debt, but we argue, using the example of Japan in the early 1930s, that a clear and credible change in the monetary policy regime may also be achieved in deep recessions. However, outside of such extreme circumstances, a central bank that has established a firm reputation for low and stable inflation may find it difficult to credibly commit to the radical change in its monetary-policy reaction function required for a money-financed fiscal action. We see monetary policy in Japan since the 1990s as demonstrating

²⁶ See Rockoff (2015) for a summary of the literature on the effects of war-time finance and a discussion of U.S. examples.

the difficulties that central banks may face in boosting actual and expected inflation, even when taking substantive action such as large-scale asset purchases to convince the public of a shift in regime. Finally, we consider the case of the Bank of England in the 1960s to show the risks that can materialize if the central bank undertakes repeated monetizations, leading to persistently higher inflation, rather than a temporary period of higher inflation as the price level moves to its new level. In the British case, the result was higher than desired inflation expectations that required a deep economic contraction to reverse.

As discussed in Bordo and Hautcoeur (2007), France borrowed heavily during the First World War and also depended on rapid money growth (which exceeded 60 percent for a time) as a source of finance. As a result, at the end of the war, France faced very large challenges, including a debt-to-GDP ratio of more than 180 percent, large ongoing budget deficits, and prices that had more than doubled relative to pre-war levels. These challenges were reinforced by the war-related decline in GDP, which was about 10 percent below its 1910 level in 1919. Given this difficult situation, Bordo and Hautcoeur (2007) note that a return to the pre-war gold parity would have been extremely difficult, although they argue that had political agreement on burden sharing been reached earlier, the ultimate devaluation in terms of gold could have been limited to roughly 50 percent. Even in that case, however, the result of the monetary financing of a significant portion of the war effort would have been a permanent doubling of the price level. As it was, prices rose by roughly a factor of 6 over twelve years. By contrast, the British moved more aggressively to return to the gold standard, with the pound going back to its pre-war parity in 1925.

A comparison of the macroeconomic outcomes in Britain and France in the 1920s shows that the decision by the French authorities to accept a greater depreciation of the franc not only boosted inflation substantially, but also led to much higher output over time, as well as reduced the burden of government debt, consistent with the results in our model. As shown in Figure 10, the price

level in France rose much further than it did in the U.K during the 1920s. The higher inflation in France lowered real interest rates and reduced the ratio of government debt to GDP. This ratio had been higher in France than in the U.K. at the end of the war, but it fell below the U.K. level by the mid-1920s. At the same time, GDP per capita, which had suffered more in France during the war, rebounded strongly, ending the 1920s about 60 percent above its 1910 level. By contrast, in the U.K., where monetary policy was constrained by the effort to return to the gold standard at the old parity, output per head rose to only 120 percent of its pre-war level by the end of the decade.

This historical example sheds light on the importance of the public's expectations for policy and prices. First, because the French government was not clear about the ultimate extent of monetization until well into the 1920s, the economic effects of the policy only developed over time, consistent with the results in our model with learning. Second, the French policy may have had its effects in part because the public saw the change in monetary policy as credible, given the extent of the fiscal challenges facing the country. Conversely, the relatively poor macroeconomic outcomes in the U.K. may have reflected initial expectations for partial monetary finance, which the British authorities had to counter with a protracted period of very tight monetary policy. That said, GDP per capita rose more rapidly in France than in the United States in the 1920s and stood at a higher level in 1929 relative to its 1910 value as well, suggesting that France's highly expansionary monetary policy played an important role in that country's relatively good economic performance.

While extraordinary wartime expenditures may have helped make the shift in French monetary policy credible, monetary-fiscal cooperation has also been implemented effectively in periods of economic stress outside of wartime. For example, in the early 1930s, Japan recovered relatively early and rapidly from the Great Depression, reflecting the effects of the "Takahashi economic policy." This policy, introduced by finance minister Korekiyo Takahashi starting in late 1931, had

three parts: a departure from the gold standard and substantial devaluation of the yen; an increase in government spending, with explicit financing of government deficits by the Bank of Japan (BOJ); and more accommodative monetary policy, including reductions in the discount rate and an easing of regulations limiting note issuance (see Shizume, 2009). As in our model, this combination of policies appeared to be effective, with the foreign exchange value of the yen falling considerably (Figure 11), consumer prices rebounding from their lows, and a recovery in Japanese GDP per capita getting underway in 1932. This strong macroeconomic impact likely reflected in part the effect of the clear and credible change in the policy regime, and the consequent effects on inflation expectations, consistent with our earlier modeling results (Shizume, 2009, p. 7).

In both the French and Japanese cases, changes in the gold value of the currency may have played an important role in both communicating the change in the monetary reaction function and making the change credible to the public. In an economy accustomed to the gold standard, a change in the gold value of the currency could provide a clear statement of the government's intentions, and one that would be easy for the public to understand. For example, Romer (2014) argues that the devaluation of the dollar in terms of gold in the United States in 1933 signaled a regime change that moved price expectations higher and helped spur the subsequent recovery.²⁷ In addition, because price levels had generally declined prior to the decision to abandon the gold standard in the Great Depression, an effort to move prices higher could have been seen by the public as appropriate and so would be more likely to be judged credible.²⁸

These historical examples make clear that fiscal policy paid for in part with seigniorage revenue can be effective in boosting output and inflation. However, in the absence of a war or a major depression, and without the signaling that a change in the gold standard could provide, it is not

²⁷ However, Hanes (2019) argues that the Roosevelt administration's labor market policies directly boosted wage inflation and so pushed prices higher. His work suggests that even in the 1930s, changes in inflation expectations may have played only a limited role in raising actual inflation.

²⁸ That said, the move to explicit price level targeting in Sweden in 1931 was aimed at stabilizing the price level and not at reversing the decline in prices over the previous few years. See Jonung (1979) for a discussion.

clear that monetary-fiscal cooperation would be as effective. For example, the experience in Japan in recent decades suggests that a central bank that is believed to prefer low and stable inflation may find it difficult to credibly commit to even a temporary period of elevated inflation. Indeed, over the decade or so prior to the financial crisis, the Bank of Japan found it hard to make such a commitment, and as a consequence, even with highly accommodative fiscal policy, a policy rate near or at zero, and a substantial increase in the size of the BOJ's balance sheet, inflation expectations remained low, actual inflation was negative for some time, and output growth was weak (Figure 12). In the end, the market's skepticism that the Bank of Japan would move towards a new framework supportive of modest price inflation proved to be well-founded, as the Bank raised rates above zero in 2000 and again in 2006, even as inflation remained stubbornly low. Those policy decisions likely strengthened the public's belief that there had been no significant change in the monetary reaction function, limiting the effectiveness of the monetary and fiscal policies employed. Of course, the policies that were pursued also kept inflation very low and relatively stable through this period, which may have been seen by policymakers as an important goal at the time.

Persistently weak economic performance and the adverse effects of the financial crisis on the Japanese economy contributed to the rise in gross central government debt to more than 200 percent of GDP and persistent very low inflation. In response to this difficult policy situation, following the election of Prime Minister Abe the Japanese authorities implemented a mix of more-accommodative monetary policy and highly accommodative fiscal policy.²⁹ With regard to monetary policy, in 2016 the BOJ cut its short term policy rate to negative territory and indicated that it would conduct purchases of longer term government securities in order to keep the yield on 10-year Japanese government bonds near zero.³⁰ In addition, the BOJ Policy Board indicated that it would maintain

²⁹ The package also included structural reforms – see Cabinet Office, Ministry of Finance, and Bank of Japan (2013).

³⁰ The BOJ also undertook purchases of corporate securities and JREITS, as well as provided low-cost financing for bank loans. See Bank of Japan (2017).

the low level of interest rates until inflation rose persistently above its 2 percent target (BOJ, 2016). This combination of policies can be seen as a form of monetary-fiscal cooperation. In particular, the overshoot of the inflation target should lead to a higher price level than would otherwise have been expected given the 2 percent inflation target, and the implied negative real interest rate on longer-term government debt should ease pressure on fiscal policymakers and make possible a more accommodative fiscal policy than might otherwise have been chosen, given the high level of government debt. Indeed, some commentators have suggested that the highly accommodative monetary policy has allowed for more fiscal expansion.

However, even with this forceful policy in place, actual and expected inflation remained muted despite relatively strong employment and economic activity prior to the pandemic. The BoJ's earlier policy decisions may well have led the public to believe that the central bank was unlikely to allow inflation to rise above 2 percent for a significant period. As a result, the BoJ's forward guidance was not seen as fully credible, and so had small near-term effects, along the lines of the learning model discussed in Section 3.2. That said, as in our model, the policy could ultimately have been effective in boosting inflation, but the arrival of the global pandemic makes it difficult to know how the economy would have evolved. Nevertheless, the shift in policy led to somewhat higher inflation and a sustained period of elevated economic activity that allowed for considerable progress on labor market reforms aimed at boosting labor force participation among women and the elderly (Wakatabe, 2019).

While the Japanese experience is a warning about the possible limited effectiveness of monetary-fiscal cooperation, there is also a converse risk. That is, that a central bank, particularly if it lacks independence from the government, could be pressured to accommodate fiscal expansion even in a period characterized by relatively strong economic activity and elevated inflation. In our model, such a situation would lead to an increase in inflation expectations as agents decided that inflation

was likely to be permanently higher rather than higher only for a short time as the price level moved to a higher target level. One example along these lines is provided by the United Kingdom in the 1960s. The Bank of England was not an independent central bank at the time, and so the government could in effect force monetary-fiscal cooperation.³¹ Money-financed fiscal actions were not called for, however, since there were no major wars or severe economic crises, monetary policy was not constrained by the effective lower bound, and inflation was not persistently at undesirably low levels. Nonetheless, the government used coordinated policies to provide accommodation based on a judgment that potential output was higher than it appears to have actually been (Nelson and Nikolov, 2003). Not surprisingly, the result was unsustainably low unemployment and, rather than a one-time jump in the price level to accommodate the fiscal expansion, a steady rise in inflation over a period of more than a decade (Figure 13). Indeed, even after a period of elevated inflation and a currency devaluation in the late 1960s, the government continued to run an accommodative policy, pushing inflation and inflation expectations higher. As a result, there was a prolonged period of undesirably high inflation that was ultimately brought to a close only by a protracted contraction that was required to re-anchor inflation and inflation expectations. One interpretation of this unfavorable outcome is that monetary-fiscal cooperation can only be used effectively if the central bank has sufficient independence to credibly state that the policy cooperation will be temporary, resulting in a higher price level but not in persistently higher inflation.

In short, the historical cases examined here suggest that to make monetary-fiscal cooperation effective the central bank needs to be able to credibly raise the expected price level, while keeping longer-run inflation expectations well-anchored. As the cases of France after World War I and Japan in the 1930s show, a gold standard or other similar commitment device could help to communicate an intended increase in the price level, making the higher price level credible, while at the same

³¹ See Cairncross (1996) for a discussion of how the Bank of England's limited degree of operational independence during this period affected its policy choices.

time limiting expectations for a permanent rise in inflation to undesirable levels. However, to keep inflation expectations anchored after a money-financed fiscal program, the program must be seen by the public as a very unusual event that will not be repeated any time soon. That sort of expectation is probably easier to convey if the monetary-fiscal cooperation is undertaken in response to extraordinary circumstances, as was the case in the French and Japanese examples. However, without a clear framework for communicating about the future level of prices, it may be very difficult to generate the desired outcome for one of two reasons. First, as in Japan in recent years, an independent central bank with a track record of low and stable inflation may find it difficult to commit credibly to even a temporary increase in inflation above the levels it is believed to prefer, potentially making monetization of a part of a fiscal action relatively ineffective for a long time. Second, as in the United Kingdom in the 1960s, if the central bank is not independent and conditions are not extraordinary, then the change in the price level may not be seen as a one-off policy step, but rather as the start of a policy of permanently higher inflation and seigniorage. Such expectations would reduce the effects of the policy on output and employment and increase those on prices.

Against this backdrop, it is clear that the Federal Reserve's new monetary policy framework – flexible average inflation targeting – is a much more limited step.³² The new framework should help to boost inflation expectations in recessionary periods, a helpful development as we have noted. However, the new strategy appears similar to allowing for a temporary price level target that rises at a 2 percent rate when the ELB becomes binding – independent of fiscal policy actions. Thus, the new framework clearly does not involve a commitment to monetization. And, unlike in Japan, there is no formal cooperation with the Treasury. While these differences may limit the new framework's traction to boost output and inflation relative to strategies involving monetary-fiscal cooperation,

³² See Federal Open Market Committee (2020) for a description of the revised policy framework, and Board of Governors of the Federal Reserve System (2020) for background on the thinking that underpinned changes to the framework.

the new framework should also pose little risk to the Federal Reserve's independence.

5. Concluding Remarks

The simulations in this paper suggest that a money-financed fiscal expansion, if understood and seen as credible by the public, could provide very substantial stimulus. A commitment to use monetary policy to boost nominal currency holdings by enough to finance the fiscal action would increase the effects of the combined action well beyond those of debt-financed fiscal stimulus alone. In particular, the change in monetary policy would raise the expected future price level and lower the expected future path of the policy rate, thus reducing real interest rates substantially. However, policymakers may find the economic effects of such a program to be undesirable because of the large (and unpredictable) effects on inflation, and because it would risk unanchoring longer-term inflation expectations that could require costly actions to rectify.

Moreover, making such a change in monetary policy clear and credible – outside of wartime and depressions – would likely be very difficult, and the macroeconomic effects could well prove to be very limited in practice, at least for a considerable time. If monetary policy is constrained by the effective lower bound on the policy rate, the change in monetary policy could not be signaled by a change in the current policy rate, but rather only by unconventional policy steps, such as asset purchases or providing forward guidance regarding future short-term nominal rates. In addition, the announced change in monetary policy might not be time consistent, and policymakers would likely find it very difficult to constrain future monetary policy decisions. Indeed, with central banks having spent considerable time building their reputations for low and stable inflation, the public would probably anticipate that policymakers would not follow through with the announced change in policy once the economy had recovered sufficiently. Moreover, by increasing uncertainty, the announcement of such a radical change in policy could even boost risk premiums and so be

counterproductive (Bernanke, 2010).

Given that the public may well doubt the central bank's commitment to a money-financed fiscal program, we considered the effects of such policies in a model where the public only gradually learns about the change in the central bank's reaction function from watching its policy actions. We also considered the effects of such policies in a model where aggregate demand and inflation are less forward looking, consistent with recent work on the "forward guidance puzzle." In both cases, the near-term effects of the policy on inflation and output are considerably reduced. Instead, much of the effects of the policies come only later, when the economy is likely to have already recovered from the recession that triggered the policy change. This difficulty is particularly acute if monetary policy is constrained in the short run by the effective lower bound. Nonetheless, we find that more limited forms of monetary-fiscal cooperation can still be valuable. In particular, expansionary fiscal policy can, by moving the economy away from the lower bound, help to make monetary policy more effective, while the accommodative monetary policy boosts the impact of the fiscal expansion. Importantly, increasing the amount of monetary accommodation by raising the target price level yields only small effects on the near-term outlook unless coupled with additional fiscal expansion because without the fiscal action monetary policy is badly constrained by the effective lower bound.

Changes in monetary and fiscal policy that involve cooperation between the authorities may also help to make the change in monetary policy more credible than it would be on its own. Such cooperation could be seen as a signal that the authorities are committed to taking bold action to address a persistently weak economy and are willing to accept the consequences. Moreover, government action on the fiscal component of the program would allow the government to signal its agreement with the proposed change in monetary policy and acknowledge the higher inflation that it would imply. That signaling might also include an indication that the government anticipates that

higher inflation would help keep the debt-to-income ratio in check, which could provide additional support for the credibility of the coordinated change in monetary policy.

Of course, such steps on the part of the government could call into question the independence of the central bank. Indeed, the central bank could, in the future, be pressed to engage in such coordinated policies in situations where they are not warranted (for example, at a time when output is not persistently low, inflation is not below target, and the policy interest rate is not constrained by its effective lower bound). However, even in the extreme case of a money-financed program, it may be possible to develop approaches that would help to preserve monetary policy independence. For example, Bernanke (2016) has suggested a “dual key” approach in which the Federal Reserve would authorize the placement of funds in a special Federal Reserve account that the Treasury could use to finance spending. However, the Congress would have to authorize the spending of funds in that account. Thus, both the Federal Reserve and the Congress would have to independently agree that a money-financed fiscal program was desirable before it could be undertaken.³³

A final issue, which we do not address here, is the possible international implications of money-financed fiscal programs. In particular, some recent research suggests that when monetary policy is constrained by the effective lower bound, more accommodative policy in one economy may have adverse implications for other economies through its effects on exchange rates and trade.³⁴ Thus, implementation of a money-financed fiscal program in one country could hurt its trading partners and potentially lead to the implementation of such programs in those economies as well. Of course, such an outcome may not be undesirable in some circumstances. However, given possible spillovers, it might be appropriate to consult with policymakers in other jurisdictions before implementing such a program, including to help to avoid disorderly outcomes in foreign exchange markets.

³³ Bartsch et al. (2019) suggest that monetary policymakers could also be delegated the authority to make some fiscal decisions, but that seems to us to push the powers of the central bank too far.

³⁴ See, for example, Caballero, Farhi, and Gournchas (2016) and Eggertson, Mehtotra, Singh, and Summers (2016) for a discussion of the international implications of monetary policy at the lower bound.

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Figure 1. Rise in Government Spending

deviations from baseline

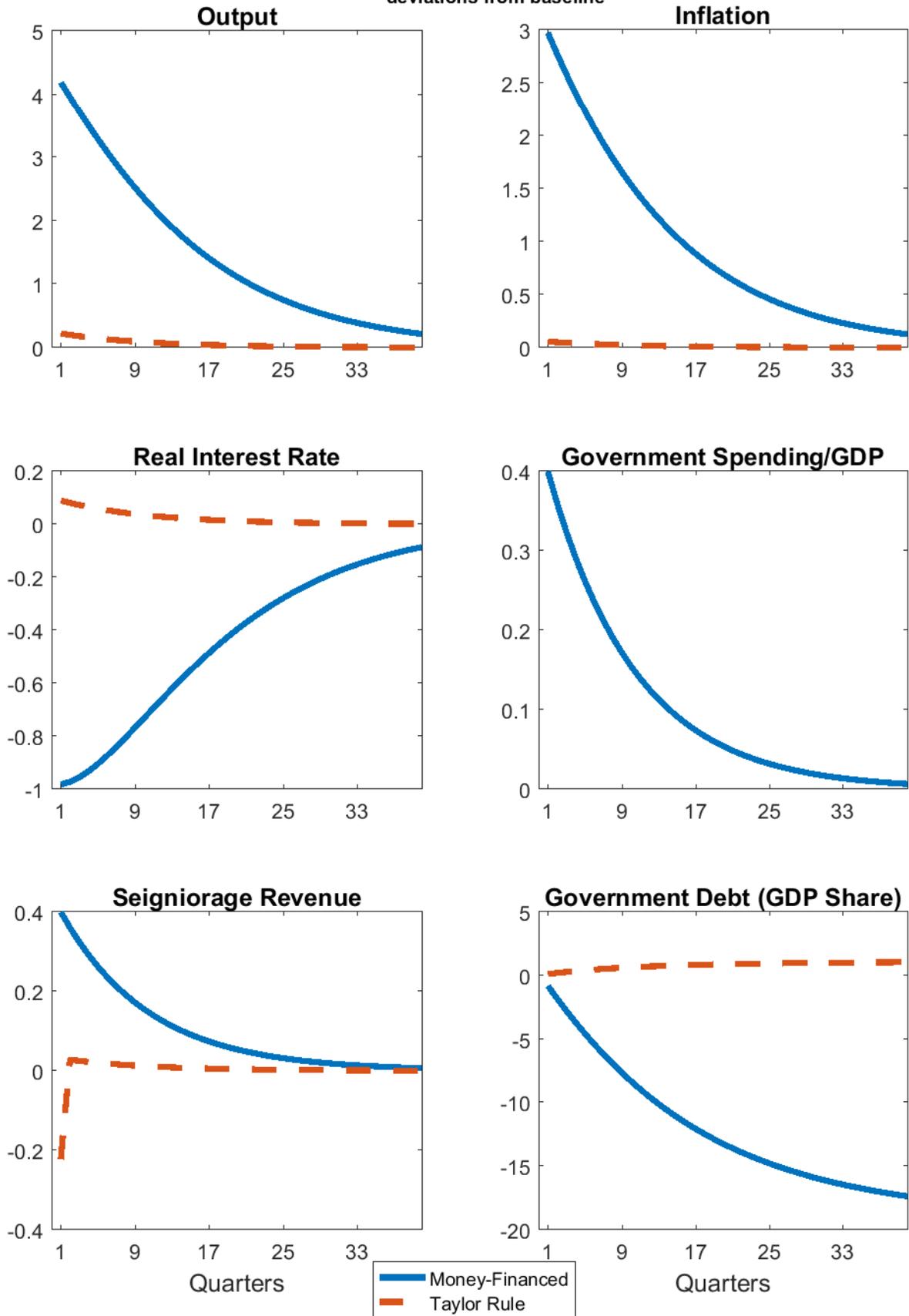


Figure 2: Rise in Government Spending in Liquidity Trap

variables in levels

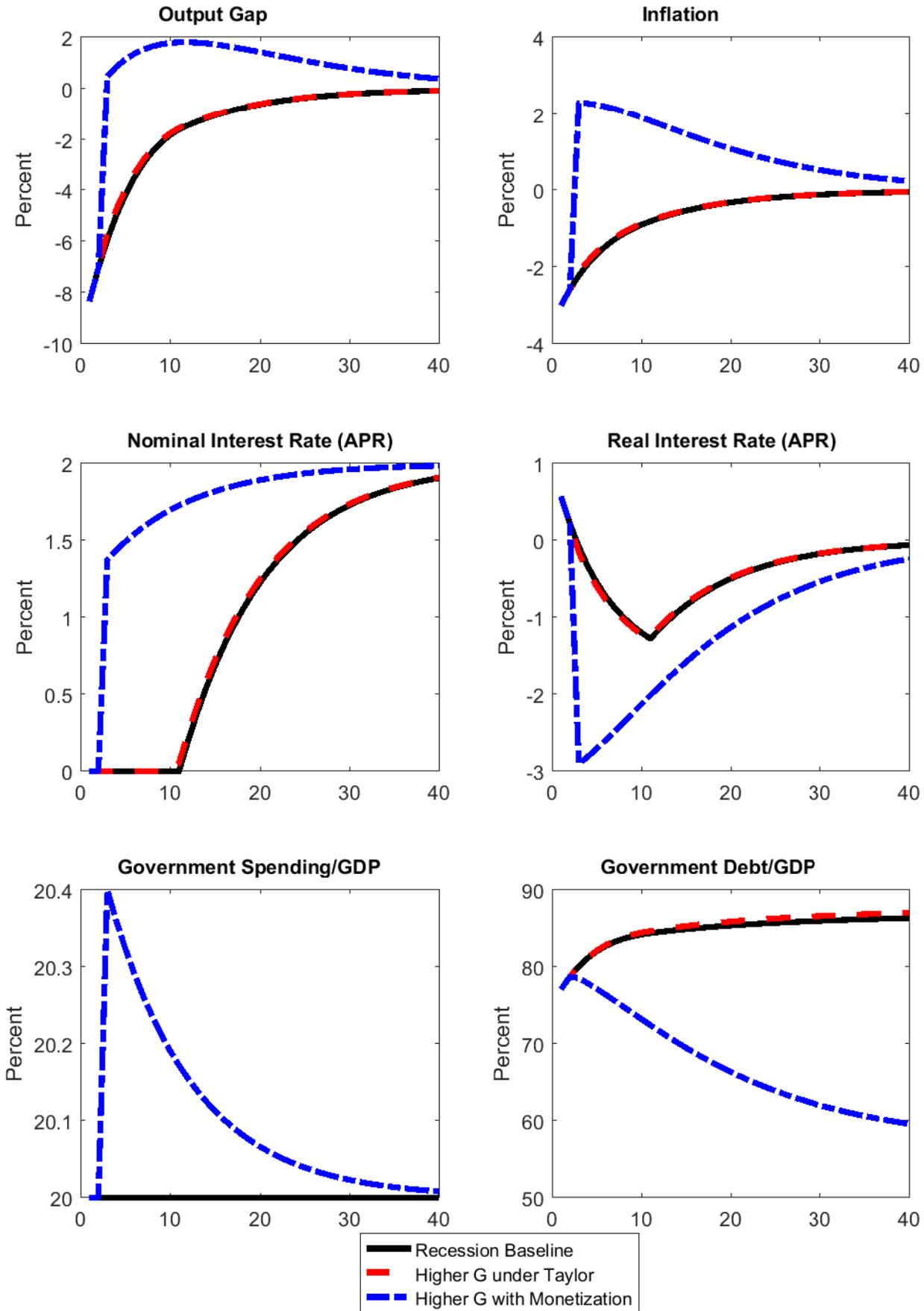


Figure 4. Money-Financed Rise in Govt Spending: Role of Money Demand

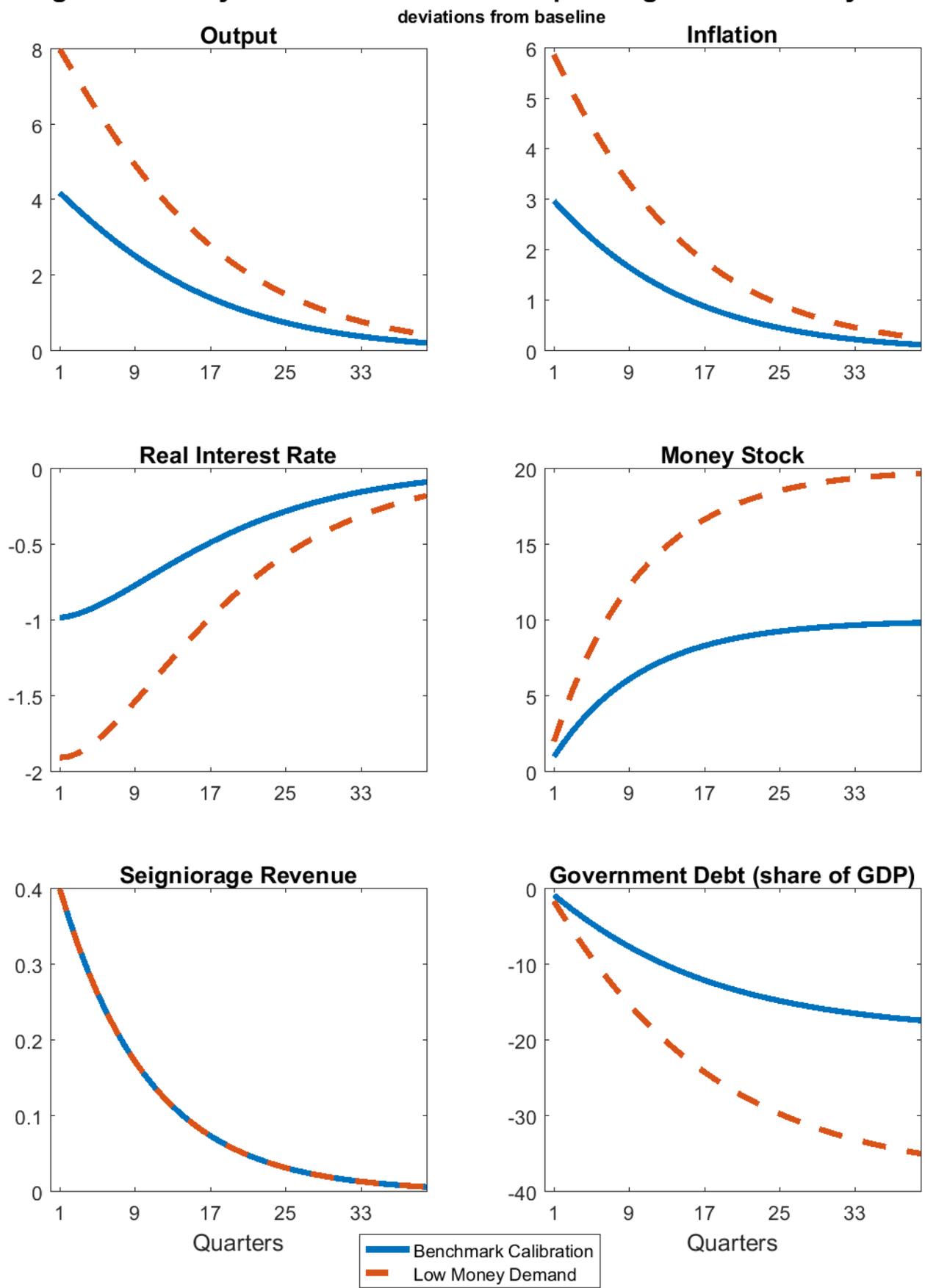


Figure 5. Money-Financed Rise in Govt Spending: Steeper Phillips Curve

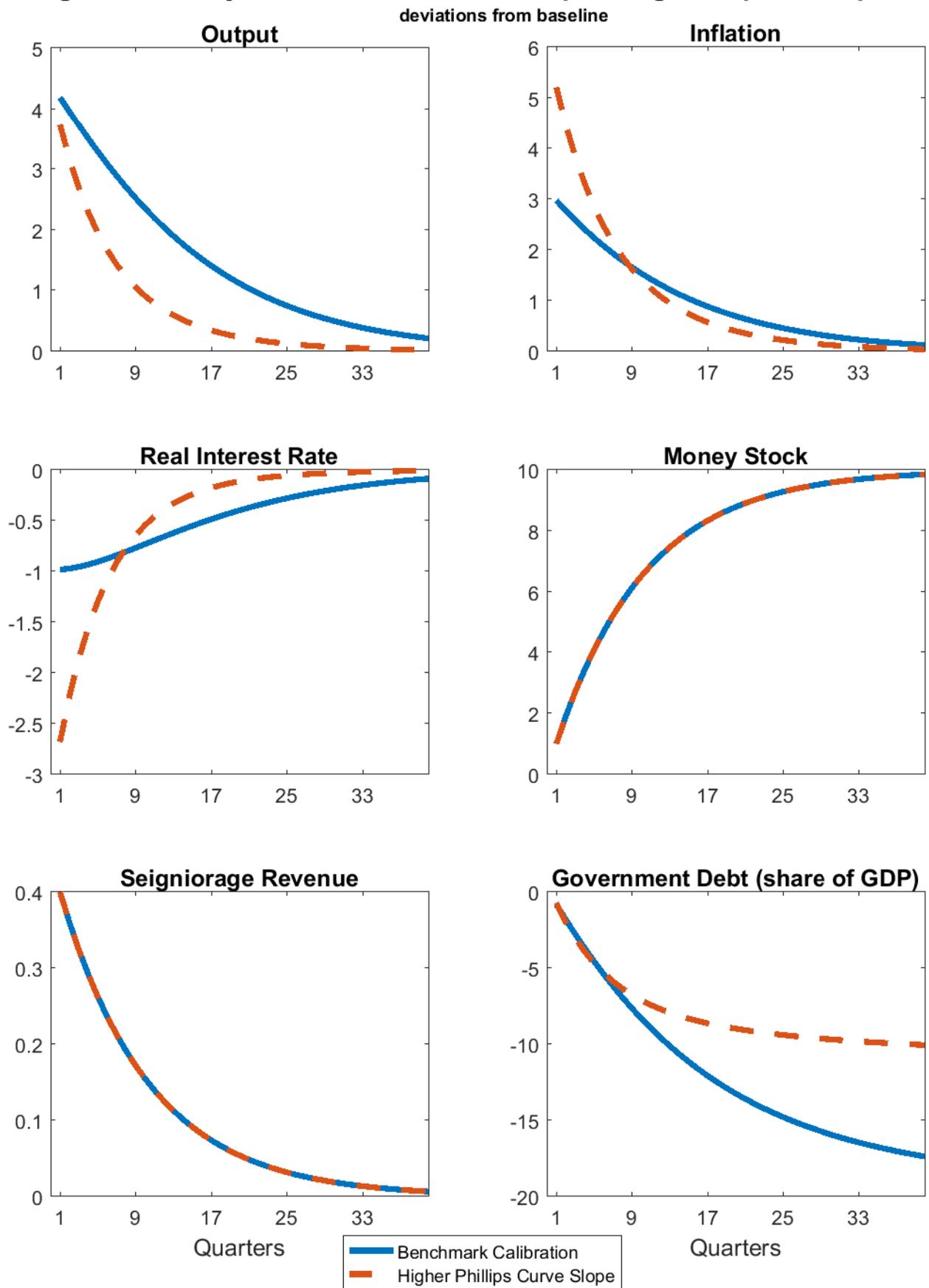
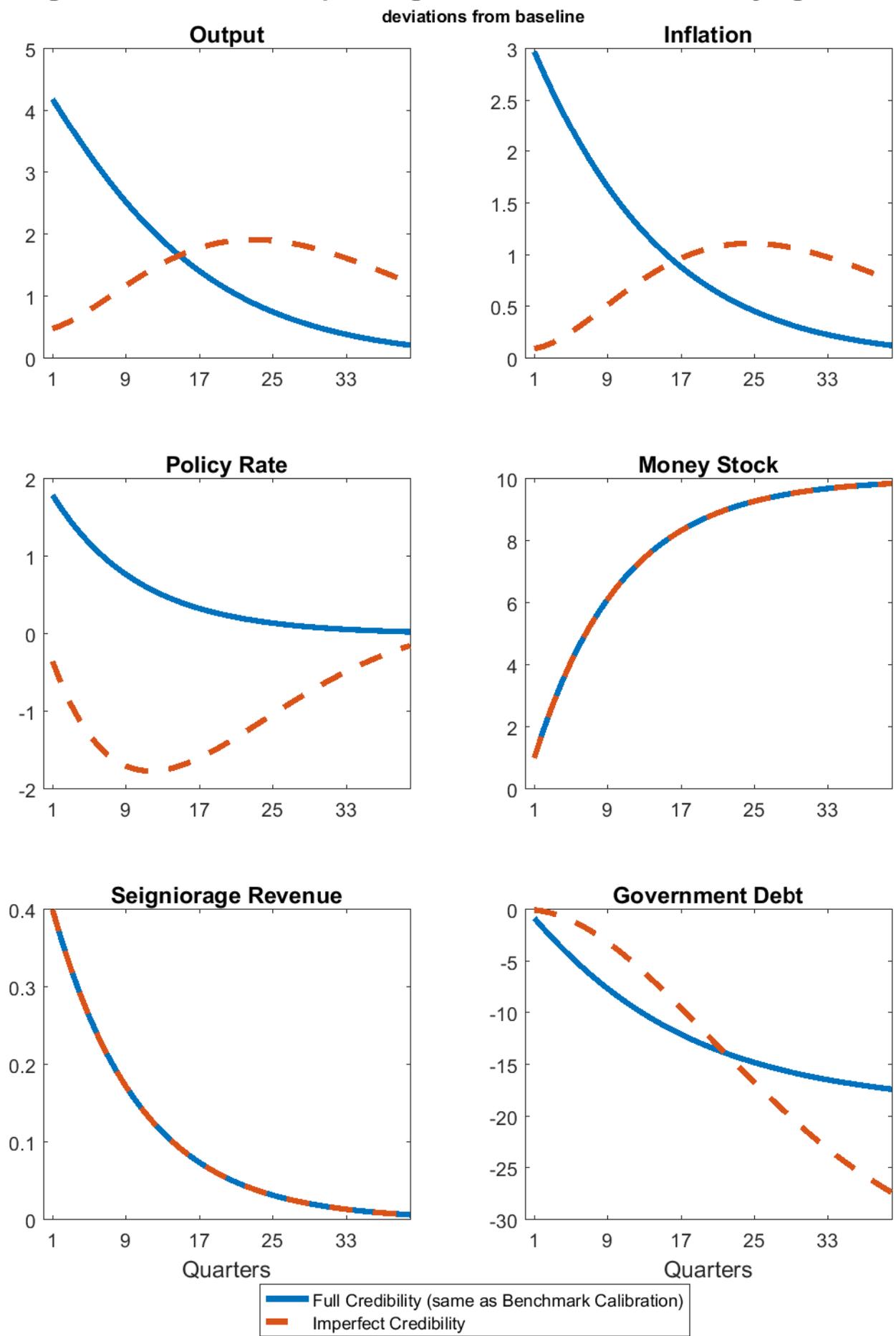


Figure 6. Government Spending with Monetization but Varying Credibility



— Full Credibility (same as Benchmark Calibration)
- - - Imperfect Credibility

Figure 7. Rise in Government Spending: Less Forward-Looking

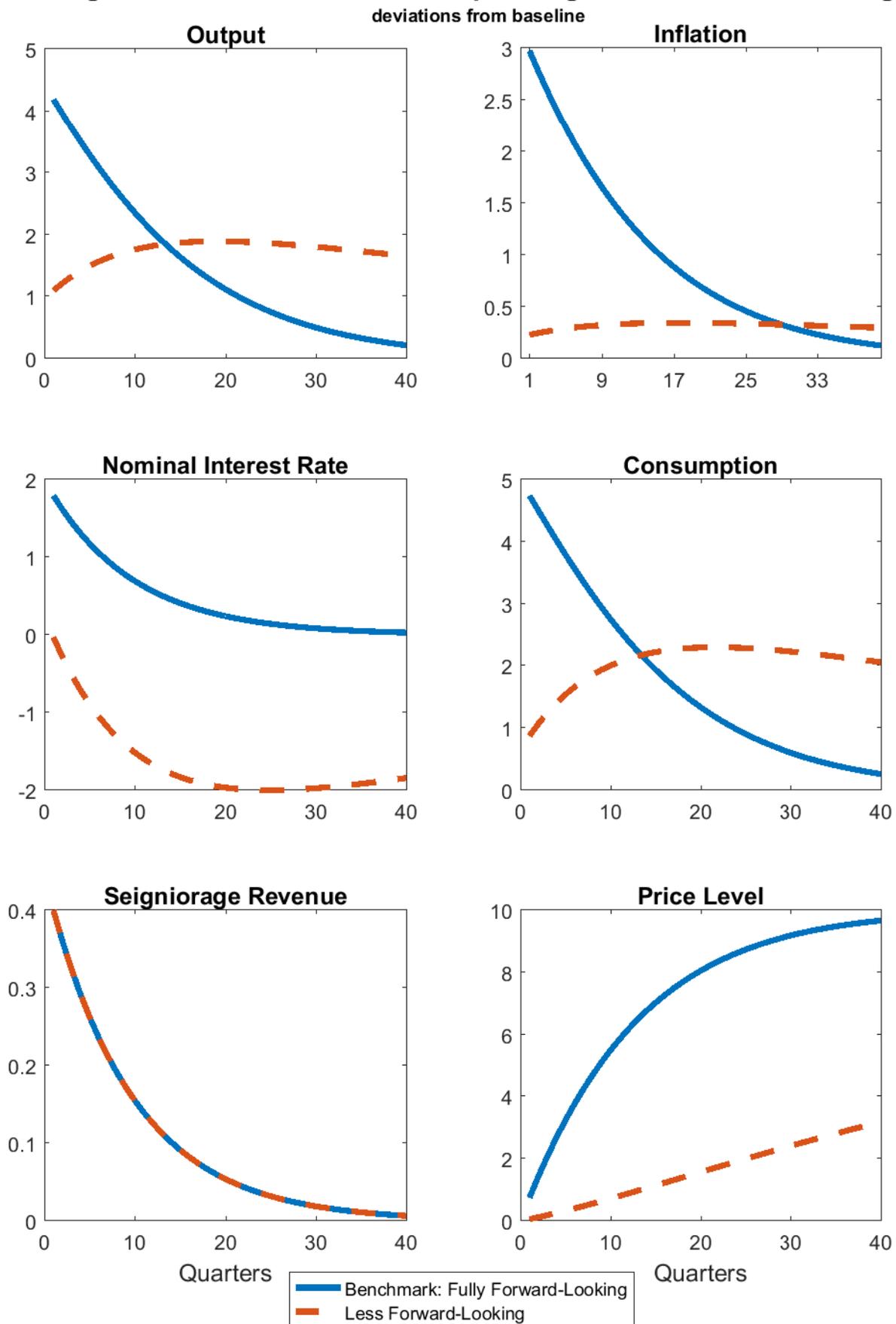


Figure 8a. Monetary Expansion in Liquidity Trap

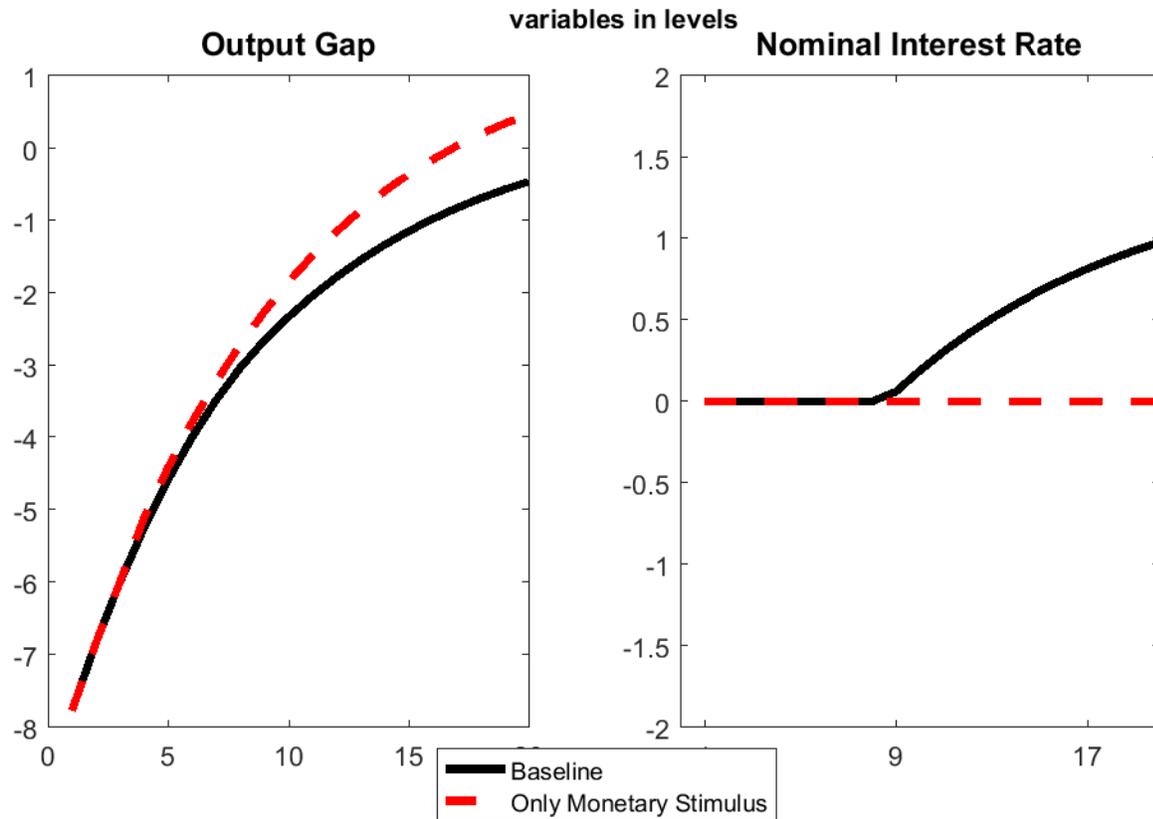


Figure 8b. Partial Effect of Monetary Expansion

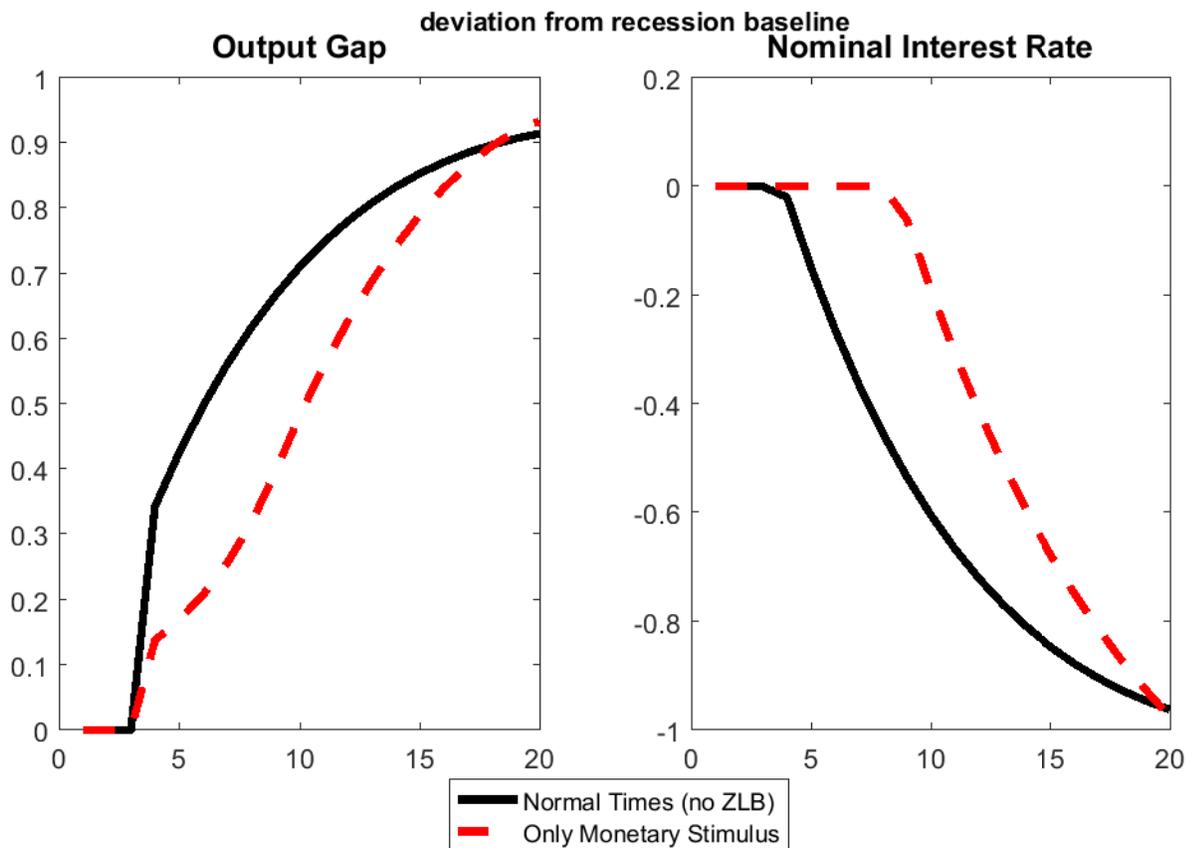


Figure 9a. Monetary Expansion in Liquidity Trap

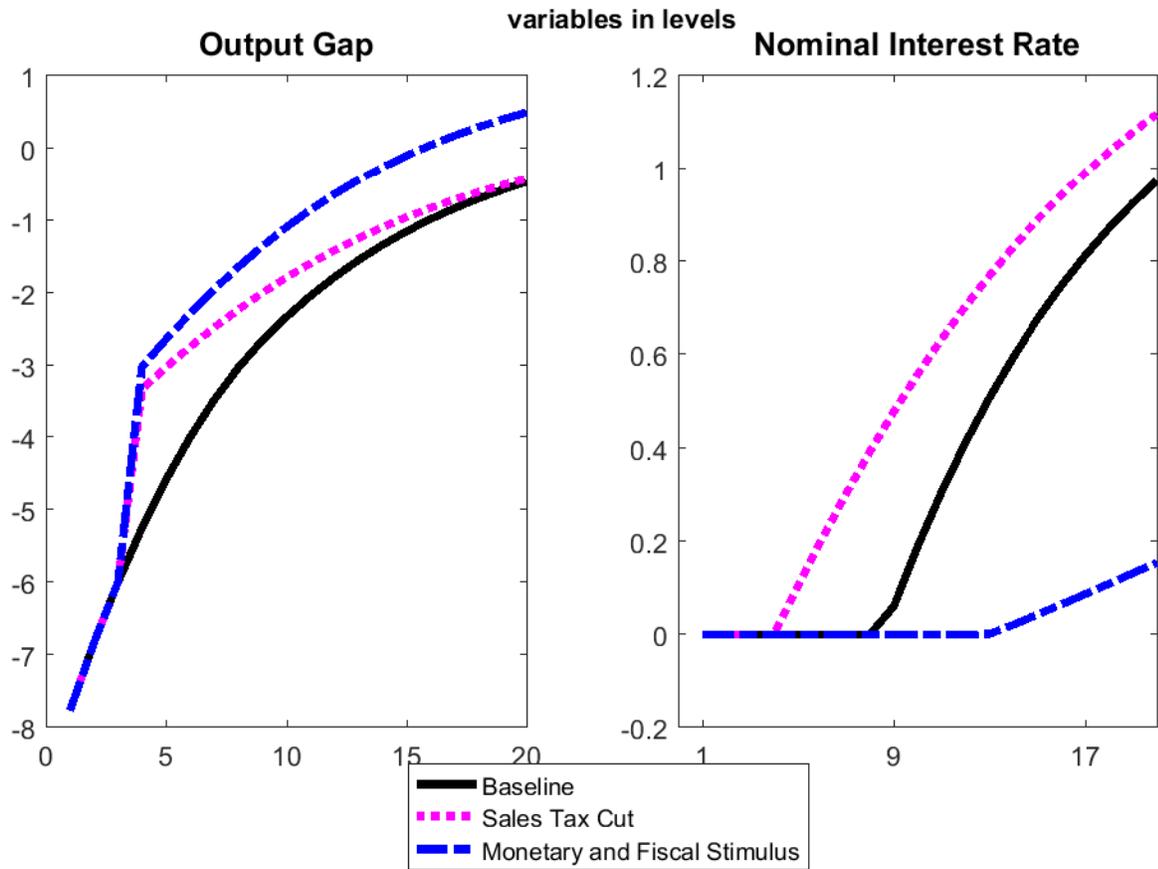


Figure 9b. Partial Effect of Monetary Expansion

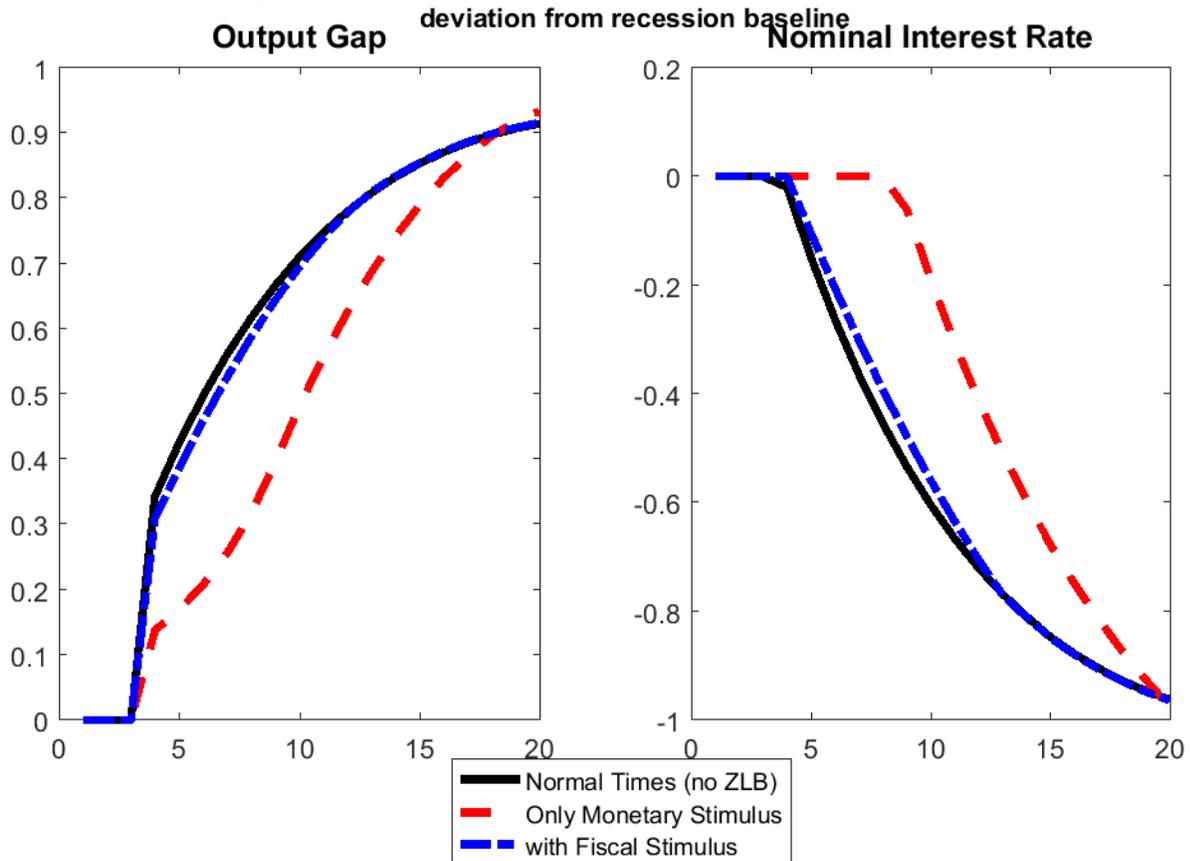
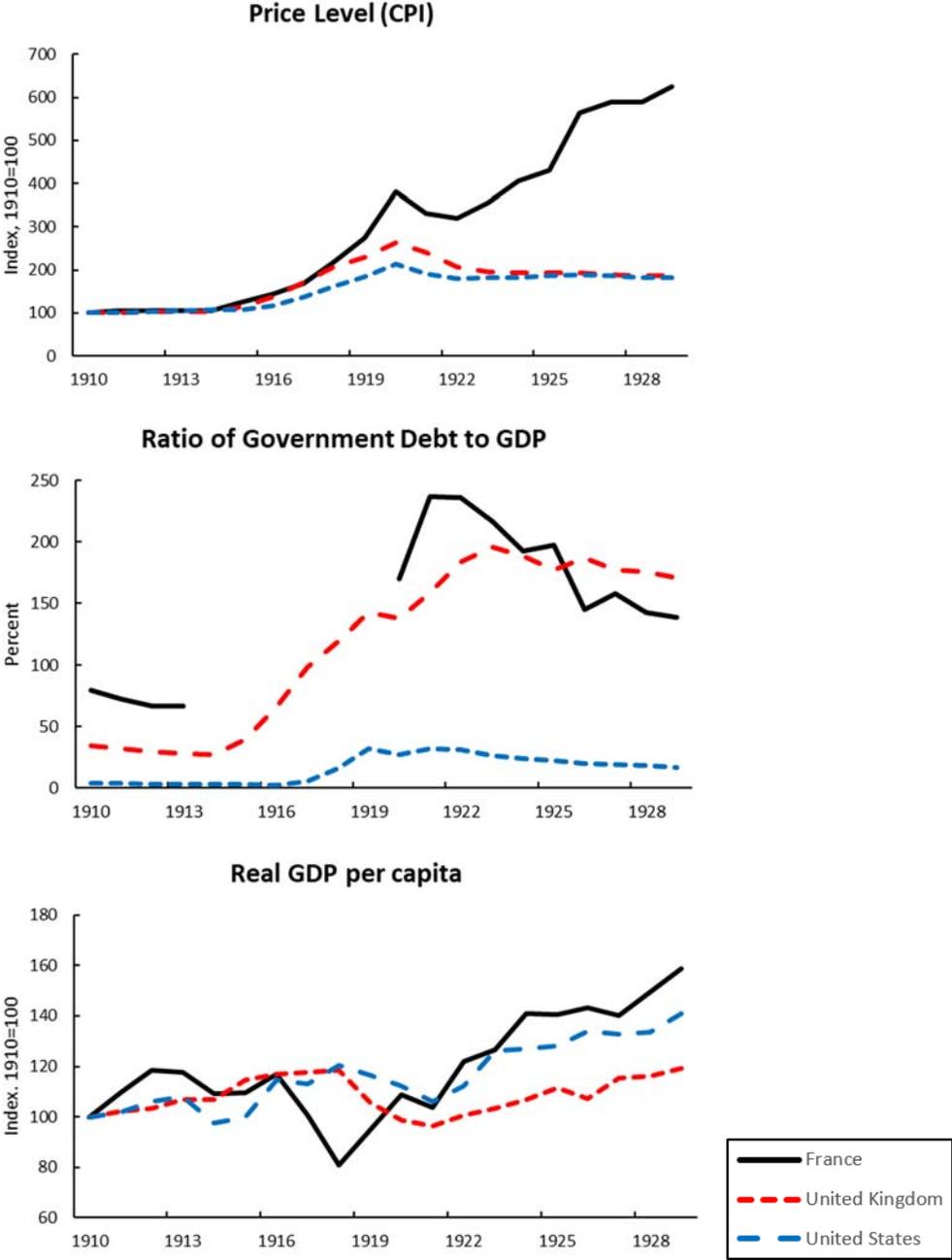
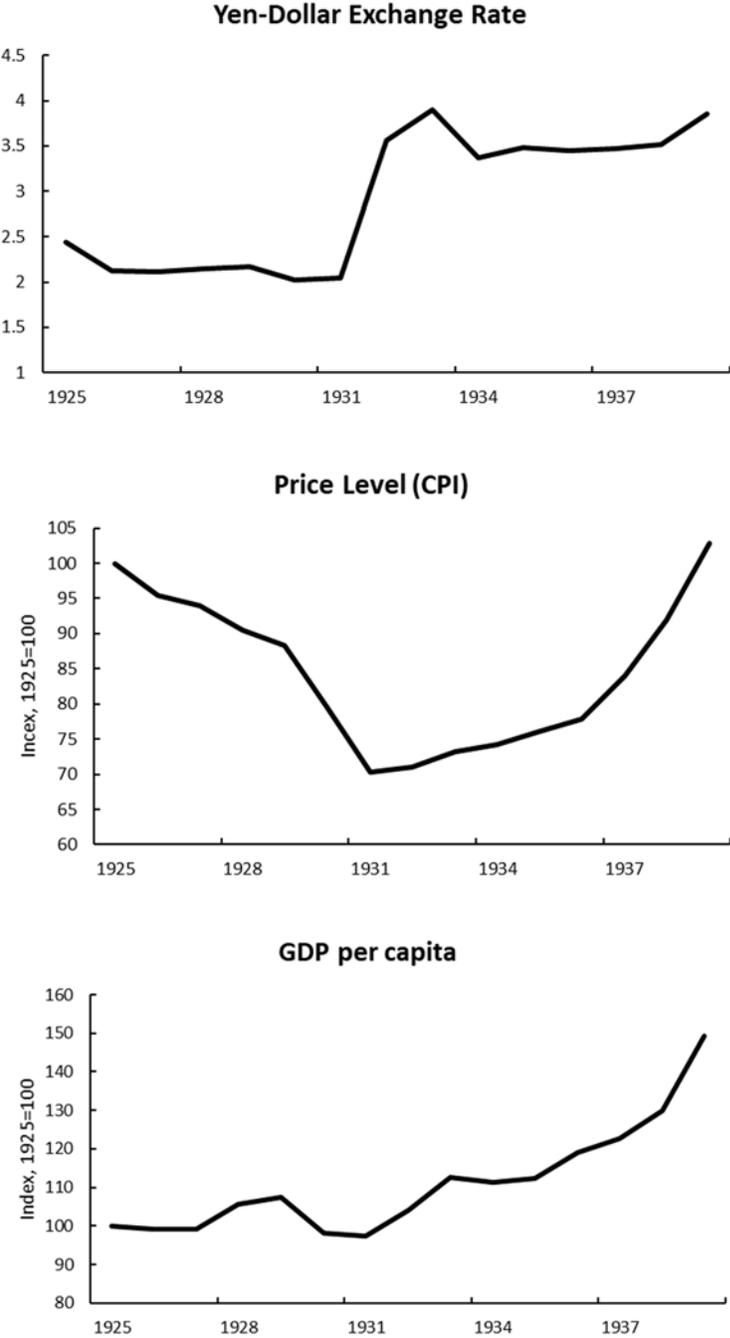


Figure 10: The French Experience, 1910-1929



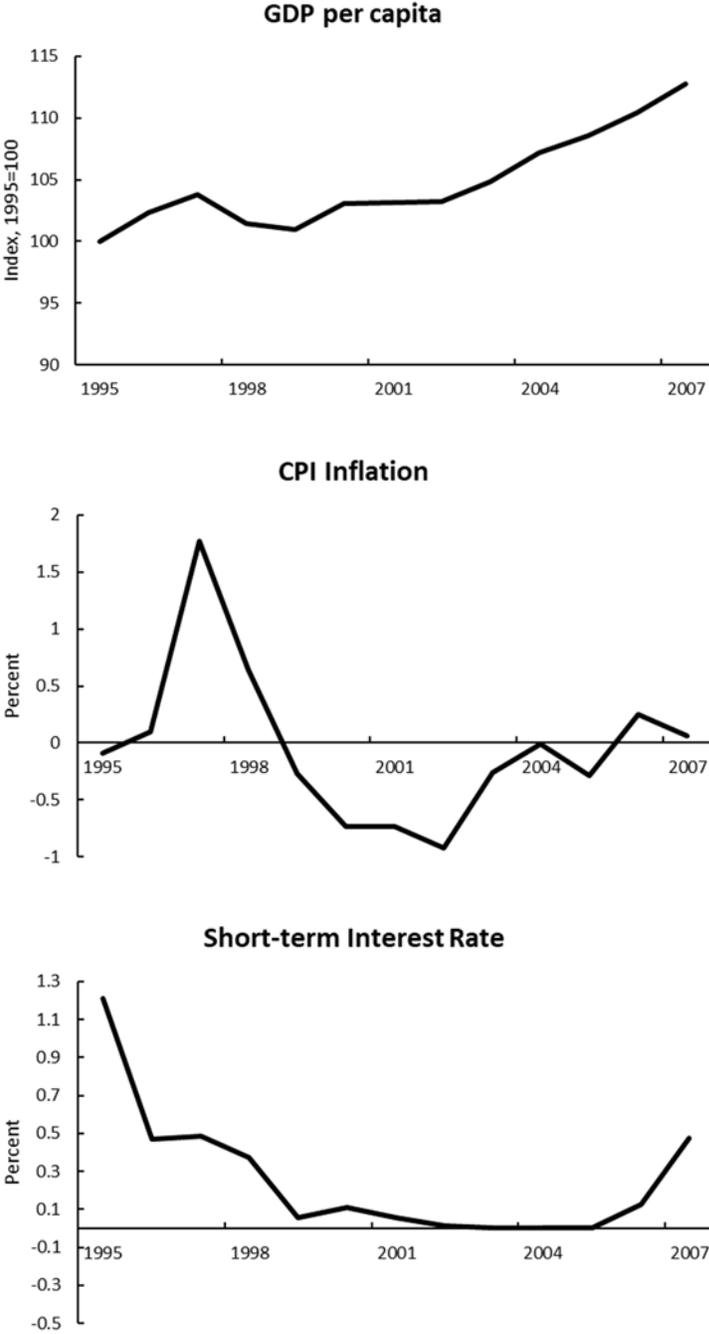
Source: Jordà, Schularick, and Taylor (2017). Data for French government debt are not available for 1914-1919.

Figure 11: The Japanese Experience in the 1930s



Source: Jordà, Schularick, and Taylor (2017).

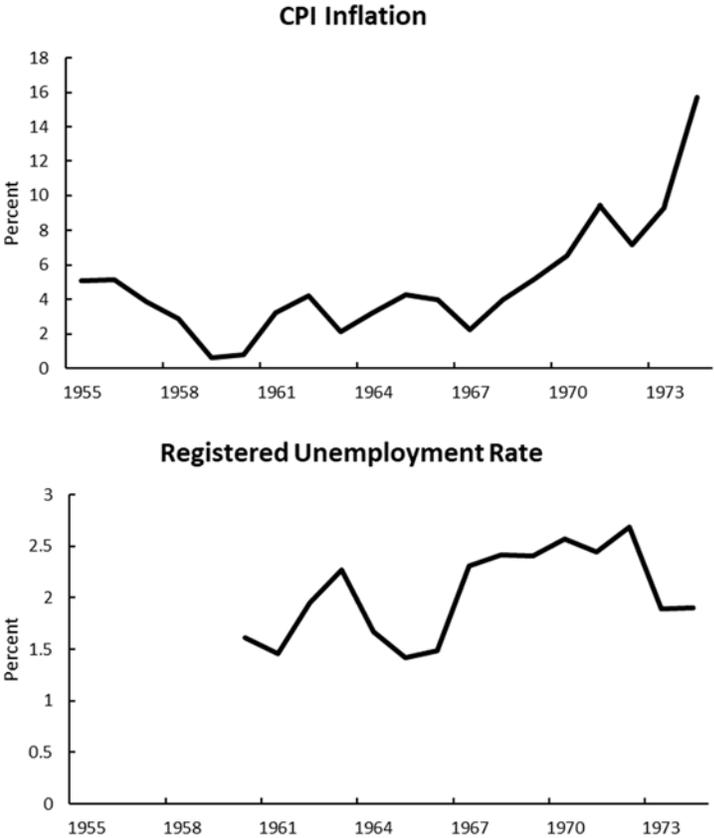
Figure 12: The Japanese Experience Prior to the Financial Crisis



Source: Jordà, Schularick, and Taylor (2017).

Note: CPI inflation in 1997 was boosted by a 2 percentage point increase in the consumption tax.

Figure 13: The U.K. Experience in the 1960s



Source: Jordà, Schularick, and Taylor (2017) for CPI inflation, Federal Reserve Economic Database for registered unemployment.