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Excess stimulus and monetary policy

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Abstract

Stimulus checks are seen increasingly as a crucial method of stimulating the economy in downturns. In early 2021, US households received stimulus amounting to 7.5 percent of their median annual income. I show, however, that it is difficult for a central bank to avoid overshooting its inflation target when credit-constrained households receive moderate excess stimulus. I find that if credit-constrained households receive excess stimulus equal to 1 percent of their median annual income, nominal interest rates must rise by 1 to 3 percentage points to prevent above-target inflation. This poses challenges to central bank credibility. I also find price-level targeting responds better than a Taylor rule to excess stimulus.

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1 Introduction

In recent years, stimulus checks have become a key tool in supporting the economy during economic downturns. Between April 2020 and April 2021, during the COVID-19 pandemic, most US individuals received stimulus checks from the federal government totaling $3,200. These payments have led to speculation that excess stimulus may be one cause of the recent surge in inflation, which reached 9.1 percent in June 2022. Lawrence Summers argued that the last round of stimulus provided through the American Rescue Plan Act, which was enacted in March 2021, could set off "inflationary pressures of a kind we have not seen in a generation."[1] However, he also argued that excess fiscal stimulus is "manageable if monetary and fiscal policy can be rapidly adjusted to address the problem." Indeed, many commentators and policymakers believe that if the Federal Reserve had acted sooner to raise interest rates, it could have contained the above-target inflation we are now witnessing (Reis, 2022).

It is important to understand how easily central banks can prevent excess stimulus from causing above-target inflation both in the current context and because fiscal stimulus is increasingly seen as a standard response to downturns. However, to my knowledge, the assumption that central banks can mitigate the inflationary effects of excessive fiscal stimulus simply by raising interest rates has not been tested. This paper examines that question. I consider a simple model incorporating credit-constrained consumers, stimulus checks, and monetary policy. I show why, intuitively, nominal interest rates likely need to rise substantially to prevent above-target inflation following excess stimulus in such an economy. I then study this premise in a fuller simulation.

My paper relates to the literature that studies the interaction between fiscal policy and monetary policy. Some papers in this literature imply that it may be difficult for central banks to prevent inflation in response to expansionary fiscal policy. However, they hold the somewhat unconventional view that fiscal policy rather than monetary policy ultimately determines the price level (Leeper, 1991; Cochrane, 2023). My paper is unusual in that it shows monetary policy may struggle to respond to excess stimulus even under the conventional view that monetary policy does ultimately determine the price level. My paper also relates to the literature studying the causes of the recent inflation spike (Jordà et al., 2022; de Soyres, Santacreu, and Young, 2022).

2 Model

I now introduce the model. There are five types of agents: patient households, credit constrained (hand-to-mouth) households, firms, the government, and the central bank. I study how the central bank responds when the government provides excess stimulus to

[1] See Lawrence Summers, "The Biden Stimulus Is Admirably Ambitious. But It Brings Some Big Risks, Too," *Washington Post*, February, 4, 2021.

households.

Patient Households Patient households decide how much to consume $C_{p,t}$ and work $L_{p,t}$. The price of consumption is P_t, and the real wage is W_t. Patient households buy and sell nominal government bonds issued in the current period B_t and receive interest i_{t-1} on bonds redeemed from the preceding period. They receive a transfer from the government, $T_{p,t}$, and profits from monopolistic firms. When $\psi > 0$, they face labor adjustment costs. Inflation is denoted by π_t. They maximize either additive utility, $U(C, L) = \frac{C^{1-\gamma}}{1-\gamma} - \frac{L^{1+\theta}}{1+\theta}$, or GHH (Greenwood, Hercowitz, and Huffman, 1988) utility, $U(C, L) = \frac{1}{1-\gamma}\left(C - \frac{L^{1+\eta}}{1+\eta}\right)^{1-\gamma}$.

$$\max \mathbb{E}\left[\sum_{t=0}^{\infty} \beta^t U(C_{p,t}, L_{p,t})\right]$$

s.t.

$$C_{p,t} + \frac{B_{p,t}}{P_t} \leq W_t L_{p,t} + \frac{B_{p,t-1}}{P_{t-1}}\frac{1+i_{t-1}}{1+\pi_t} + T_{p,t} + profits_t - \frac{\psi}{2}(L_{p,t} - L_{p,t-1})^2$$

This yields the following first-order conditions where $\mu_{p,t}$ is the Lagrange multiplier:

$$[C_{p,t}] : U_c(C_{p,t}, L_{p,t}) = \mu_{p,t} \tag{1}$$

$$[L_{p,t}] : -U_l(C_{p,t}, L_{p,t}) = \mu_{p,t} W_t - \psi\mu_{p,t}(L_{p,t} - L_{p,t-1}) + \beta\psi\mathbb{E}_t\left[\mu_{p,t+1}(L_{p,t+1} - L_{p,t})\right] \tag{2}$$

$$\left[\frac{B_{p,t}}{P_t}\right] : \mu_{p,t} = \beta\mathbb{E}_t\left[\mu_{p,t+1}\frac{1+i_t}{1+\pi_{t+1}}\right] \tag{3}$$

Credit-Constrained (Hand-to-Mouth) Households Similar to patient households, credit-constrained households face a budget constraint (equation (4)). They are credit constrained, which means they try to spend any money they receive. However, it may take credit-constrained consumers time to find appropriate purchases, so I specify that consumers spend ρ_h of any money they receive in a period using equation (5). When $\rho_h = 1$, credit-constrained households spend a stimulus check immediately. When $\rho_h < 1$, they spend some of the check and save the remainder to spend in subsequent periods. Finally, I assume that credit-constrained households choose their labor supply in a manner similar to that of patient households (equations (6) and (7)).

$$C_{h,t} + \frac{B_{h,t}}{P_t} = W_t L_{h,t} + \frac{B_{h,t-1}}{P_{t-1}}\frac{1+i_{t-1}}{1+\pi_t} + T_{h,t} - \frac{\psi}{2}(L_{h,t} - L_{h,t-1})^2 \tag{4}$$

$$C_{h,t} = \rho_h\left(W_t L_{h,t} + \frac{i_{t-1}}{\pi_t}\frac{B_{h,t-1}}{P_{t-1}} + T_{h,t}\right) + (1-\rho_h)\bar{C}_h \tag{5}$$

$$-U_l(C_{h,t}, L_{h,t}) = \mu_{h,t} W_t - \psi\mu_{h,t}(L_{h,t} - L_{h,t-1}) + \beta\psi\mathbb{E}_t\left[\mu_{h,t+1}(L_{h,t+1} - L_{h,t})\right] \tag{6}$$

$$U_c(C_{h,t}, L_{h,t}) = \mu_{h,t} \tag{7}$$

Firms I assume that firms follow a standard Calvo framework in which a competitive final-goods firm, using a constant elasticity of substitution production function, aggregates intermediate goods from monopolistic intermediate firms that can change their price only with a fixed probability each period. There are no productivity shocks, and intermediate-goods firms have linear production over labor, which yields the aggregate production function equation (8). Solving the problem of the intermediate-goods firms (see Online Appendix A for details) yields a standard New Keynesian Phillips curve (equation (9)). There are no productivity shocks, so the firms' marginal cost equals the wage ($\widehat{MC}_t = \hat{W}_t$).

$$\hat{Y}_t = \hat{L}_t \tag{8}$$

$$\hat{\pi}_t = \kappa \hat{W}_t + \beta \mathbb{E}_t[\hat{\pi}_{t+1}] \tag{9}$$

Government The government provides transfers to the households and issues debt to do so. If the government provides $1 extra in transfers to the patient households, they save exactly $1 extra in government bonds, so the choice to transfer funds to patient households, $T_{p,t}$, has no effect on central bank policy. On the other hand, the choice to transfer funds to the credit-constrained households, $T_{h,t}$, directly affects how much those households consume. $T_{h,t}$ is assumed to follow the process equation (10).

$$T_{h,t} = \bar{T}_h + \epsilon_{h,t} \tag{10}$$

Central Bank The central bank targets zero inflation through one of three potential monetary policy rules. The first rule, equation (11), is strict inflation targeting, where the central bank sets the interest rate so that inflation is exactly on target. The second rule, equation (12), is a Taylor rule (the first rule is a special case of the second when $\phi_\pi \to \infty$). The third rule is a price-level target.

$$\hat{\pi}_t = 0 \tag{11}$$

$$\hat{i}_t = \phi_\pi \hat{\pi}_t \tag{12}$$

$$\hat{i}_t = \phi_p \hat{P}_t \tag{13}$$

Resource Condition The share of households that are patient is p. There is an aggregate labor condition (equation (14)) and a resource condition (equation (15)).

$$L_t = pL_{p,t} + (1-p)L_{h,t} \tag{14}$$

$$pC_{p,t} + (1-p)C_{h,t} = Y_t - p\frac{\psi}{2}(L_{p,t} - L_{p,t-1})^2 - (1-p)\frac{\psi}{2}(L_{h,t} - L_{h,t-1})^2 \tag{15}$$

DSGE Conditions The model comprises 12 variables ($C_{p,t}$, $L_{p,t}$, $\mu_{p,t}$, i_t, π_t, W_t, $C_{h,t}$, $L_{h,t}$, $\frac{B_{h,t}}{P_t}$, $T_{h,t}$, L_t, and Y_t) and 12 equations (equations (1) to (6), (8) to (10), (14), and (15) and a monetary policy condition).

3 Intuition

The relationship between interest rates and excess stimulus can be simplified to one equation under three assumptions. First, I assume that the government provides excess stimulus to the credit-constrained households, which consume all the excess stimulus in the same period ($\rho_h = 1$). This means the effects of excess stimulus last only for a single period, which in this simple case can be thought of as representing approximately one year. Second, I assume GHH utility, which means the consumption-leisure effect can be ignored. In the model in section 4, I primarily consider additive utility. Third, I assume the central bank strictly follows its inflation target.

Since all the excess stimulus is consumed within the same period and monetary policy responds such that inflation remains on target, the model is expected to return to the steady state from period $t+1$ onward. Therefore, $\mathbb{E}_t[\hat{\pi}_{t+1}] = 0$, so by the Phillips curve (equation (9)), the only way inflation can remain on target is if wages are unchanged. Under GHH utility, there is no consumption-leisure effect, so the only way labor supply can increase is if wages rise. Therefore, with no change in wages, the labor supply from both types of households remains unchanged, so output is unchanged.

Since output is unchanged, the only way the credit-constrained households can raise their spending in line with the excess stimulus is if patient households cut back their spending by an equal amount (equation (16)). By the Euler condition, the only way patient households cut back their spending is if interest rates rise, motivating patient households to save (equation (17)).

$$p\bar{C}_p\hat{C}_{p,t} = -(1-p)\bar{C}_h\hat{C}_{h,t} \tag{16}$$

$$\gamma\bar{C}_p\hat{C}_{p,t} = -\left(\bar{C}_p - \frac{\bar{L}_p^{1+\theta}}{1+\theta}\right)\hat{i}_t \tag{17}$$

Combining equations (16) and (17), noting that the intertemporal elasticity subsitution (IES) is given by $\frac{1}{\gamma}$, and making the simplifying assumption that $(1-p)\bar{C}_h = p\left(\bar{C}_p - \frac{\bar{L}_p^{1+\theta}}{1+\theta}\right)$, results in equation (18). As the IES falls, patient households become less willing to save more when interest rates rise, so interest rates must rise by more. In this paper, I consider the impact of an excess stimulus shock equivalent to 5 percent of the credit-constrained households' annual steady state income.[2] Assuming that the IES takes the value of 0.5, I

[2]This may sound large, but between December 2020 and April 2021, the US government issued stimulus checks equivalent to 7.5 percent of median household income.

find that interest rates must rise 10 percentage points to prevent inflation.

$$\hat{i}_0 \approx \frac{1}{IES}\hat{C}_{h,t} \tag{18}$$

4 Calibrated Model Results

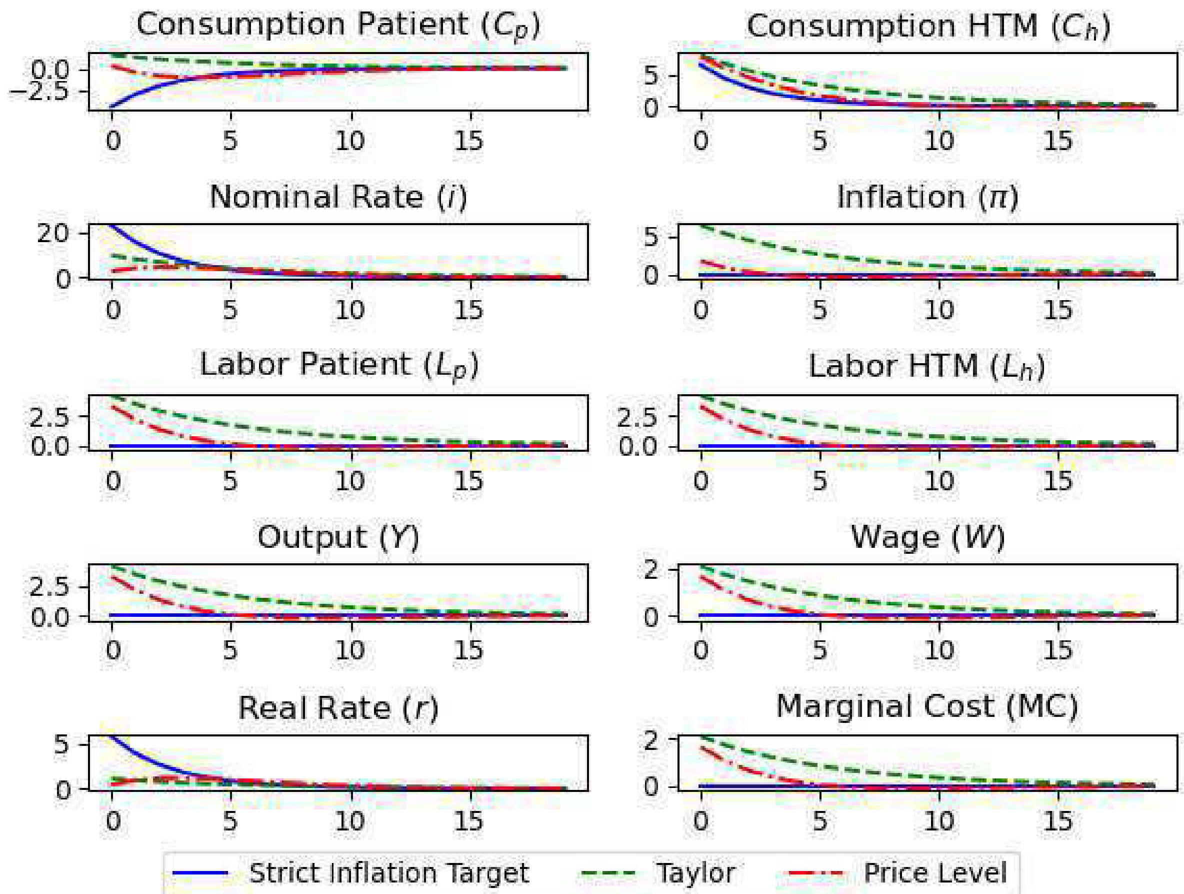
I now calibrate the model and obtain results. I calibrate a period to represent one quarter, so I set β as $0.96^{\frac{1}{4}}$ and the frequency of price change to be 30 percent. I set standard monetary policy parameters: $\phi_\pi = 1.5$, $\phi_p = 0.5$. I set γ as 2, which implies the intertemporal elasticity of substitution is 0.5. In the baseline model, I set θ as 0.5, which corresponds to a high elasticity of labor supply (ELS) of 2, which fits macroeconomic estimates. I set p as 0.6 and the transfers such that $\frac{\bar{C}_h}{\bar{C}_p} = 1$, which implies that 40 percent of steady-state spending is by credit-constrained households. I set ρ_h as 0.33, which implies that credit-constrained households spend 33 percent of the excess stimulus in the first quarter and 80 percent in the first year, all else being equal. This is low compared with some estimates of spending from stimulus checks (Souleles, 1999; Parker et al., 2013) because I consider a relatively large stimulus check. A higher ρ_h would imply that interest rates would need to rise substantially more in initial quarters but moderately less in later quarters to prevent above-target inflation. I do not include labor adjustment costs in the baseline model ($\psi = 0$). See more details on the calibration in Online Appendix B.

Figure 1 shows the results when households have GHH utility. The blue solid line shows the response when the central bank strictly targets inflation each period. Hand-to-mouth consumption rises until the stimulus checks are exhausted. With no other adjustment, the increase in this consumption would be inflationary. Therefore, the central bank raises the nominal interest rate, which in turn raises the real interest rate. This motivates patient consumers to reduce their consumption. Firms are not producing above cost, which would be inflationary, so the real marginal cost and real wages do not change. Under GHH preferences, labor supply is determined by the real wage, which is unchanged.

Figure 2 presents the impulse responses when households have additive utility. With additive utility, agents experience a consumption-leisure effect and are therefore motivated to work more when their marginal utility of consumption is greater. Therefore, credit-constrained agents reduce their labor supply following excess stimulus. This means there is a smaller increase in demand for goods, so nominal interest rates do not need to rise as much as in the GHH utility case. However, in this case, credit-constrained households immediately reduce their labor supply by 10 percent, which seems unrealistic. Indeed, Coibion, Gorodnichenko, and Weber (2020) conducted a survey of intentions following the 2020 distribution of US stimulus checks and found no meaningful impact on labor supply decisions except that unemployed people expected to search harder for a job, which implies credit-constrained consumers would work more, not less.

Therefore, in figure 3, I introduce labor adjustment costs to provide a more realistic re-

Figure 1: GHH Utility



sponse of labor supply. In this alternative calibration, households pay labor adjustment costs of 0.01 percent and 1 percent of their steady-state consumption to increase their labor supply by 1 percent and 10 percent from one quarter to the next, respectively. Consequently, credit-constrained households reduce their labor supply by less, and their consumption rises by more, implying that interest rates and inflation increase by more. I also find similar results when I consider the additive utility case without labor adjustment costs but with a lower elasticity of labor supply (ELS) of 0.5 in figure 4 rather than the baseline ELS of 2 I normally consider. This alternative ELS matches microeconomic estimates that focus on intensive margin changes in labor supply. This could be more realistic than the higher macroeconomic estimates of ELS because firms may not hire large numbers of workers in response to temporary rises in consumption due to stimulus checks.

Panel A of table 1 summarizes the degree to which interest rates need to respond to prevent inflation following excess fiscal stimulus equaling 5 percent of credit-constrained households' annual income. I find that nominal interest rates need to rise at least 4.4 percentage points on average over the subsequent year. And, excluding the case in

Figure 2: Additive Utility

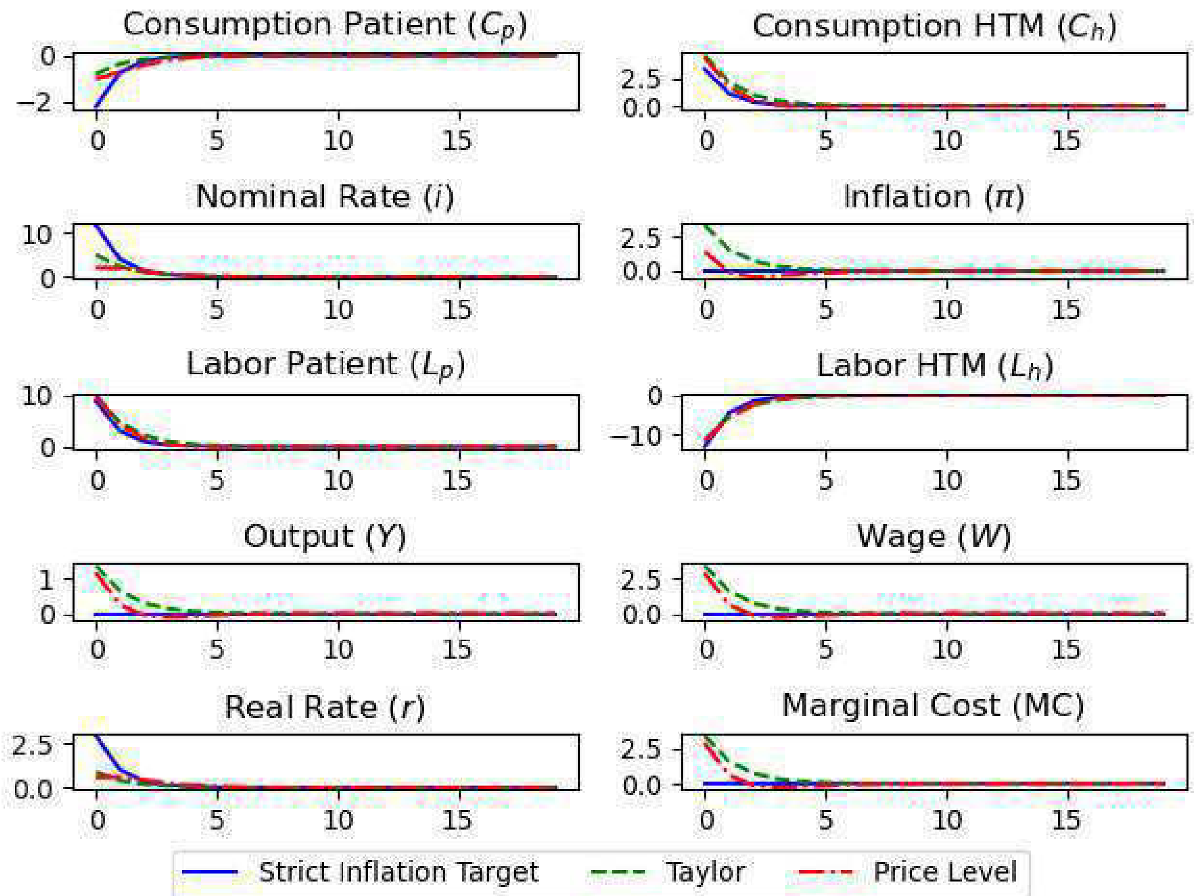
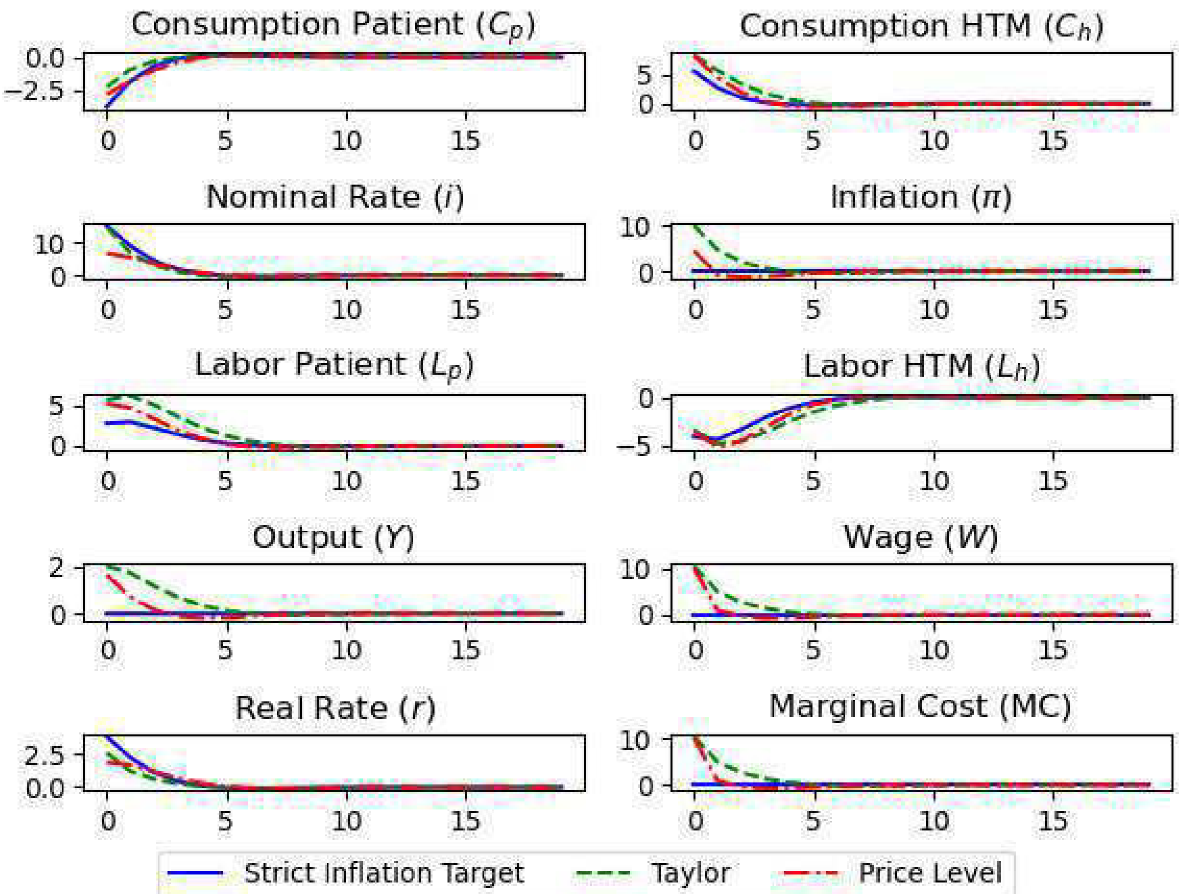


figure 2 where the labor supply from credit-constrained households falls greatly, I find interest rates need to rise at least 6.5 percentage points. Therefore, it appears to be very difficult for a central bank to maintain its inflation target following significant excess stimulus.

I also consider the impact of excess stimulus under alternative monetary policy rules. I show the results under a Taylor rule in the green dashed lines in the figures and in panel B of table 1 and the results under a price-level rule in the red dotted/dashed lines in the figures and in panel C of table 1. Under a Taylor rule, both inflation and interest rates rise substantially in equilibrium. Under a price-level rule, interest rates do not need to rise as much because patient households know that if the price level rises above target, the central bank will set higher interest rates in the future, which causes them to reduce their consumption now. Excluding the case in figure 2, I find that interest rates need to rise at least 6.5 percentage points on average over the subsequent year under a Taylor rule but only 3.6 percentage points under a price-level rule. Additionally, under a Taylor rule, inflation rises substantially above target before returning to the target, whereas, under a price-level rule, the price level moves moderately above target before returning to the

Figure 3: Additive Utility and Labor Adjustment Costs



target. Therefore, an additional advantage of a price-level target is that it ensures the credibility of the central bank, unlike a Taylor rule, where occasional excess fiscal stimulus could lead to periods of significantly above-target inflation and upward revisions in long-term inflation beliefs.

5 Conclusion

I investigate how central banks can respond to excess fiscal stimulus. I find it is very difficult for central banks to prevent above-target inflation following excess stimulus and may require untenable increases in interest rates. Price-level targets perform better and may be more credible in the long-term but still require large interest rate rises.

Figure 4: Additive Utility and Low Intertemporal Elasticity of Substitution

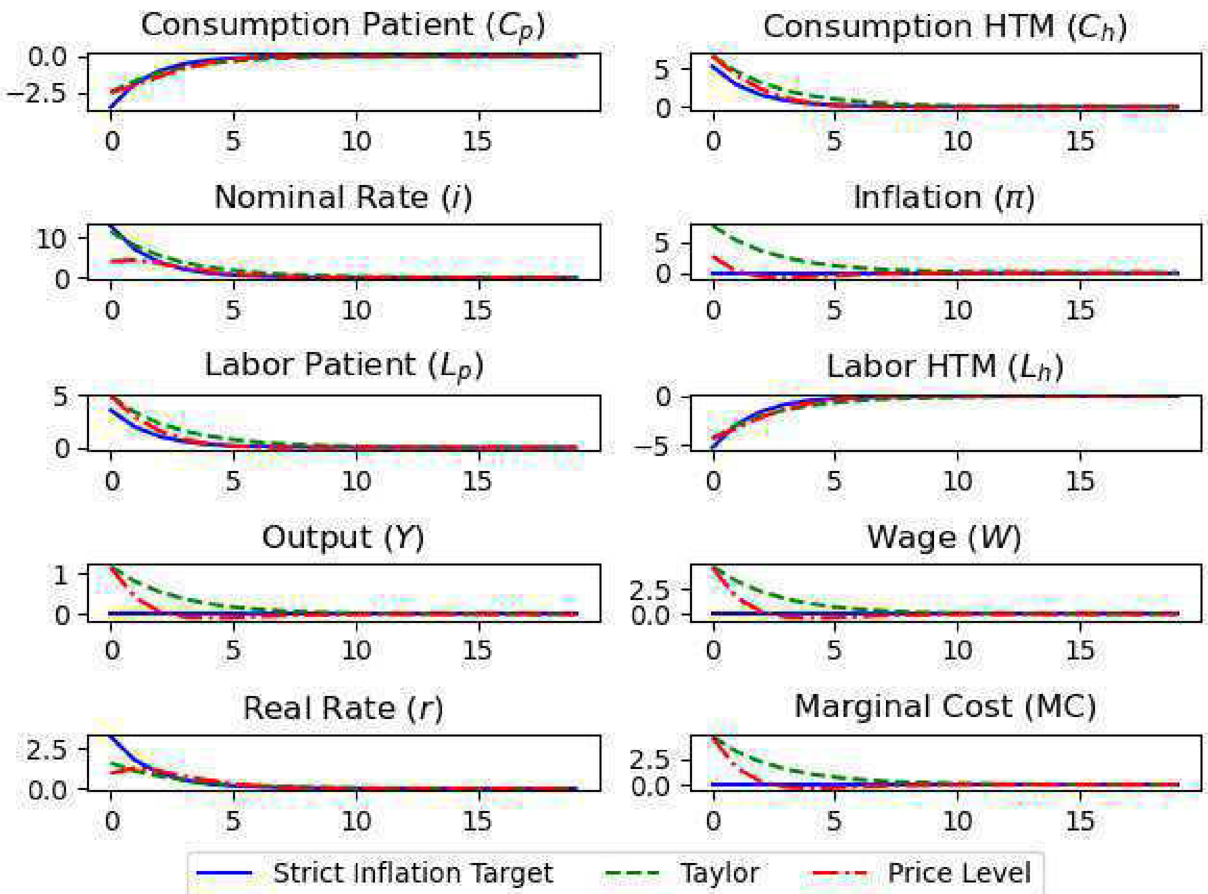


Table 1: Results Summary

	Year 1			Year 2			Year 3		
Nominal Rate Δi, Inflation $\Delta\pi$, Patient Consumption ΔC_p	Δi	$\Delta\pi$	ΔC_p	Δi	$\Delta\pi$	ΔC_p	Δi	$\Delta\pi$	ΔC_p
Panel A: Strict Inflation Target (Blue, Solid)									
A. GHH Utility (Figure 1)	13.97	0.00	-2.69	2.92	0.00	-0.56	0.61	0.00	-0.12
B. Additive Utility (Figure 2)	4.37	0.00	-0.83	0.06	0.00	-0.01	0.00	0.00	-0.00
C. Additive Utility and Labor Adjustment Costs (Figure 3)	7.68	0.00	-1.58	-0.11	0.00	0.11	-0.10	0.00	0.02
D. Additive Utility with Lower Elasticity of Labor Supply	6.46	0.00	-1.76	0.55	0.00	-0.15	0.05	0.00	-0.01
Panel B: Taylor Rule (Green, Dashed)									
E. GHH Utility (Figure 1)	7.45	4.97	1.20	3.62	2.42	0.58	1.76	1.17	0.28
F. Additive Utility (Figure 2)	2.22	1.48	-0.36	0.11	0.07	-0.02	0.01	0.00	-0.00
G. Additive Utility and Labor Adjustment Costs (Figure 3)	6.53	4.34	-0.88	-0.43	-0.29	0.12	-0.21	-0.14	0.03
H. Additive Utility with Lower Elasticity of Labor Supply	7.19	4.79	-1.55	1.58	1.06	-0.34	0.35	0.23	-0.08
Panel C: Price-Level Rule (Red, Dotted/Dashed)									
I. GHH Utility (Figure 1)	3.79	0.71	-0.51	3.09	-0.34	-0.89	1.21	-0.26	-0.41
J. Additive Utility (Figure 2)	1.53	0.12	-0.60	0.15	-0.12	-0.04	-0.00	-0.00	0.00
K. Additive Utility and Labor Adjustment Costs (Figure 3)	4.46	0.32	-1.49	0.09	-0.36	0.07	-0.12	0.04	0.03
L. Additive Utility with Lower Elasticity of Labor Supply	3.63	0.40	-1.72	0.75	-0.38	-0.23	0.01	-0.03	0.00

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