Fiscal Policy in An Expectations Driven Liquidity Trap

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Intro

Global recession, short-term interest rates at historical lows.

Fiscal policy as a stabilization tool is back.

Questions:

1. How effective are fiscal policy interventions in general?
2. How effective are fiscal policy interventions in low or zero interest rate environment?
3. Demand or supply oriented stimulus?

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3. Demand or supply oriented stimulus?

   Demand stimulus becomes more effective. Supply stimulus is counterproductive at zero interest rates.

   Eggertson (2009)

This paper

Fiscal policy in New Keynesian model under a liquidity trap (depressed output levels, deflation and zero nominal interest rates)

As in previous papers, liquidity trap after a shock that induces high private savings.

Identical model environment, but a different shock: loss in “confidence”

1. Large drops in output and welfare can occur in an expectations driven liquidity trap
2. Demand stimulating fiscal policies (spending and sales tax cuts) become *less* effective than usual.
3. Supply stimulating fiscal policies (cuts in marginal labor income tax) become *more* effective.
4. Higher inflation targets are a bad idea.

Model Environment

Standard New Keynesian model

1. Agents: households, final goods producers, intermediate goods producers, government
2. Monopolistic competition in intermediate goods sector, staggered price setting
3. Monetary policy operating an interest rate rule responsive to inflation, subject to the zero bound.
4. Fiscal instruments: government spending, sales taxes, labor income tax

Households

Preferences

$$V_0 = E_0 \sum_{t=0}^{\infty} (\omega_t \beta)^t \, u(c_t, l_t, m_t)$$

Budget constraints

$$(1+\tau_{c,t}) P_t c_t + M_t + \frac{B_t}{1+i_t} \leq (1-\tau_{n,t}) W_t (1-l_t) + B_{t-1} + M_{t-1} + T_t + \Pi_t$$

$$M_{-1} \geq 0 \quad , \quad B_{-1} \geq 0 \text{ given}$$

No-Ponzi constraints

$$\lim_{s\to\infty} E_t \frac{B_{t+s}}{(1+i_t)\cdots(1+i_{t+s})} \geq 0$$

$$m_t = M_t/P_t \geq 0, \; c_t > 0, \; 0 \leq l_t \leq 1$$

▸ Restrictions on preferences.

Optimality requires:

$$\frac{U_l(c_t, l_t)}{U_c(c_t, l_t)} = \frac{(1-\tau_{n,t})W_t}{(1+\tau_{c,t})P_t}$$

$$U_c(c_t, l_t) = \beta(1+i_t)E_t\left[\frac{\omega_{t+1}}{\omega_t}\frac{(1+\tau_{c,t})P_t}{(1+\tau_{c,t+1})P_{t+1}}U_c(c_{t+1}, l_{t+1})\right]$$

$$\frac{\bar{U}_m(m_t)}{U_c(c_t, l_t)} = \frac{i_t}{1+i_t}\frac{1}{(1+\tau_{c,t})}$$

$$\lim_{s\to\infty} E_t\left[\frac{B_{t+s}+M_{t+s}}{(1+i_t)\cdots(1+i_{t+s})}\right] = 0$$

Final Goods Sector

Final goods technology

$$y_t = \left(\int_0^1 y_{it}^{1-1/\eta} di \right)^{1/(1-1/\eta)}$$

implying demand functions

$$y_{it} = \left(\frac{P_{it}}{P_t} \right)^{-\eta} y_t$$

where P_{it} is the date t price of intermediate good of variety i.
P_t is the price of the final good defined as

$$P_t = \left(\int_0^1 P_{it}^{1-\eta} di \right)^{1/(1-\eta)}$$

Intermediate Goods Sector

Intermediate goods producer i

$$y_{it} = n_{it}$$

Each period, reset prices with probability $(1-\xi) \in (0,1]$.

Profit maximization

$$E_t \sum_{s=t}^{\infty} \xi^{s-t} Q_{t,s} \Pi_{is}\left(P_{it}^*\right)$$

where

$$\begin{aligned} \Pi_{is}\left(P_{it}^*\right) &= \left(P_{it}^* - \left(1-\tau_r\right) W_s\right) \left(\frac{P_{it}^*}{P_s}\right)^{-\eta} y_s \\ Q_{t,s} &= \beta^{s-t} \left(U_c(c_s, l_s)/U_c(c_t, l_t)\right) \left(P_t/P_s\right) \end{aligned}$$

Assuming $\tau_r = 1/\eta$, optimality requires

$$E_t \sum_{s=t}^{\infty} \xi^{s-t} Q_{t,s} \left[\left(P_{it}^* - W_s\right) y_{is}\right] = 0$$

Government

Monetary policy

$$1 + i_t = \phi\left(\frac{\pi_t}{\tilde{\pi}}\right)$$

where $\tilde{\pi} \geq 1$ is the inflation target
$\phi(1) = \beta^{-1}\tilde{\pi}$, $\phi(\cdot) \geq 1$ for all π_t , and $\phi'(\cdot)$ is sufficiently large when $i_t > 0$.

Fiscal policy

$$\frac{B_t}{1 + i_t} = B_{t-1} - M_t + M_{t-1} + D_t$$

$$D_t = P_t g_t + T_t + \frac{1}{\eta} W_t n_t - \left(\tau_{c,t} P_t c_t + \tau_{n,t} W_t (1 - l_t)\right)$$

Fiscal policies are Ricardian.

Equilibrium

A competitive rational expectations equilibrium is a sequence of allocations $(c_t, n_t, l_t, y_t)_{t=0}^{\infty}$, a price system $(\pi_t, w_t, p_t^*, v_t)_{t=0}^{\infty}$, monetary policies $(i_t, m_t)_{t=0}^{\infty}$, and fiscal policies $(b_t, d_t, g_t, \tau_{c,t}, \tau_{n,t}, t_t)_{t=0}^{\infty}$ such that

(i) Households maximize utility subject to all constraints,

(ii) Producers maximize profits

(iii) Monetary policy is guided by the interest rate rule, fiscal policies are consistent with the government budget constraint, and

(iv) Goods, asset and labor markets clear

for given initial conditions $b_{-1}, m_{-1} \geq 0$ and $v_{-1} \geq 1$, a law of motion for ω_t and specifications of fiscal policies.

▸ v_t is price dispersion.

Multiplicity of Equilibria

In monetary models, possible multiplicity of equilibria under interest rate rules is well known

Sargent and Wallace (JPE 1975), . . . , Atkeson, Chari and Kehoe (QJE 2010)

Even if local determinacy under Taylor Principle, global multiplicity due to zero lower bound.

Benhabib, Schmitt-Grohé and Uribe (AER 2001, JET 2001, JPE 2002): perfect foresight, endowment monetary economy

We analyze sunspot equilibria in production economy with nominal rigidities.

Shell (1977), Cass and Shell (JPE 1983)

For given (Ricardian) fiscal policies and law of motion for the preference shock ω_t, equilibrium sequences (y_t, π_t, v_t) are solutions to

$$\begin{aligned}
1 &= \beta\phi\left(\frac{\pi_t}{\tilde{\pi}}\right) E_t\left[\frac{\omega_{t+1}}{\omega_t}\frac{(1+\tau_{c,t})}{(1+\tau_{c,t+1})\,\pi_{t+1}}\frac{U_c\left(y_{t+1}-g_{t+1},1-v_{t+1}y_{t+1}\right)}{U_c\left(y_t-g_t,1-v_t y_t\right)}\right] \\
p_t^*\pi_t &= \frac{E_t\sum_{s=t}^{\infty}(\beta\xi)^{s-t}\,\omega_s\,\frac{U_l(y_s-g_s,1-v_s y_s)}{1-\tau_{n,s}}\left(\prod_{j=0}^{s-t}\pi_{t+j}\right)^{\eta} y_s}{E_t\sum_{s=t}^{\infty}(\beta\xi)^{s-t}\,\omega_s\,\frac{U_c(y_s-g_s,1-v_s y_s)}{1+\tau_{c,s}}\left(\prod_{j=0}^{s-t}\pi_{t+j}\right)^{\eta-1} y_s} \\
v_t &= \xi\pi_t^{\eta}v_{t-1}+(1-\xi)\,p_t^{*-\eta}
\end{aligned}$$

for a given initial condition v_{-1}.

We focus on Markov equilibria that can be generated from

$$\begin{aligned}
u_t &= f\left(s_t\right) \\
s_t &= h\left(s_{t-1}\right)+\mu\varepsilon_t,\ s_0 \text{ given}
\end{aligned}$$

s_t vector of state variables, u_t inflation/output vector, random innovation ε_t

Steady States

Assume no preference shocks ($\omega_t = 1$, for all t). A steady state is a fixed point $s = h(s)$, $u = f(s)$.

Intended Steady State (π^I, y^I, v^I) where $\pi^I = \tilde{\pi}$, the nominal interest rate is positive and

$$\frac{U_l(y^I, 1 - v^I y^I)}{U_c(y^I, 1 - v^I y^I)} = \frac{1 - \xi\beta\tilde{\pi}^{\eta}}{1 - \xi\beta\tilde{\pi}^{\eta-1}} \left(\frac{1 - \xi}{1 - \xi\tilde{\pi}^{\eta-1}}\right)^{\frac{1}{\eta-1}} \quad , \quad v^I = \frac{1 - \xi}{1 - \xi\tilde{\pi}^{\eta}} \left(\frac{1 - \xi\tilde{\pi}^{\eta-1}}{1 - \xi}\right)^{\frac{\eta}{\eta-1}}$$

Special case of zero inflation target $\tilde{\pi} = 1$, no price dispersion and output level is efficient.

Unintended Steady State (π^U, y^U, v^U) where $\pi^U = \beta < 1$, the nominal interest rate is zero and

$$\frac{U_l(y^U, 1 - v^U y^U)}{U_c(y^U, 1 - v^U y^U)} = \frac{1 - \xi\beta^{1+\eta}}{1 - \xi\beta^{\eta}} \left(\frac{1 - \xi}{1 - \xi\beta^{\eta-1}}\right)^{\frac{1}{\eta-1}} \quad , \quad v^U = \frac{1 - \xi}{1 - \xi\beta^{\eta}} \left(\frac{1 - \xi\beta^{\eta-1}}{1 - \xi}\right)^{\frac{\eta}{\eta-1}}$$

Output level is inefficient because of price dispersion.

Sunspot Equilibria

Sunspot variable, ψ_t follows discrete Markov chain $\psi_t \in [\psi_1, ..., \psi_n]$ with transition matrix R.

A **Markov sunspot equilibrium** is an equilibrium defined by a pair of functions $f(s_t)$ and $h(s_t)$ for which $f([v_{t-1}, \omega_t, \psi_t = \psi_i]) \neq f([v_{t-1}, \omega_t, \psi_t = \psi_j])$ and $h([v_{t-1}, \omega_t, \psi_t = \psi_i]) \neq h([v_{t-1}, \omega_t, \psi_t = \psi_j])$ for $i \neq j$, where $i, j = 1, ..., n$. Therefore, output and inflation are stochastic processes whose values depend on the realization of the state of confidence ψ_t.

Temporary liquidity traps:

- Low confidence triggers negative spiral of increased desire to save and soaring real interest rates.
- Monetary authority can locally defeat low confidence, but not globally because of the zero bound.
- Temporary nature is crucial: intertemporal substitution, forward looking price setting.

A Two State Example

Suppose the sunspot variable ψ_t follows a two-state Markov chain with transition matrix R,

$$\psi_t \in [\psi_O, \psi_P] \quad , \quad R = \begin{bmatrix} 1 & 0 \\ 1-q & q \end{bmatrix} \quad , \quad 0 < q < 1$$

No fiscal policy $g_t = \tau_{n,t} = \tau_{c,t} = 0$ for all t. No preference shock $\omega_t = 1$.

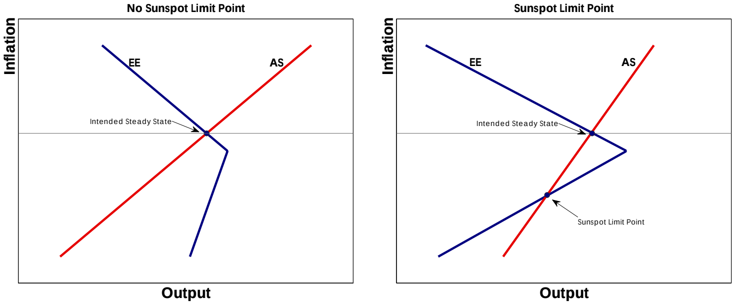
Let π_P, y_P and v_P denote the fixed points of the system defined by $f([v_{t-1}, \psi_t = \psi_P])$ and $h([v_{t-1}, \psi_t = \psi_P])$, determined by

$$U_c(y_P, 1 - v_P y_P) = \beta\phi\left(\frac{\pi_P}{\tilde{\pi}}\right)\left[\frac{q}{\pi_P}U_c(y_P, 1 - v_P y_P) + \frac{1-q}{\pi_O'}U_c(y_O', 1 - v_O' y_O')\right] \qquad \text{(EE)}$$

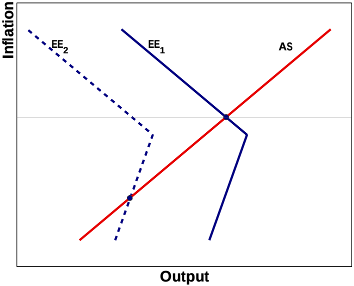
$$p_P^* = \frac{(1 - \beta\xi q \pi_P^{\eta-1})}{\left(1 - \beta\xi q \pi_P^{\eta}\right)}\left(\Lambda_P \frac{U_l(y_P, 1 - v_P y_P)}{U_c(y_P, 1 - v_P y_P)} + (1 - \Lambda_P) p_O^{*\prime} \pi_O'\right) \qquad \text{(AS)}$$

where $0 < \Lambda_P < 1$ and π_O', y_O' and v_O' are obtained from $f([v_P, \psi_O])$ and $h([v_P, \psi_O])$

Existence of SS Liquidity Trap



Existence of Preference Shock induced Liquidity Trap



Lessons

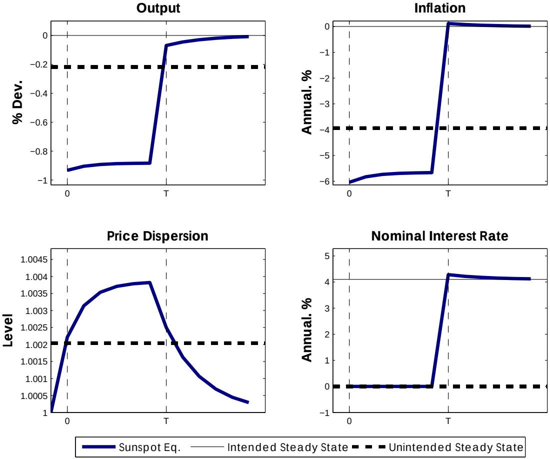
- Expectational liquidity trap exists for $q > q^{crit}$
- Liquidity trap induced by preference shock (cfr. Eggertson (2009), Christiano et al. (2009), Woodford (2010)) exists for $q < q^{crit}$
- Largest output and welfare losses are obtained when EE and AS have similar slopes.
- The difference in slopes of the EE and AS schedules is the reason why policy interventions will lead to different outcomes depending on the type of shock

Numerical Example

Consider the functional forms

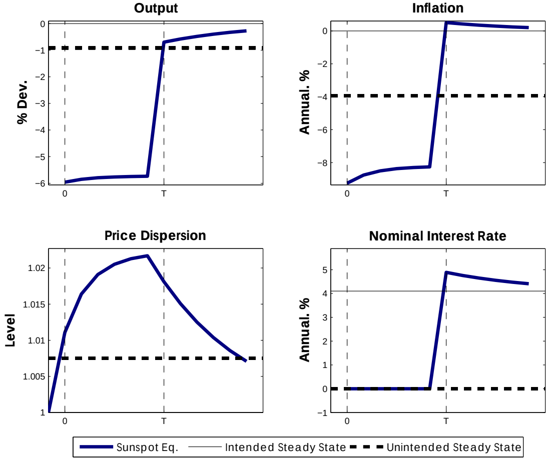
$$U(c_t, l_t) = \frac{c_t^{1-\sigma} - 1}{1-\sigma} + \theta \frac{l_t^{1-\kappa} - 1}{1-\kappa}, \ \sigma, \theta, \kappa > 0 \quad (1)$$

$$\phi\left(\frac{\pi_t}{\tilde{\pi}}\right) = \max\left(\frac{\pi_t^{\phi_\pi}}{\beta}, 1\right), \ \phi_\pi > 1 \quad (2)$$



$\beta = 0.99,\ \kappa = 2.65,\ \sigma = 1,\ \eta = 10,\ \phi_\pi = 1.5,\ \xi = 0.65,\ q = 0.8$

Sensitivity



$\beta = 0.99,\ \kappa = 2.65,\ \sigma = 0.7,\ \eta = 10,\ \phi_\pi = 1.5,\ \xi = 0.82,\ q = 0.8$

Sensitivity

The Role of Policy

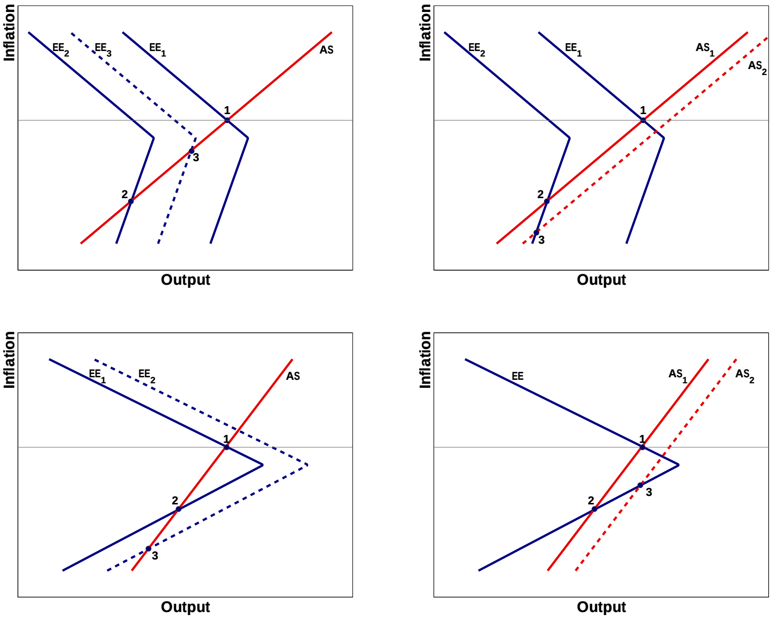
Ex Ante: How to prevent nonfundamental fluctuations/liquidity traps

Benhabib, Schmitt-Grohé and Uribe (JPE 2002): threat of unsustainable fiscal/monetary policy

Atkeson, Chari and Kehoe (QJE 2010): sophisticated monetary policies

Ex Post: How to respond in liquidity trap

Christiano et al. (2009), Eggertson and Woodford (2004), ...


Inflation
EE_2
EE_3
EE_1
AS
1
2
3
Output
Inflation
EE_2
EE_1
AS_1
AS_2
1
2
3
Output
Inflation
EE_1
EE_2
AS
1
2
3
Output
Inflation
EE
AS_1
AS_2
1
2
3
Output

Fiscal Multipliers

Fiscal instruments: spending g_t, sales tax $\tau_{c,t}$, labor income tax $\tau_{n,t}$

Let $(y_t)_{t=0}^{\infty}$ be an equilibrium path for output in the model where fiscal instruments are constant.

Let $(y_t(\delta))_{t=0}^{\infty}$ be an equilibrium path where fiscal instrument changes by δ in a liquidity trap.

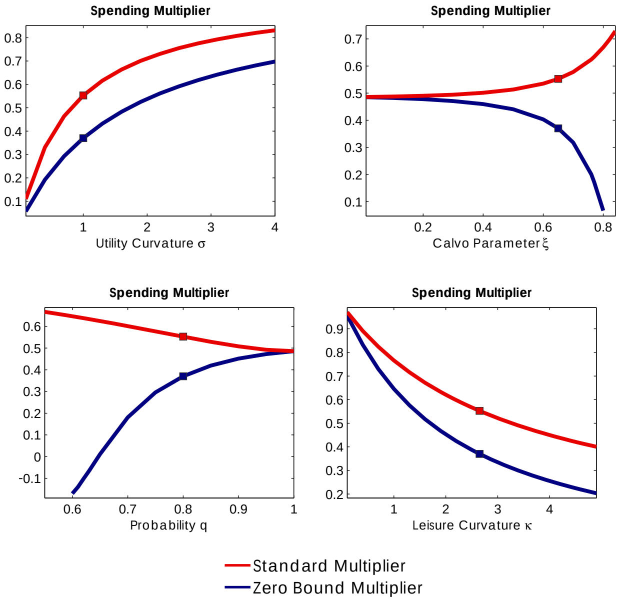
Marginal spending multiplier:

$$m_t^g = \lim_{\delta \to 0} \frac{y_t(\delta) - y_t}{\delta}$$

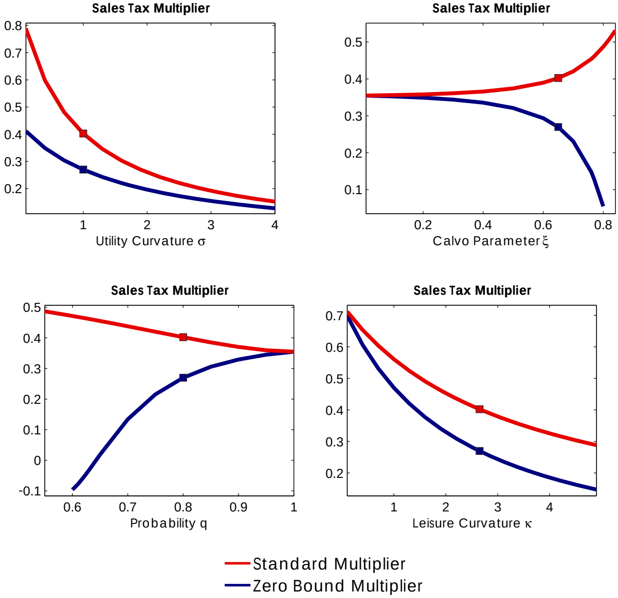
Marginal tax multiplier:

$$m_t^\tau = - \lim_{\delta \to 0} \frac{y_t(\delta) - y_t}{y_t \delta}$$

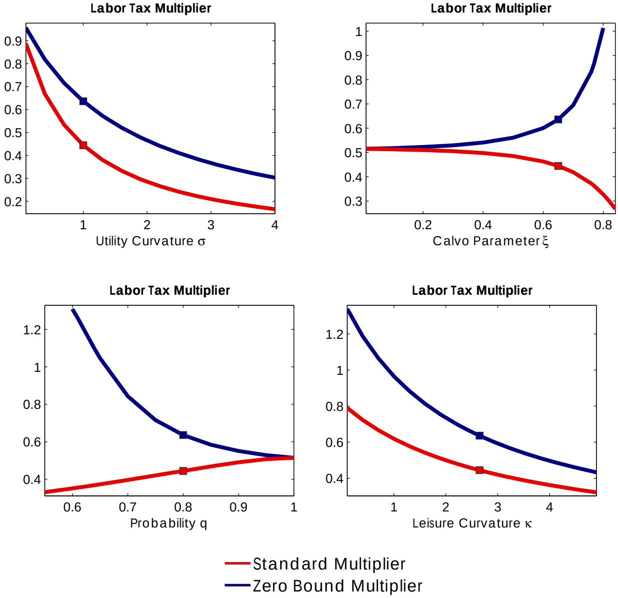
Spending Multipliers



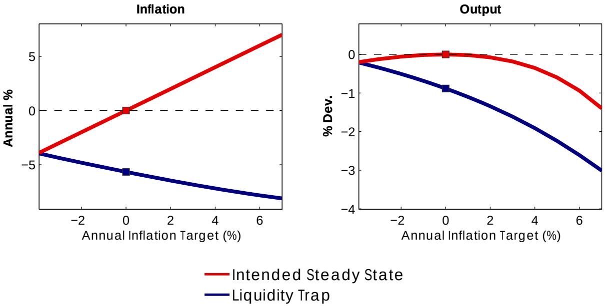
Sales Tax Multipliers



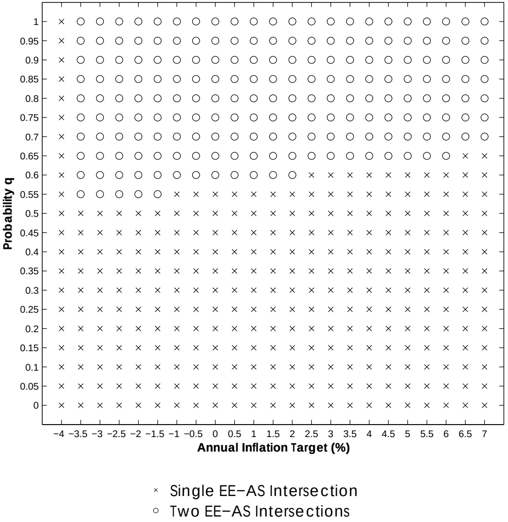
Payroll Tax Multipliers



Higher Inflation Target



Higher Inflation Target



Conclusion

1. Large drops in output and welfare can occur in an expectations driven liquidity trap
2. Demand stimulating fiscal policies (spending and sales tax cuts) become *less* effective than usual.
3. Supply stimulating fiscal policies (cuts in marginal labor income tax) become *more* effective.
4. Higher inflation targets are a bad idea.

Effects of policy in a liquidity trap depend on the type of shock.

Restrictions on preferences:

$$u(c_t, l_t, m_t) = U(c_t, l_t) + \bar{U}(m_t)$$

$$U_{cl} \geq 0$$

$$\lim_{c \to 0_+} U_c(c, l) = \infty \quad , \quad \lim_{c \to \infty} U_c(c, l) = 0 \ , \quad \forall l \geq 0$$

$$\lim_{l \to 0_+} U_l(c, l) = \infty \quad , \quad \lim_{l \to 1} U_l(c, l) = 0 \ , \quad \forall c \geq 0$$

$$\lim_{m \to \infty} \frac{\bar{U}_m(m)}{U_c(c, l)} < 0 \ , \quad \forall c, l \geq 0$$

Back

Price Dispersion

Aggregation

$$y_t = c_t + g_t$$

$$n_t = \int_0^1 n_{it} di = \int_0^1 \left(\frac{P_{it}}{P_t}\right)^{-\eta} y_t di = v_t y_t$$

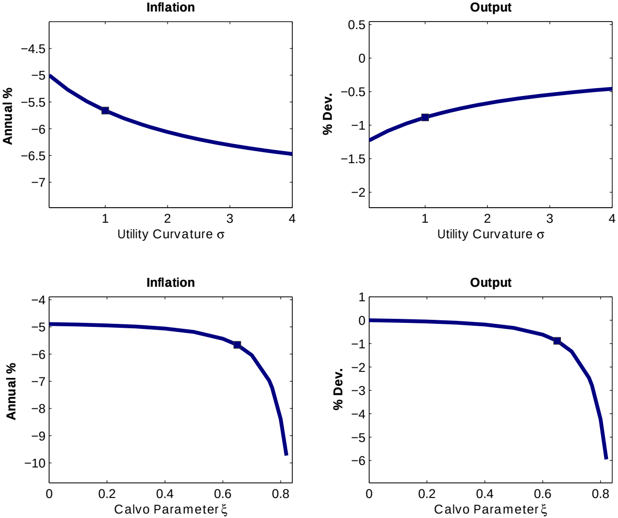
where $v_t = \int_0^1 (P_{it}/P_t)^{-\eta} \, di$ is a price dispersion term that is determined recursively as

$$v_t = \xi \pi_t^{\eta} v_{t-1} + (1-\xi) \, p_t^{*-\eta}$$

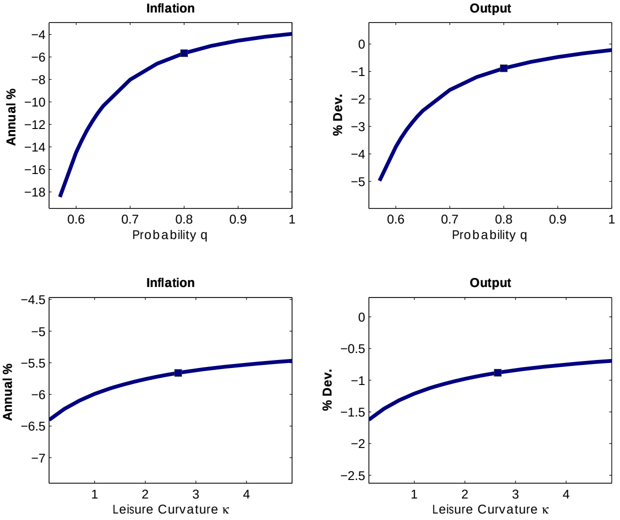
Price index:

$$1 = \xi \pi_t^{\eta - 1} + (1-\xi) \, p_t^{*1-\eta}$$

▸ Back



Calibrated Benchmark: $\sigma = 1$, $\xi = 0.65$, $\kappa = 2.65$, $q = 0.80$



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