The Effects of a Money-Financed Fiscal Stimulus

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Motivation

- How to jumpstart a depressed economy
  - expansionary monetary policy?
  - debt-financed fiscal expansion?
  - supply-side policies?
Motivation

- How to jumpstart a depressed economy
  - expansionary monetary policy?
  - debt-financed fiscal expansion?
  - supply-side policies?
- An alternative: a money-financed fiscal stimulus
Present Paper

- Question: What are the effects of a money-financed fiscal stimulus?
- Basic New Keynesian model
- Tax cut vs. Increase in government purchases
- Comparison to debt-financed fiscal stimulus
- Role of nominal rigidities
- Welfare effects
- Two environments: "Normal times" and "ZLB times"
Experiments: Exogenous Fiscal Stimuli

- **Tax cut**
  \[ \hat{t}_t^* = -\delta^t < 0 \]
  for \( t = 0, 1, 2, \ldots \) where \( \hat{t}_t^* \equiv \frac{T_t^* - T^*}{Y} \)

- **Increase in government purchases**
  \[ \hat{g}_t = \delta^t > 0 \]
  for \( t = 0, 1, 2, \ldots \) where \( \hat{g}_t \equiv \frac{G_t - G}{Y} \).
Experiments: Financing Regimes

- Debt financing (+ inflation targeting)

\[ \pi_t = 0 \]

\[ m_t = p_{-1} + l(c_t, i_t) \]

\[ \hat{b}_t = (1 + \rho - \psi_b)\hat{b}_{t-1} + b(1 + \rho)i_{t-1} + \delta^t - \kappa\Delta m_t \]

where \( \hat{b}_t \equiv \frac{B_{t-B}}{\bar{Y}} \)

- Money financing

\[ \hat{b}_t = 0 \]

\[ \Delta m_t = (1/\kappa)\left[\delta^t + b(1 + \rho)(\hat{i}_{t-1} - \pi_t)\right] \]
Households

\[ \max E_0 \sum_{t=0}^{\infty} \beta^t [U(C_t, L_t) - V(N_t)] Z_t \]

subject to:

\[ P_t C_t + B_t + M_t = B_{t-1}(1 + i_{t-1}) + M_{t-1} + W_t N_t + P_t D_t - P_t T_t \]

Firms: monopolistic competition, staggered price setting à la Calvo
Simulations

- Exogenous fiscal stimulus: $\delta = 0.5$
  
  (i) Tax cut vs. increase in government purchases
  (ii) Money financing vs. debt financing
Figure 1. Dynamic Effects of a Tax Cut: Debt vs. Money Financing
Figure 2. Dynamic Effects of an Increase in Government Purchases: 
*Debt vs. Money Financing*
Figure 5a. Fiscal Multipliers: The Role of Price Stickiness

Graph showing the relationship between tax cut and increase in G with markers for MF and DF.
Welfare

- First order effects on utility

\[
\hat{U}_t = U_c C \hat{c}_t + U_l \hat{L}_t - V_n \hat{N}_t
\]

\[
= U_c C \left[ \hat{c}_t - \left( \frac{1 - \alpha}{M} \right) \hat{n}_t + \chi (1 - \beta) \hat{l}_t \right]
\]

\[
= U_c C \left[ \left( 1 - \frac{1}{M} \right) \hat{y}_t - \hat{g}_t + \chi (1 - \beta) \hat{l}_t \right]
\]

for \( t = 0, 1, 2, \ldots \) where \( M \equiv M_p M_w \)

- Simulations
Figure 4. Welfare Effects

Tax cut
- Red circle: money financing
- Blue diamond: deficit financing

G increase

periods

0 5 10 15

0 0.02 0.04 0.06 0.08 0.1 0.12 0.14 0.16

-0.9 -0.8 -0.7 -0.6 -0.5 -0.4 -0.3 -0.2 -0.1 0

0 5 10 15
The Effects of Fiscal Stimuli under the ZLB

- Negative Z shock \( \Rightarrow \)
  \[ r^n_t = -0.5\% \]
  for \( t = 0, 1, 2, \ldots T \), followed by \( r^n_t = 0.5\% \), for \( t \geq T + 1 \).

- ZLB constraint and slackness condition:
  \[ i_t \geq 0 \quad ; \quad l_t \geq l(c_t, i_t) \]
  \[ i_t[l_t - l(c_t, i_t)] = 0 \]

- **Tax response**
  \[ \hat{t}^* = -1\% \]
  for \( t = 0, 1, 2, \ldots T \), followed by \( \hat{t}^* = 0 \), for \( t \geq T + 1 \).

- **Government purchases response**
  \[ \hat{g}_t = +1\% \]
  for \( t = 0, 1, 2, \ldots T \), followed by \( \hat{g}_t = 0 \), for \( t \geq T + 1 \).
Figure 6a. Dynamic Effects of a Tax cut in a Liquidity Trap

- Output
- Consumption
- Inflation (qar)
- Inflation (yoy)
- Debt
- Debt-output ratio
- Nominal rate
- Real rate
- Money growth
- Taxes
- Z shock
Figure 6b. Dynamic Effects of a Tax cut in a Liquidity Trap

- **Output**: Graph showing output over time.
- **Consumption**: Graph showing consumption over time.
- **Real Rate**: Graph showing the real rate over time.
- **Inflation (qar)**: Graph showing inflation over time.
- **Inflation (yoy)**: Graph showing year-over-year inflation over time.
- **Debt**: Graph showing debt over time.
- **Debt-output Ratio**: Graph showing the debt-output ratio over time.
- **Money Growth**: Graph showing money growth over time.
- **Taxes**: Graph showing taxes over time.
- **Z Shock**: Graph showing the impact of a z shock over time.
Figure 6. Dynamic Effects of a Tax Cut in a Liquidity Trap

- Output
- Consumption
- Inflation (qar)
- Inflation (yoy)
- Debt
- Debt-output ratio
- Nominal rate
- Real rate
- Money growth
- Taxes
- Z shock

Legend:
- MF
- DF
- No response
Figure 7b. Dynamic Effects of an Increase in Government Purchases in a Liquidity Trap
Figure 7. Dynamic Effects of an Increase in Government Purchases in a Liquidity Trap
Figure 9a. Fiscal Stimuli and Welfare in a Liquidity Trap

The Case of Small Distortions

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**Tax cut**

- Red line: Money financing
- Blue line: Deficit financing
- Black line: No response

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**G increase**

- Red line: Money financing
- Blue line: Deficit financing
- Black line: No response
Figure 9b. Fiscal Stimuli and Welfare in a Liquidity Trap

The Case of Large Distortions

- Tax cut
- G increase

Legend:
- money financing
- deficit financing
- no response
Money-financed fiscal stimuli can boost economic activity effectively. No side effects, other than reasonably higher inflation.

G increase more effective than tax cut, but the latter has better welfare properties.

Money-financed discal stimuli more effective than debt-financed counterparts, and better welfare properties.

Reasonable price rigidities are key to the above results.

Money-financed fiscal stimuli are also more effective countercyclical policies when the ZLB is binding. G and T have similar effectiveness. When initial distortions are large, increase in G may be desirable even if wasteful.
Individual household’s IBC:

\[ \sum_{t=0}^{\infty} \Lambda_{0,t} \left( C_t + \frac{i_t}{1 + i_t} L_t \right) = \mathcal{A}_0 + \sum_{t=0}^{\infty} \Lambda_{0,t} (Y_t - T_t) \]

where \( \Lambda_{0,t} \equiv R_0^{-1} R_1^{-1} \ldots R_{t-1}^{-1} \).

Consolidated government’s IBC

\[ \sum_{t=0}^{\infty} \Lambda_{0,t} G_t + \frac{B_{-1}(1 + i_{-1})}{P_0} = \sum_{t=0}^{\infty} \Lambda_{0,t} \left( T_t + \frac{\Delta M_t}{P_t} \right) \]

Combining both we can rewrite the individual IBC

\[ \sum_{t=0}^{\infty} \Lambda_{0,t} \left( C_t + \frac{i_t}{1 + i_t} L_t \right) = \frac{M_{-1}}{P_0} + \sum_{t=0}^{\infty} \Lambda_{0,t} \left( Y_t - G_t + \frac{\Delta M_t}{P_t} \right) \]
In the log-log case \( \chi C_t = \frac{i_t}{1+i_t} L_t \),

\[
\sum_{t=0}^{\infty} \Lambda_{0,t} C_t = \frac{1}{1+\chi} \left( \frac{M_{-1}}{P_0} + \sum_{t=0}^{\infty} \Lambda_{0,t} \left( Y_t - G_t + \frac{\Delta M_t}{P_t} \right) \right)
\]

The Euler equation (without preference shocks) implies \( \Lambda_{0,t} = \beta^t \left( C_0 / C_t \right) \) thus we must have:

\[
C_0 = \frac{1 - \beta}{1+\chi} \left( \frac{M_{-1}}{P_0} + \sum_{t=0}^{\infty} \Lambda_{0,t} \left( Y_t - G_t + \frac{\Delta M_t}{P_t} \right) \right)
\]
A Fiscal and Monetary Framework

- Fiscal authority’s budget constraint:
  \[ P_t G_t + B_{t-1}^F (1 + i_{t-1}) = P_t (T_t + S_t) + B_t^F \]

- Central bank’s budget constraint:
  \[ B_t^M + P_t S_t = B_{t-1}^M (1 + i_{t-1}) + \Delta M_t \]

- Consolidated budget constraint (letting \( B_t = B_t^F - B_t^M \))
  \[ P_t G_t + B_{t-1} (1 + i_{t-1}) = P_t T_t + B_t + \Delta M_t \]
  \[ G_t + B_{t-1} R_{t-1} = T_t + B_t + \frac{\Delta M_t}{P_t} \]

where \( B_t \equiv B_t / P_t \) and \( R_t = (1 + i_t)(P_t / P_{t+1}) \)
A Fiscal and Monetary Framework

- Steady state (zero inflation, no growth, constant $B$, $r = \rho$):
  \[ \Delta M = 0 \]
  \[ T = G + \rho B \]
  \[ S = \rho B^M \]

- Seignorage and money growth:
  \[ (\Delta M_t / P_t)(1/ Y) = (\Delta M_t / M_{t-1})(P_{t-1} / P_t)L_{t-1} / Y \]
  \[ \approx \kappa \Delta m_t \]

  where $L_t \equiv M_t / P_t$, $m_t \equiv \log M_t$, and $\kappa \equiv L / Y$
A Fiscal and Monetary Framework

- Linearized debt dynamics around steady state:

\[ \hat{b}_t = (1 + \rho)\hat{b}_{t-1} + b(1 + \rho)(\hat{i}_{t-1} - \pi_t) + \hat{g}_t - \hat{t}_t - \kappa \Delta m_t \]

where \( \hat{i}_t \equiv \log \frac{1 + i_t}{1 + \rho}, \hat{b}_t \equiv \frac{B_t - B}{Y}, \hat{g}_t \equiv \frac{G_t - G}{Y} \) and \( \hat{t}_t \equiv \frac{T_t - T}{Y} \)

- Tax rule

\[ \hat{t}_t = \psi_b \hat{b}_{t-1} + \hat{t}^*_t \]

- Implied debt dynamics:

\[ \hat{b}_t = (1 + \rho - \psi_b)\hat{b}_{t-1} + b(1 + \rho)(\hat{i}_{t-1} - \pi_t) + \hat{g}_t - \hat{t}^*_t - \kappa \Delta m_t \]

- Assumption: \( \psi_b > \rho \) \( \Rightarrow \) Ricardian fiscal policy
Aside: Alternative Money Financing Regimes

- "Targeted Funding"
  \[
  \Delta m_t = (1/\kappa)\delta^t
  \]
  \[
  \hat{b}_t = (1 + \rho - \psi_b)\hat{b}_{t-1} + b(1 + \rho)(i_{t-1} - \pi_t)
  \]

- Constant nominal debt
  \[
  \hat{b}_t = -b\hat{p}_t
  \]
  \[
  \Delta m_t = (1/\kappa)\left[\delta^t + b(1 + \rho)(i_{t-1} - \pi_t) + b\hat{p}_t - b(1 + \rho - \psi_b)\hat{p}_{t-1}\right]
  \]
  where \(\hat{p}_t \equiv p_t - p_{t-1}\).
Non-Policy Block: Households

- Preferences

\[ E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, L_t, N_t; Z_t) \]

Assumption:

\[ U(C, L, N; Z) = (U(C, L) - V(N)) Z \]

where \( \frac{U_L}{U_C} = h(L/C) \) with \( h(\cdot) \) continuous and decreasing, satisfying \( h(\bar{x}) = 0 \) for some \( 0 < \bar{x} < \infty \).

- Budget constraint

\[ P_t C_t + B_t + M_t = B_{t-1} (1 + i_{t-1}) + M_{t-1} + W_t N_t + P_t D_t - P_t T_t \]
Non-Policy Block: Households

- **Euler equation**

\[ U_{c,t} = \beta(1 + i_t)E_t \{ U_{c,t+1}(P_t / P_{t+1}) \} \]

- **Money demand**

\[ L_t = C_t h^{-1}(i_t / (1 + i_t)) \]

- **Wage setting**

\[ W_t / P_t = \mathcal{M}_w(V_{n,t} / U_{c,t}) \]

where \( \mathcal{M}_w \equiv \epsilon_w / (\epsilon_w - 1) \)
Non-Policy Block: Firms

- Final goods (perfect competition):

\[ Y_t \equiv \left( \int_0^1 X_t(i)^{1 - \frac{1}{\epsilon_p}} \, di \right)^{\frac{\epsilon_p}{\epsilon_p - 1}} \]

- Intermediate goods (monopolistic competition + sticky prices)

  (i) **Technology:**

\[ X_t(i) = N_t(i)^{1 - \alpha} \]

where \( N_t(i) = \left( \int_0^1 N_t(i, j)^{1 - \frac{1}{\epsilon_w}} \, dj \right)^{\frac{\epsilon_w}{\epsilon_w - 1}} \)

(ii) **Demand schedule:**

\[ X_t(i) = (P_t(i)/P_t)^{-\epsilon} Y_t \]

(iii) **Staggered price setting à la Calvo**
Calibration

- **Households**
  \[ \sigma = 1 \]
  \[ \varphi = 5 \text{ (inverse Frisch labor supply elasticity)} \]
  \[ \eta = 7 \text{ (} \approx 1.8 \times 4, \text{ Ireland (2009)} \) \]
  \[ \kappa = 1/3 \text{ (annual M0 velocity } \approx 12) \]

- **Firms**
  \[ \alpha = 0.25 \]
  \[ \epsilon_p = 9 \Rightarrow \mathcal{M}_p = 1.12 \text{ ["large distortions": } \mathcal{M}_p = 1.35] \]
  \[ \epsilon_w = 4.5 \Rightarrow \mathcal{M}_w = 1.28 \text{ ["large distortions": } \mathcal{M}_w = 1.82] \]
  \[ \theta = 3/4 \]
Simulations

- Exogenous fiscal stimulus: $\delta = 0.5$
  (i) Tax cut vs. increase in government purchases
  (ii) Money financing vs. debt financing

- Remark: Equivalence of money-financed tax cut with sequence of asset purchases by the central bank (OMOs) given by:

$$\Delta m_t = \left(\frac{1}{\kappa}\right) \left[ \delta^t + b(1 + \rho)(\hat{i}_{t-1} - \pi_t) \right]$$

with path for $\{\hat{b}^M_t\}$ and $\{\hat{b}^F_t\}$ depending on the transfer and (endogenous) tax policies policy $\{\hat{s}_t, \hat{t}_t\}$. 
Fiscal Stimuli under the ZLB: Financing Regimes

- Money financing:
  \[ \hat{b}_t = 0 \]
  for all \( t \). For \( t = 0, 1, 2, \ldots, T \),
  \[ \Delta m_t = \left( \frac{1}{\kappa} \right) \left[ 0.01 + b(1 + \rho)(\hat{i}_{t-1} - \pi_t) \right] \]
  For \( t \geq T + 1 \),
  \[ \Delta m_t = \left( \frac{1}{\kappa} \right) b(1 + \rho)(\hat{i}_{t-1} - \pi_t) \]

- Debt financing
  \[ i_t \pi_t = 0 \]
  \[ m_t = p_t + l(c_t, i_t) \]
  for all \( t \). For \( t = 0, 1, 2, \ldots, T \),
  \[ \hat{b}_t = (1 + \rho - \psi_b)\hat{b}_{t-1} + b(1 + \rho)(\hat{i}_{t-1} - \pi_t) + 0.01 - \kappa \Delta m_t \]
  For \( t \geq T + 1 \)
  \[ \hat{b}_t = (1 + \rho - \psi_b)\hat{b}_{t-1} \]
Figure 3. Dynamic Effects of a *Money-Financed* Fiscal Stimulus: *Tax Cut vs. Increase in Government Purchases*
Figure 8. Dynamic Effects of Money-Financed Fiscal Stimuli in a Liquidity Trap

- Output
- Consumption
- Inflation (qar)
- Inflation (yoy)
- Debt
- Debt-output ratio
- Nominal rate
- Real rate
- Money growth
- Government purchases
- Taxes
- Z shock
Figure 5b. Fiscal Multipliers: The Role of Shock Persistence
Dynamic Effects of a Money-Financed Tax Cut:
The Role of Price Stickiness

- Output
- Consumption
- Real rate
- Inflation (qar)
- Inflation (yoy)
- Nominal rate
- Debt
- Debt-output ratio
- Money growth
- Taxes

Flexible vs. Sticky Prices
Dynamic Effects of a *Money-Financed* Increase in Government Purchases: *The Role of Price Stickiness*
Welfare Effects: *The Role of Price Stickiness*

**Tax cut**

- Flexible
- Sticky

**G increase**

- Periods for both graphs range from 0 to 16.
Welfare Effects: The Role of Distortions

Small distortions

Tax cut

G increase

Large distortions

Tax cut

G increase