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Lack of confidence, the zero lower bound, and the virtue of fiscal rules

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Abstract

In the presence of the zero lower bound, standard business cycle models with a Taylor-type monetary policy rule are prone to equilibrium multiplicity. A drop in confidence can drive the economy into a liquidity trap without any change in fundamentals. Using a prototypical sticky-price model, I show that Ricardian fiscal spending rules that prevent real marginal costs from declining in the face of a confidence shock insulate the economy from such expectations-driven liquidity traps.

Keywords: Multiple Equilibria, Liquidity Trap, Sunspots, Government Spending, Ricardian Fiscal Policy

JEL-Codes: E52, E62

Non-technical summary

The presence of an effective lower bound on nominal interest rates can impede macroeconomic stabilization policy in several ways. Not only can the realization of a large contractionary fundamental shock render a policy rate cut to zero insufficient to prevent a decline in inflation and real activity. The presence of the zero lower bound also makes economies prone to purely expectations-driven liquidity traps in which deflationary expectations become self-fulfilling.

This paper addresses the latter threat, asking how to avoid such liquidity traps that are caused by a drop in confidence without any change in the economy's fundamentals. Using a standard New Keynesian model with price adjustment costs, I show that it is possible to design fiscal rules that eliminate expectations-driven liquidity trap equilibria without having to abandon the empirically realistic assumption of Ricardian policy regimes. The key feature of any such fiscal rule or target criterion is that when confronted with a drop in confidence it stipulates an endogenous policy response that is sufficiently aggressive to prevent a decline in real marginal costs. This is because in the presence of nominal rigidities deflationary expectations can only be supported as an equilibrium outcome when real marginal costs are allowed to fall. I then provide an example of a fiscal spending rule that satisfies this requirement, supporting the existence of the intended equilibrium where inflation is at target and the nominal interest rate is strictly positive as the unique stable equilibrium. The finding is shown in the context of steady state equilibria as well as in a stochastic setup where uncertainty arises due to a non-fundamental confidence shock.

1 Introduction

The presence of an effective lower bound on nominal interest rates can impede macroeconomic stabilization policy in several ways. Not only can the realization of a large contractionary fundamental shock render a policy rate cut to zero insufficient to prevent a decline in inflation and real activity. The presence of the zero lower bound also makes economies prone to purely expectations-driven liquidity traps in which deflationary expectations become self-fulfilling (see Benhabib et al., 2001).

This paper addresses the latter threat, asking how to avoid liquidity trap equilibria that leave the economy stuck with deflation and a subdued level of private consumption. I work with a dynamic, stochastic rational expectations model with quadratic price adjustment costs. Fiscal policy is Ricardian and monetary policy is characterized by a Taylor-type nominal interest rate rule.[1] In general, the model features two steady states. Besides the *intended steady state equilibrium* where inflation and real GDP are stabilized at their target levels, there exists an *unintended steady state equilibrium* where the zero bound is binding and the inflation rate is negative. This steady state indeterminacy also gives rise to the possibility of equilibria where sunspots matter.[2] A sunspot shock that leads to a transitory drop in agents confidence can drive the economy into a liquidity trap without any change in fundamentals.

The central contribution of this paper is to show that it is possible to design fiscal rules that eliminate expectations-driven liquidity trap equilibria without having to abandon the empirically realistic assumption of Ricardian policy regimes. The key feature of any such fiscal rule or target criterion is that when confronted with a drop in confidence it stipulates an endogenous policy response that is sufficiently aggressive to prevent a decline in real marginal costs. This is because in the presence of nominal rigidities deflationary expectations can only be supported as an equilibrium outcome when real marginal costs are allowed to fall. I then provide an example of a fiscal spending rule that satisfies this requirement, supporting the existence of the intended equilibrium as the unique stable equilibrium. The finding is shown in the context of steady state equilibria as well as in a stochastic setup where uncertainty arises due to a two-state sunspot shock.

My paper is related to work by Mertens and Ravn (2014), Christiano and Eichenbaum (2012), Braun et al. (2013) and Aruoba et al. (2013) who study temporary expectations-driven liquidity trap scenarios in models similar to the one I use here, but treat government spending as an exogenous process. A key finding of their analyses is that, contrary to common wisdom based on liquidity trap scenarios that are caused by fundamental shocks, in an expectations-driven liquidity trap a marginal increase in government

[1] Following the terminology of Benhabib et al. (2002), fiscal policies are Ricardian if they ensure that the present discounted value of total government liabilities converges to zero under all possible equilibrium or off-equilibrium paths of the endogenous model variables. Accordingly, non-Ricardian fiscal policies are those that do not satisfy this criterion.

[2] Cass and Shell (1983) use the term sunspots to characterize random phenomena that do not affect fundamentals such as tastes and endowments.

spending lowers equilibrium inflation and reduces the level of private consumption. My finding emphasizes the design of the systematic component of fiscal stabilization policies, showing that the same instrument that is rendered ineffective in an expectations-driven liquidity trap can be used to protect the economy from falling into such a trap.

The paper is also related to Benhabib et al. (2002) and Woodford (2003) who examine non-Ricardian fiscal policies that trigger an off-equilibrium violation of the transversality condition to rule out perfect-foresight equilibria in which the economy slides into a permanent liquidity trap. A potential disadvantage of non-Ricardian monetary-fiscal regimes is, however, that they are associated with a heightened degree of macroeconomic volatility in the wake of fundamental shocks, see, for instance, Bianchi and Melosi (2014). Correia et al. (2013) show in the context of a New Keynesian model how a mix of distortionary taxes can be used to completely circumvent the zero nominal interest rate bound problem. Alstadheim and Henderson (2006) and Sugo and Ueda (2008) consider steady state equilibria and propose monetary policy rules that eliminate the liquidity trap steady state equilibrium. Schmitt-Grohe and Uribe (2012) and Schmitt-Grohe and Uribe (2014) design interest-rate-rule-based exit strategies from deflationary trajectories towards the liquidity trap steady state.

Finally, Benhabib et al. (2014) investigate the implications of the zero lower bound in a sticky-price model where private agents form expectations using adaptive learning rules. They find that under a standard Taylor-type monetary policy rule, large pessimistic shocks to expectations can trigger unstable deflationary paths and propose a so-called switching rule for government spending that prevents actual inflation rates from embarking on a deflationary path.

The remainder of the paper is organized as follows. Section 2 presents the model. Section 3 considers steady state equilibria. I first recapitulate the threat of expectations-driven liquidity traps and then show how a Ricardian policy regime can avoid such liquidity traps through endogenous fiscal stabilization policy. Section 4 extends the analysis to a stochastic setup, assuming that agents' confidence is captured by a sunspot shock that follows a two-state Markov process. Finally, section 5 concludes.

2 The model

I consider a small monetary business cycle model with nominal rigidities and monopolistic competition. The economy is inhabited by a continuum of identical households of measure one, a final good producer, a continuum of intermediate-goods-producing firms of measure one, and the government which decides about monetary and fiscal policy. Following Woodford (2003), the model is treated as a cashless limiting economy. While the model does not feature any fundamental shocks I do allow for extrinsic uncertainty. Time is discrete and indexed by t.

2.1 Representative household

The representative household maximizes expected lifetime utility

$$\mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{C_t^{1-\sigma} - 1}{1-\sigma} - \chi \frac{h_t^{1+\eta}}{1+\eta} \right) \tag{1}$$

subject to a sequence of budget constraints

$$P_t C_t + \frac{B_t}{R_t} \leq W_t h_t + B_{t-1} - P_t T_t + P_t D_t \tag{2}$$

and a no-Ponzi game condition. The household obtains utility from private consumption C_t and dislikes labor h_t. E_t is the rational expectations operator conditional on information in period t, $\beta \in (0,1)$ is the subjective discount factor, $\sigma > 0$ is the inverse of the intertemporal elasticity of substitution in private consumption and $\eta > 0$ is the inverse of the labor supply elasticity. The household has access to non-state-contingent, one-period, nominal government bonds B_t that are traded at price $\frac{1}{R_t}$, where $R_t \geq 1$ is the gross nominal interest rate between periods t and $t+1$. He earns labor income $W_t h_t$, where W_t is the nominal wage rate, pays lump-sum taxes T_t and receives dividend payments from the intermediate-goods-producing firms D_t. The last two variables are expressed in real terms. Moreover, the household observes a confidence shock ξ_t that follows some exogenous process.

The first-order necessary conditions to the optimization problem are given by

$$R_t^{-1} = E_t \beta \frac{C_{t+1}^{-\sigma}}{C_t^{-\sigma}} \pi_{t+1}^{-1} \tag{3}$$

$$w_t = \chi h_t^{\eta} C_t^{\sigma}, \tag{4}$$

where $\pi_t = P_t / P_{t-1}$ is the gross inflation rate between periods $t-1$ and t, and $w_t = W_t / P_t$ is the real wage rate, as well as the transversality condition

$$\lim_{T \to \infty} E_t (Q_{t,T} B_T) = 0, \tag{5}$$

where $Q_{t,T} \equiv \beta^{T-t} \frac{C_T^{-\sigma}/P_T}{C_t^{-\sigma}/P_t}$ is the stochastic discount factor between periods t and $T \geq t$.

2.2 Firms

The final consumption good is produced under perfect competition using the following technology

$$Y_t = \left(\int_0^1 Y_t(j)^{\frac{\theta-1}{\theta}} dj \right)^{\frac{\theta}{\theta-1}},$$

where $\theta > 1$ and $Y_t(j)$ denotes the intermediate input j.

The market for intermediate goods features monopolistic competition. Expenditure minimization by the producer of the final good results in the following demand for intermediate good j

$$Y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\theta} Y_t, \tag{6}$$

where $P_t(j)$ denotes the price charged by firm j and $P_t \equiv \left(\int_0^1 P_t(j)^{1-\theta} dj\right)^{\frac{1}{1-\theta}}$ represents the price for the final consumption good.

Intermediate goods are produced using labor

$$Y_t(j) = h_t(j).$$

The intermediate-goods-producing firms are owned by the households and face quadratic price adjustment costs. In period t, firm j chooses the price of good j, $P_t(j)$, to maximize

$$E_t \sum_{l=0}^{\infty} Q_{t,t+l} \left[Y_{t+l}(j)\left((1+\nu)P_{t+l}(j) - W_{t+l}\right) - \frac{\phi}{2}\left(\frac{P_{t+l}(j)}{P_{t+l-1}(j)} - 1\right)^2 P_{t+l}(C_{t+l} + G_{t+l}) \right]$$

subject to (6). The parameter ν denotes a constant production subsidy that eliminates the distortions arising from monopolistic competition, and G_t is government consumption.

The first-order necessary condition for the optimization problem of firm j in period t is

$$\begin{aligned}
&(1-\theta)(1+\nu)Y_t(j) + \theta w_t \frac{P_t}{P_t(j)} Y_t(j) - \phi\left(\frac{P_t(j)}{P_{t-1}(j)} - 1\right)\frac{P_t}{P_{t-1}(j)}(C_t + G_t) \\
&+ \beta E_t \left(\frac{C_{t+1}^{-\sigma}}{P_{t+1}} \frac{P_t}{C_t^{-\sigma}} \phi \left(\frac{P_{t+1}(j)}{P_t(j)} - 1\right) \frac{P_{t+1}(j) P_{t+1}}{P_t(j)^2}(C_{t+1} + G_{t+1})\right) = 0.
\end{aligned} \tag{7}$$

Finally, the aggregate resource constraint of the economy is given by

$$Y_t = C_t + G_t + \frac{\phi}{2}(\pi_t - 1)^2 (C_t + G_t), \tag{8}$$

that is, total output is used for private consumption, for public consumption and for price adjustments.

2.3 Policy

Monetary policy is characterized by an interest rate feedback rule that accounts for the presence of the zero lower bound

$$R_t = \max\left\{1, \frac{\pi^*}{\beta}\left(\frac{\pi_t}{\pi^*}\right)^{\alpha}\right\}, \quad (9)$$

where π^* is the inflation target and $\alpha > 1$. For convenience in what follows I assume $\pi^* = 1$.

The fiscal authority consumes part of the final good, levies lump-sum taxes and issues one-period nominal bonds. Its flow budget constraint is given by

$$P_t G_t + B_{t-1} = \frac{B_t}{R_t} + P_t T_t. \quad (10)$$

The level of government spending is determined by a generalized fiscal rule

$$G_t = g\left(Z_t, \xi_t, \Omega\right), \quad (11)$$

where Z_t is the vector of endogenous variables excluding G_t and Ω is the vector of model parameters. Throughout the paper I assume that fiscal policies are Ricardian, i.e. lump-sum taxes adjust such that the transversality condition (5) holds regardless of the evolution of the other endogenous variables.

2.4 Equilibrium

In a symmetric equilibrium $P_t(j) = P_t$ for all j. Hence, $Y_t(j) = Y_t$ for all j and $h_t = Y_t$, where $h_t = \int_0^1 h_t(j)dj$.

Let $b_t = B_t/P_t$. A rational expectations equilibrium consists of sequences of non-negative allocations $\{C_t, Y_t, h_t\}_{t=0}^{\infty}$, non-negative prices $\{w_t, \pi_t\}_{t=0}^{\infty}$, and policies $\{R_t, G_t, b_t, T_t\}_{t=0}^{\infty}$ such that for a given initial level of government debt b_{-1} and a process $\{\xi_t\}_{t=0}^{\infty}$ for the confidence shock (i) the representative household solves his optimization problem given prices and policies, (ii) firms maximize profits, (iii) fiscal policy satisfies the government budget constraint, government consumption follows the specified spending rule and monetary policy follows the imposed interest rate rule, and (iv) the goods market, the labor market and asset markets clear.

The consolidated system of conditions for an interior equilibrium consists of

$$1 = \beta\left[\max\left\{1, \frac{1}{\beta}\left(\frac{\pi_t}{1}\right)^{\alpha}\right\}\right] E_t \frac{C_{t+1}^{-\sigma}}{C_t^{-\sigma}} \pi_{t+1}^{-1} \quad (12)$$

$$Y_t(\chi Y_t^{\eta} C_t^{\sigma} - 1) = \frac{\phi}{\theta}\left[(\pi_t - 1)\pi_t(C_t + G_t) - \beta E_t \frac{C_{t+1}^{-\sigma}}{C_t^{-\sigma}}(\pi_{t+1} - 1)\pi_{t+1}(C_{t+1} + G_{t+1})\right] \quad (13)$$

$$Y_t = (C_t + G_t)\left(1 + \frac{\phi}{2}(\pi_t - 1)^2\right) \quad (14)$$

as well as fiscal rule (11). Equation (12) is the consumption Euler equation where the nominal interest rate has been substituted out using monetary policy rule (9), equation

(13) is the New Keynesian Phillips curve where the real wage rate has been substituted out using the representative household's labor supply condition (4) and imposing $1 + \nu = \frac{\theta}{\theta-1}$, and equation (14) is the aggregate resource constraint. Since I consider a Ricardian policy regime, the exact debt stabilization policy is irrelevant for equilibrium determination.

3 Steady state equilibria

It is most convenient to start the analysis by considering steady state equilibria. A steady state equilibrium consists of a vector $\{C, G, Y, \pi, R\}$ that satisfies

$$1 = \left[\max\left\{1, \frac{1}{\beta}\left(\frac{\pi}{1}\right)^{\alpha}\right\}\right]\frac{\beta}{\pi} \tag{15}$$

$$Y(\chi Y^{\eta} C^{\sigma} - 1) = \frac{\phi}{\theta}(1-\beta)(\pi-1)\pi(C+G) \tag{16}$$

$$Y = (C+G)\left(1 + \frac{\phi}{2}(\pi-1)^2\right) \tag{17}$$

$$G = g(Z, \Omega), \tag{18}$$

where a variable written without time subscript denotes its steady state value.

3.1 The threat of permanent liquidity traps

Let us first assume, that the steady state level of government spending is given exogenously. Specifically, for ease of exposition, let $G = 0$. The model then features two steady state equilibria.

In the *intended equilibrium*

$$\pi = 1, \quad R = 1/\beta, \quad Y = (1/\chi)^{\frac{1}{\sigma+\eta}}, \quad C = (1/\chi)^{\frac{1}{\sigma+\eta}}. \tag{19}$$

In the *liquidity trap equilibrium*

$$\pi = \beta, \quad R = 1, \quad Y = \left(\frac{1}{\chi\Lambda^{-\sigma}} - \frac{\phi}{\theta\chi\Lambda^{1-\sigma}}(1-\beta)^2\beta\right)^{\frac{1}{\sigma+\eta}},$$

$$\text{and } C = \left(\frac{1}{\chi\Lambda^{\eta}} - \frac{\phi}{\theta\chi\Lambda^{1+\eta}}(1-\beta)^2\beta\right)^{\frac{1}{\sigma+\eta}}, \tag{20}$$

where $\Lambda \equiv 1 + \frac{\phi}{2}(1-\beta)^2$. In the second equilibrium, the economy is caught in a permanent expectations-driven liquidity trap and monetary policy as prescribed by Taylor rule (9) has exhausted its room for maneuver. From $\beta < 1$ and $\Lambda > 1$ follows that the liquidity trap steady state equilibrium is characterized by deflation and a subdued level of private consumption compared to the intended steady state equilibrium.

3.2 Avoiding permanent liquidity traps

I now show that it is possible to design fiscal stabilization policies within a Ricardian monetary-fiscal regime to rule out the unintended liquidity trap equilibrium.

Proposition 1 *A fiscal spending rule that ensures*

$$\chi Y^{\eta} C^{\sigma} \geq 1 \tag{21}$$

eliminates the liquidity trap equilibrium.

Proof. Monetary policy rule (9) with $\pi^* = 1$ implies that $R = 1$ only if $\pi < 1$. If $\pi < 1$, then in equilibrium the left-hand-side and the right-hand-side of (16) are strictly negative. The left-hand-side of (16) is strictly negative if and only if $\chi Y^{\eta} C^{\sigma} < 1$. Hence, $\chi Y^{\eta} C^{\sigma} \geq 1$ is incompatible with an expectations-driven liquidity trap equilibrium. ∎

Condition (21) says that real marginal costs, i.e. the real wage rate, must not fall below the intended steady state. It is straightforward to find a fiscal spending rule that satisfies (21). Using the resource constraint (17) to substitute out total output in (21), solving for government spending, and imposing equality subject to the non-negativity constraint $G \geq 0$, one obtains

$$G = \max\left\{\frac{1}{1+\frac{\phi}{2}(\pi-1)^2}\left(\frac{1}{\chi}C^{-\sigma}\right)^{\frac{1}{\eta}} - C, 0\right\}. \tag{22}$$

For $G > 0$, fiscal spending rule (22) satisfies $\frac{\partial G}{\partial C} < -1$. Thus it stipulates a more than one-for-one increase in government spending when there is a decline in private consumption. Moreover, it supports the intended steady state as an equilibrium outcome.

Before providing some intuition for this result, let us consider the full stochastic model.

4 Sunspot equilibria

Even so there is no uncertainty regarding the economy's fundamentals, agents expectations might be affected by the non-fundamental sunspot shock ξ_t. I assume that ξ_t follows a two-state Markov process, $\xi_t \in \{\xi_L, \xi_H\}$, where ξ_L denotes the low confidence state and ξ_H denotes the high confidence state. In the initial period 0, $\xi_0 = \xi_L$. Each period thereafter, the confidence shock irreversibly returns to ξ_H with constant probability $0 < 1 - \mu < 1$. Once $\xi_t = \xi_H$, all uncertainty is resolved and agents coordinate on the equilibrium commensurate with the intended steady state.

Let T denote the stochastic period in which ξ_t jumps back from ξ_L to ξ_H. The conditions characterizing a stationary equilibrium for all periods $t < T$ then read

$$1 = \beta \left[\max \left\{ 1, \frac{1}{\beta} \left(\frac{\pi_L}{1} \right)^{\alpha} \right\} \right] \left(\mu \frac{1}{\pi_L} + (1-\mu) \frac{C_L^{\sigma}}{C^{\sigma}} \right) \tag{23}$$

$$\theta Y_L (\chi Y_L^{\eta} C_L^{\sigma} - 1) = \phi (1 - \beta\mu)(\pi_L - 1)\pi_L (C_L + G_L) \tag{24}$$

$$Y_L = (C_L + G_L) \left(1 + \frac{\phi}{2} (\pi_L - 1)^2 \right) \tag{25}$$

$$G_L = g(Z_L, \xi_L, \Omega) \tag{26}$$

where a variable written with subscript L denotes the value of that variable in the low confidence state, and C refers to the level of private consumption in the intended steady state. Substituting out Y_L, C_L, and G_L in equilibrium condition (24) with the help of (23), (25) and (26), one can reduce the system of equilibrium conditions to a single condition $f(\pi_L) = 0$ with a single unknown. Let $S = \{\pi_L : \pi^{lb} < \pi_L < \pi^{ub}\}$, where $\pi^{lb} = \beta\mu$ and $\pi^{ub} = (1/\mu)^{\frac{1}{\alpha - 1}}$.

Proposition 2 *In a rational expectations equilibrium, $\pi_L \in S$.*

Proof. See Appendix. ∎

4.1 The threat of temporary liquidity traps

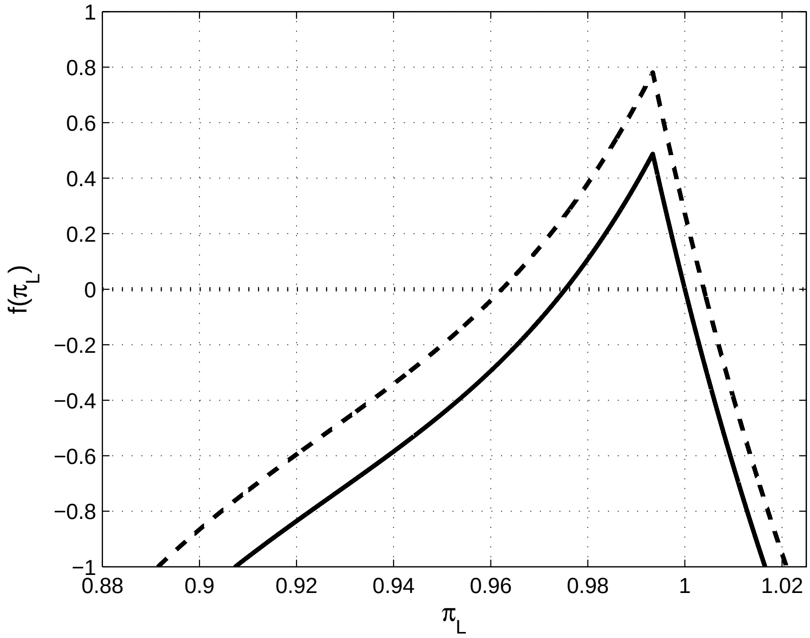
Function $f(\pi_L)$ can have more than one root that is an element of S, giving rise to the possibility of multiple equilibria. Let us for the moment assume that government spending is determined exogenously. Figure 1 provides a quantitative illustration of equilibrium multiplicity, plotting function $f(\pi_L)$ for the case where $G_L = G$ (solid line).[3] The function $f(\pi_L)$ has two roots.[4] The first equilibrium is the intended no-sunspot equilibrium with $\pi_L = 1$. The second equilibrium lies to the left of the kink which marks the region for which the zero lower bound is binding and features deflation, $\pi_L < 1$. Hence, a drop in agents' confidence can drive the economy into a temporary liquidity trap.

In the case just considered, the level of government spending is constant across the two confidence states. The dashed line plots $f(\pi_L)$ when there is an exogenous increase in government spending in the low confidence state, $G_L = 1.1 \times G$. In the expectations-driven liquidity trap equilibrium, an exogenous increase in government spending reduces the equilibrium inflation rate. This is the result emphasized by Mertens and Ravn (2014), Christiano and Eichenbaum (2012), Braun et al. (2013) and Aruoba et al. (2013).

[3]The calibration loosely resembles the one used by Mertens and Ravn (2014). Specifically, I set $\beta = 0.99$, $\sigma = 1$, $\eta = 4/3$, $G = 0.2$, $\chi = 1.25$, $\theta = 10$, $\phi = 46.89$, $\mu = 0.7$, and $\alpha = 1.5$.

[4]For illustratory purposes the figure considers only a subset of S. It has been verified that there exist no admissible roots outside of this subset.

Figure 1: Multiple equilibria



Note: The figure displays function $f(\pi_L)$ for the case of exogenous government spending. Solid line: $G_L = 0.2$; dashed line: $G_L = 0.22$.

Intuitively, since an increase in government spending ceteris paribus shifts aggregate demand upwards, expectations have to be even more pessimistic to be commensurate with the liquidity trap equilibrium.

Table 1 compares the intended equilibrium with the two sunspot equilibria considered in Figure 1. Private consumption in the expectations-driven liquidity trap is lower

Table 1: Equilibrium outcomes

	Intended equilibrium	Sunspot equilibrium	
Government spending	0.2	0.2	0.22
Total output	1	0.9935	1.0060
Real GDP ($C + G$)	1	0.9795	0.9736
Private consumption	0.8	0.7795	0.7536
Inflation rate (annualized %)	0	-9.86	-15.07
Nominal interest rate (annualized %)	4	0	0

than in the intended equilibrium, and an exogenous increase in government spending in the sunspot equilibrium reduces private consumption even further, i.e. the GDP multiplier is smaller than one.

4.2 Avoiding temporary liquidity traps

I now show that fiscal policy can be used within a Ricardian monetary-fiscal regime to protect the economy from such deflationary sunspot equilibria. The line of reasoning is similar to the one in the case of steady state equilibria.

Proposition 3 *A fiscal spending rule that ensures*

$$\chi Y_L^{\eta} C_L^{\sigma} \geq 1 \tag{27}$$

eliminates expectations-driven liquidity trap equilibria.

Proof. Monetary policy rule (9) with $\pi^* = 1$ implies that $R_L = 1$ only if $\pi_L < 1$. If $\pi_L < 1$, then in equilibrium the left-hand-side and the right-hand-side of (24) are strictly negative. The left-hand-side of (24) is strictly negative if and only if $\chi Y_L^{\eta} C_L^{\sigma} < 1$. Hence, $\chi Y_L^{\eta} C_L^{\sigma} \geq 1$ is incompatible with an expectations-driven liquidity trap equilibrium. ∎

Condition (27) says that real marginal costs must not fall below the intended steady state when the economy is faced with a drop in confidence. While monetary policy rule (9) becomes unable to boost marginal costs when the zero lower bound is reached, government spending remains effective.[5]

As in the deterministic setup, we can design a fiscal spending rule that satisfies (27). Using the resource constraint (25) to substitute out total output in (27), solving for government spending, and imposing equality subject to the non-negativity constraint $G_L \geq 0$, one obtains

$$G_L = \max\left\{ \frac{1}{1 + \frac{\phi}{2}(\pi_L - 1)^2} \left(\frac{1}{\chi} C_L^{-\sigma} \right)^{\frac{1}{\eta}} - C_L, 0 \right\}. \tag{28}$$

Fiscal spending rule (28) has the following properties. First, for $G_L > 0$, $\frac{\partial G_L}{\partial C_L} < -1$, so that government spending is increased more than one-for-one when there is a decline in private consumption. Second, when $\pi_L = \pi$ and $C_L = C$, then $G_L = G$, i.e. the fiscal rule supports the the intended steady state as an equilibrium outcome.[6]

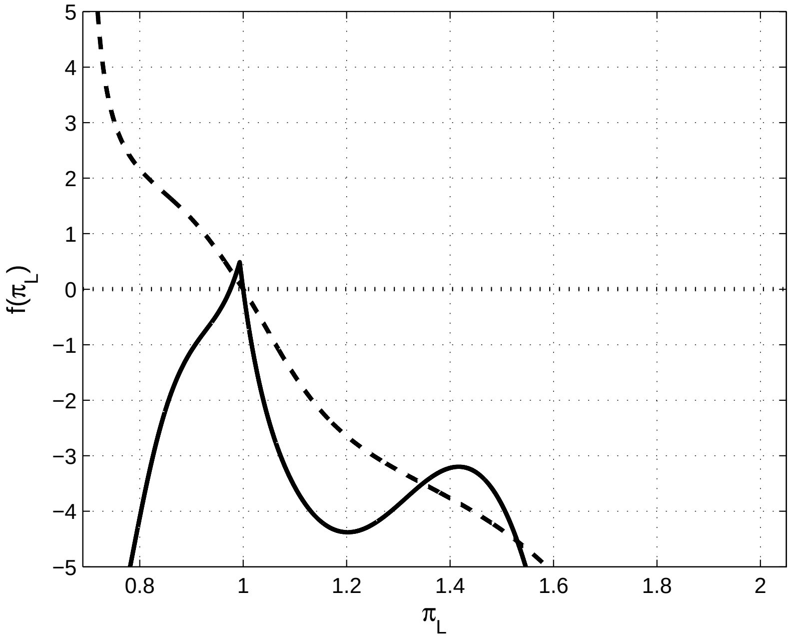
Figure 2 compares the function $f(\pi_L)$ of the exogenous government spending regime $G_L = G$ (solid line) with the one of a regime that follows fiscal rule (28) (dashed line). Indeed, under the endogenous fiscal spending rule the intended equilibrium is unique.

Intuitively, in a self-fulfilling liquidity trap equilibrium, an expected decline in the inflation rate leads to an increase in the ex-ante real interest rate when monetary policy is constrained by the zero lower bound. As a consequence, the representative household reduces consumption and increases labor supply for a given wage rate. Since firms reduce production, labor market clearing requires equilibrium real wages and thus equilibrium

[5] Note, that the condition in Proposition 3 does not rule out the existence of multiple equilibria with $R > 1$. However, inflationary sunspot equilibria can be ruled out by imposing that (27) has to hold with equality.

[6] By making use of the resource constraint when deriving the fiscal rule it is also ensured that $G_L \leq Y_L$.

Figure 2: Avoiding sunspot equilibria



Note: The figure displays function $f(\pi_L)$. Solid line: exogenous government spending with $G_L = G$; dashed line: fiscal spending rule (28).

real marginal costs to fall. A decline in real marginal costs in turn leads to a decline in inflation, validating the pessimistic expectations. The fiscal rule introduces an endogenous feedback mechanism that leads to ever higher demand stimulus the lower the level of confidence, thereby impeding a decline in real marginal costs and invalidating the pessimistic expectations.

5 Conclusion

In the presence of the zero lower bound, a drop in agents' confidence can become self-fulfilling, leaving the economy stuck in a liquidity trap with zero nominal interest rates, deflation and a subdued level of private consumption. I propose a remedy that is based on fiscal stabilization rules. The central feature of such a fiscal rule or target criterion is that it stipulates a sufficiently aggressive endogenous policy response when confronted with a drop in confidence so that it prevents a decline in real marginal costs. In this case, deflationary expectations are no longer supported as an equilibrium outcome. Importantly, undesirable expectations-driven liquidity trap equilibria can be avoided without abandoning the empirically realistic assumption of a Ricardian policy regime.

A Appendix

Proof of Proposition 2

Consider consumption Euler (23) and suppose $R_L = 1$, so that

$$1 = \beta \left(\mu \frac{1}{\pi_L} + (1-\mu) \frac{C_L^\sigma}{C^\sigma} \right). \tag{A.1}$$

Solving for C_L leads to

$$C_L = \left(\frac{\pi_L - \beta\mu}{(1-\mu)\beta\pi_L} \right)^{\frac{1}{\sigma}} C. \tag{A.2}$$

Hence, $C_L > 0$ only if $\pi_L > \beta\mu$.

Next, consider consumption Euler (23) and suppose $R_L > 1$, so that

$$1 = \beta \left[\frac{1}{\beta} \left(\frac{\pi_L}{1} \right)^\alpha \right] \left(\mu \frac{1}{\pi_L} + (1-\mu) \frac{C_L^\sigma}{C^\sigma} \right). \tag{A.3}$$

Solving for C_L leads to

$$C_L = \left(\frac{\pi_L - \mu\pi_L^\alpha}{(1-\mu)\pi_L^{1+\alpha}} \right)^{\frac{1}{\sigma}} C. \tag{A.4}$$

Hence, $C_L > 0$ only if $\pi_L - \mu\pi_L^\alpha > 0$. Solving for π_L leads to the condition $\pi_L < (1/\mu)^{\frac{1}{\alpha-1}}$.

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