Non-Neutrality of Open-Market Operations

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Motivation

- "Old-Style" vs "New-Style" Central Banking

- Several central banks around the world (Bank of England, Bank of Japan, ECB, Fed, Riksbank) are holding **risky** securities in their balance sheets as a consequence of *unconventional* open-market operations (like LSAP's).

- **Main question**: Do purchases of risky securities have any effect on output and inflation?

  1. Is unconventional policy an additional dimension of monetary policy?
  2. Are there any consequences on equilibrium *output* and *inflation* of the possible income losses on risky securities?

- A negative answer points toward the irrelevance (*"neutrality"*) of OMO's.

Neutrality Property

- **Neutrality Property:**
  Given a conventional monetary and fiscal policy, all alternative CB balance-sheet compositions/sizes are consistent with the same equilibrium paths of output and prices.

$\Rightarrow$ Open-market operations are irrelevant for equilibrium output and inflation.

- *Main intuition*: if the central bank bears some risk that was before in the hands of the private sector, the materialization of that risk does not affect equilibrium output and inflation if it is ultimately borne by the private sector.

- Neutrality granted by specific transfer policies:

  1. between treasury and private sector
  2. between central bank and treasury (key is the separation of treasury and central bank balance sheets)

Real Bills Doctrine 2.0

- **RBD 1.0:** the CB holds "Real Bills" (safe short-term assets, thereby CB always profitable) and sets the discount rate on these assets by open-market operations in order to control the value of money (inverse of the price level).

$\Rightarrow$ Real Bills provide the backing of the value of currency

- **RBD 2.0:** if neutrality holds, the CB can still control the value of money by setting the discount rate on safe securities *independently* on what it holds in its balance sheet. How is it possible?

$\Rightarrow$ Taxpayers provide the backing of the value of currency

Main results

1. Neutrality Property holds:
    - passive fiscal policy, and
    - passive remittances' policy (or full treasury's support)
2. Non-neutrality case I:
    - passive fiscal policy, and
    - absence of treasury support **IF** losses are significant in size
3. Non-neutrality case II:
    - passive fiscal policy, and
    - central bank's commitment to financial independence
4. Non-neutrality case III:
    - active fiscal policy $\Rightarrow$ LSAPs as a way to implement helicopter money
5. Non-neutral OMOs to escape suboptimal policies during a liquidity trap

Related Literature

- Propositions of Neutrality (Wallace, 1981, Chamley and Polemarchakis, 1984, Sargent and Smith, 1987, Eggertsson and Woodford, 2003);
- Relationship between central bank's financial strength and objectives of monetary policy (Sims, 2000, 2005, Del Negro and Sims, 2014, Stella 1997, 2005, Reis 2015);
- Implications of accounting procedures and remittance policies for central bank's solvency (Bassetto and Messer, 2013; Hall and Reis 2013);
- Fiscal Theory of the Price Level (Sargent and Wallace, 1981, Sargent, 1982, Leeper, 1991; Sims, 1994,2013; Woodford, 1995,1995).
- Signalling effects of QE (Krishnamurthy and Vissing-Jorgensen, 2011; Woodford, 2012; Bhattarai, Eggertsson and Gafarov, 2015)

Intuition: a simple endowment economy

Equilibrium in the money market:

$$\frac{M_t}{P_t} \geq Y_t; \tag{1}$$

Euler Equation:

$$\frac{1}{1+i_t} = E_t \left\{ \beta \frac{\xi_{t+1} U_c(Y_{t+1})}{\xi_t U_c(Y_t)} \frac{P_t}{P_{t+1}} \right\}, \tag{2}$$

- **Conventional monetary policy** specifies one between $\{i_t, M_t\}$ as a function of other variables: $\mathcal{I}(\cdot)$ or $\mathcal{M}(\cdot)$
- *"REE":* a collection of stochastic processes $\{\Pi_t, i_t, M_t\}$ satisfying equations (1)-(2) consistently with the specification of *conventional monetary policy* and subject to $i_t \geq 0$, given exogenous processes $\{Y_t, \xi_t\}$

Intuition

Given the "equilibrium" processes $\{\Pi_t, i_t, M_t\}$ one can evaluate the pricing kernel

$$R_{t,T} = \beta^{T-t} \frac{\xi_T U_c(Y_T)}{\xi_t U_c(Y_t)} \tag{3}$$

and use it to price long-term securities (with decaying geometric coupons and subject to exogenous default risk $\varkappa$)

$$Q_t = E_t \left\{ R_{t,t+1} \frac{(1-\varkappa_{t+1})(1+\delta Q_{t+1})}{\Pi_{t+1}} \right\} \tag{4}$$

with return

$$1 + r_{t+1} \equiv (1-\varkappa_{t+1})(1+\delta Q_{t+1}) / Q_t. \tag{5}$$

Intuition

- Consider a process $\{\mathbf{Z}_t^*\} \equiv \{\Pi_t^*, i_t^*, M_t^*, Q_t^*, r_t^*, R_{t,T}^*\}$ that satisfies equations (1)–(5), **for a given** *conventional monetary policy*, $\mathcal{I}(\cdot)$ or $\mathcal{M}(\cdot)$: a "candidate equilibrium"

- and consider alternatively $\{B_t^C, D_t^C\}$ and $\{\tilde{B}_t^C, \tilde{D}_t^C\}$, where
  - B_t^C : treasury bills held by the CB
  - D_t^C : long-term risky securities held by the CB (private or public)

- These alternative *balance-sheet policies* are said to be "neutral" if $\{\mathbf{Z}_t^*\}$ is still an equilibrium for the same *conventional monetary policy*.

- How could it not be, if nothing has changed in (1)–(5) or in the policy rule?

- Other conditions actually need to be satisfied for $\{\mathbf{Z}_t^*\}$ to be a REE.

Intuition

- Transversality condition for households:

$$\lim_{T \longrightarrow \infty} E_t \left\{ R_{t,T} \frac{\mathcal{W}_{T-1}}{P_T} \right\} = 0 \qquad (6)$$

where private wealth $\mathcal{W}_T$ includes

✓ M_t : currency, carrying non-pecuniary return
✓ B_t : short-term treasury bills, carrying the risk-free rate i_t
✓ X_t : CB reserves, carrying the risk-free rate i_t
✓ D_t : long-term securities (private or public), bearing default risk

- Treasury's flow budget constraint

$$Q_t D_t^F + \frac{B_t^F}{1+i_t} = (1+r_t) Q_{t-1} D_{t-1}^F + B_{t-1}^F - T_t^F - T_t^C \qquad (7)$$

where

- T_t^F : primary surplus
- T_t^C : remittances from CB

Intuition

- CB's balance sheet:

$$N_t + M_t + \frac{X_t}{1+i_t} = Q_t D_t^C + \frac{B_t^C}{1+i_t} \tag{8}$$

- CB's profits:

$$\Psi_t = i_{t-1}(N_{t-1} + M_{t-1}) + (r_t - i_{t-1}) Q_{t-1} D_{t-1}^C \tag{9}$$

- Law of motion of net worth

$$N_t = N_{t-1} + \Psi_t - T_t^C \tag{10}$$

- Equilibrium requires

$$B_t^F = B_t + B_t^C \tag{11}$$

$$D_t^F = D_t + D_t^C \tag{12}$$

Intuition

Under Neutrality, equations (7)–(12) determine

$$\{\mathbf{K}_t\} \equiv \{B_t, B_t^F, B_t^C, D_t, D_t^F, D_t^C, T_t^F, T_t^C, X_t, N_t, \Psi_t\}$$

given

$$\{\mathbf{Z}_t^*\} \equiv \{\Pi_t^*, i_t^*, M_t^*, Q_t^*, r_t^*, R_{t,T}^*\}$$

and exogenous processes $\{Y_t,\ \xi_t,\ \varkappa_t\}$ if we specify (five degrees of freedom)

1. **Transfer Policies (TP)**

   specify $\{T_t^F,\ T_t^C\}$ as functions of other variables: $\mathcal{T}(\cdot)$

2. **Balance-sheet Policies (BSP)**

   specify $\{B_t^C,\ D_t^C,\ D_t^F\}$ as functions of other variables: $\mathcal{B}(\cdot)$

Central Bank's solvency condition

Solvency of central bank requires:

$$\frac{X_{t-1}}{P_t^*} + \frac{M_{t-1}^*}{P_t^*} - \frac{B_{t-1}^C}{P_t^*} - (1 + r_t^*)\frac{Q_{t-1}^* D_{t-1}^C}{P_t^*} = E_t \sum_{T=t}^{\infty} R_{t,T}^* \left[\frac{i_T^*}{1 + i_T^*} \frac{M_T^*}{P_T^*} - \frac{T_T^C}{P_T^*} \right], \quad (13)$$

⇒ the *candidate* equilibrium $\mathbf{Z}_t^*$ is a feasible allocation if it is also consistent with (13) given the specific balance-sheet policy (B_{t-1}^C, D_{t-1}^C).

⇒ the **Neutrality Property** requires consistency for *any BSP*.

⇒ Critical is the specification of the **transfer policy** between CB and treasury.

Remittances' policies

- Consider a transfer policy $T_t^C/P_t = \bar{T}^C$, it follows:

$$\frac{X_{t-1}}{P_t^*} + \frac{M_{t-1}^*}{P_t^*} - \frac{B_{t-1}^C}{P_t^*} - (1 + r_t^*)\frac{Q_{t-1}^* D_{t-1}^C}{P_t^*} = E_t \sum_{T=t}^{\infty} R_{t,T}^* \left[\frac{i_T^*}{1 + i_T^*} \frac{M_T^*}{P_T^*} - \bar{T}^C \right],$$

$\Rightarrow$ price (and quantity) determination through the solvency condition of the CB.

- A **passive remittances' policy** is such that CB is solvent, at *any candidate* equilibrium $\mathbf{Z}_t^*$, *for any BSP*. In this class:

$$\frac{T_t^C}{P_t} = \bar{T}^C + \gamma_c \frac{\Psi_t^C}{P_t} + \phi_c \frac{N_{t-1}}{P_t},$$

for $\gamma_c \in (0, 2)$ and $\phi_c \in (0, 2)$.

$\Rightarrow$ However, there are fiscal consequences of the above rule...

Fiscal consequences of central-bank income losses

The candidate equilibrium should also be consistent with solvency of the treasury:

$$\frac{B^F_{t-1}}{P^*_t} + (1+r^*_t)\frac{Q^*_{t-1}D^F_{t-1}}{P^*_t} = E_t \sum_{T=t}^{\infty} R^*_{t,T}\left[\frac{T^F_t}{P^*_T} + \frac{T^C_T}{P^*_T}\right],$$

⇒ Lower remittances should be offset by a higher primary surplus, otherwise prices and quantities should adjust (FTPL).

- A **passive fiscal policy** is such that Treasury is solvent, at *any candidate* equilibrium $\mathbf{Z}^*_t$, *for any remittances' policy* and *any BSP*. In this class:

$$\frac{T^F_t}{P_t} = \bar{T}^F - \gamma_f \frac{T^C_t}{P_t} + \phi_f \left[\frac{(1+r_t)Q_{t-1}D^F_{t-1} + B^F_{t-1}}{P_t}\right]$$

for $\gamma_f = 1$ and $\phi_f \in (0, 2)$.

"Passive" Transfer Policies support Neutrality

1. "Passive" remittances' policy:

$$\frac{T_t^C}{P_t} = \bar{T}^C + \gamma_c \frac{\Psi_t^C}{P_t} + \phi_c \frac{N_{t-1}^C}{P_t} \qquad (14)$$

   for $\gamma_c \in (0, 2)$ and $\phi_c \in (0, 2)$

2. and "passive" fiscal policy:

$$\frac{T_t^F}{P_t} = \bar{T}^F - \gamma_f \frac{T_t^C}{P_t} + \phi_f \left[\frac{(1 + r_t) Q_{t-1} D_{t-1}^F + B_{t-1}^F}{P_t} \right] \qquad (15)$$

   for $\gamma_f = 1$ and $\phi_f \in (0, 2)$.

- (15) $\Rightarrow$ the treasury transfers resources to the CB in the case of losses
- (14) $\Rightarrow$ the treasury raises these resources from the private sector

$\Rightarrow$ risk remains in the hands of the private sector

$\Rightarrow$ no wealth effects (shifts from financial to human wealth).

"Full Treasury's Support" ($T_t^C = \Psi_t^C$)

"Full Treasury's Support" and "passive" fiscal policy satisfy Neutrality:

1. Net worth is constant (and stationary)

$$N_t = N_{t-1} + \Psi_t^C - T_t^C = N_{t-1} = \overline{N}$$

2. Interest-bearing reserves adjust appropriately

$$Q_t^* D_t^C + \frac{B_t^C}{1+i_t^*} - M_t^* - \frac{X_t}{1+i_t^*} = \overline{N}$$

   for any appropriately bounded processes $\{B_t^C, D_t^C\}$.

3. Paying interest on reserves expands the set of neutrality cases

Policy experiment I

Credit-Risk due to partial default on long-term securities:

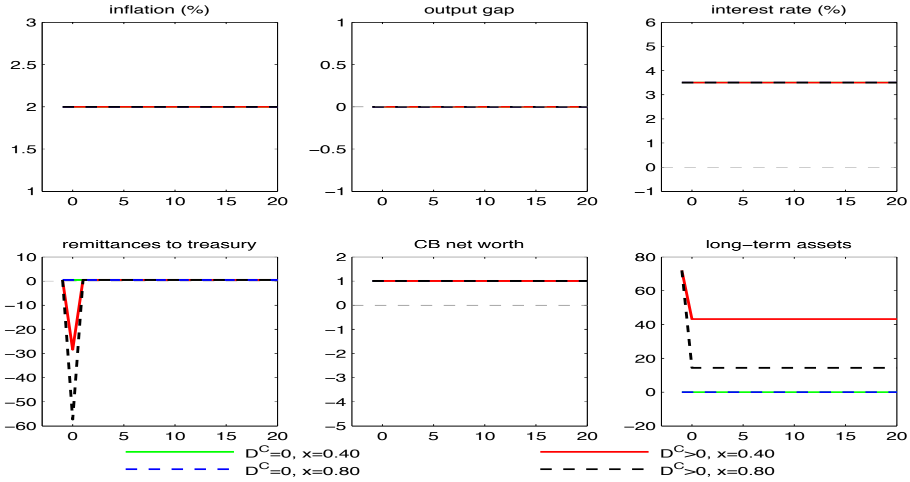
- Shock hits unexpectedly at time 0;
  1. "Mild" credit event, haircut of 40%;
  2. "Strong" credit event, haircut of 80%;

⇒ Optimal monetary policy stabilizes inflation and output gap when credit risk is in the hands of the private sector ($D_t^C = 0$, for all t);

⇒ Optimal monetary policy *is the same* if CB holds risky securities ($D_t^C > 0$, for some t) and if there is

- ✓ full treasury's support, and
- ✓ passive fiscal policy

Neutrality Result: Credit risk



Policy experiment II

Interest-rate risk due to exit from liquidity trap:

- At $t_0 - 1$: economy in liquidity trap with negative natural rate of interest;
- At t_0: CB commits to a state-contingent path for endogenous variables;
- At $t_0 + 4$: natural rate of interest turns back positive (unexpected movement in the yield curve);

$\Rightarrow$ Optimal monetary policy is to stay at ZLB 6 quarters longer, when interest-rate risk is in the hands of the private sector ($D_t^C = 0$, for all t);

$\Rightarrow$ Optimal monetary policy *is the same* if CB holds risky securities ($D_t^C > 0$, for some t) and if there is

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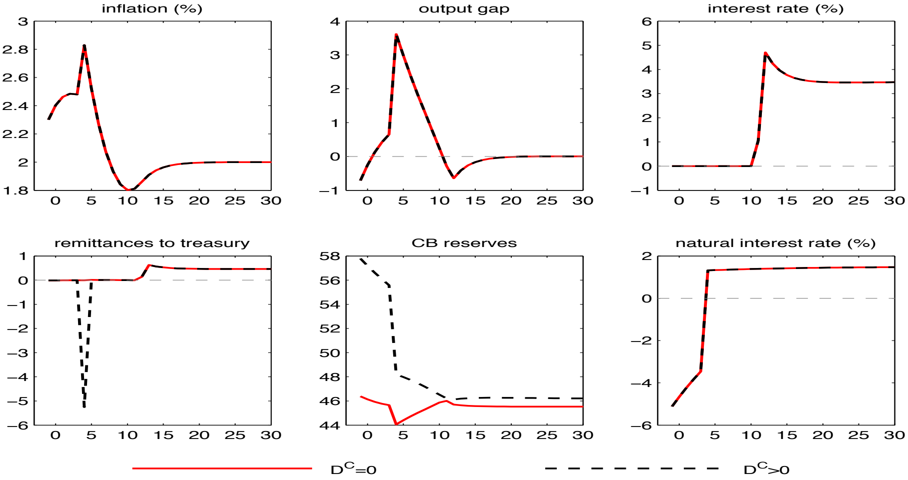
Neutrality Result: Interest-rate risk



Non-Neutrality case I: No treasury's support $(T_t^C \geq 0)$

- Case of exogenous remittances $\Rightarrow$ Neutrality never holds

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- Case of exogenous remittances $\Rightarrow$ Neutrality never holds
- In general, negative profits translate into declining net worth:

$$N_t = N_{t-1} + \Psi_t^C - T_t^C < N_{t-1}.$$

- Rewrite solvency condition of CB as

$$\underbrace{\frac{N_t}{P_t^*} + E_t \sum_{T=t}^{\infty} R_{t,T}^* \left(\frac{i_T^*}{1+i_T^*} \frac{M_T^*}{P_T^*} \right)}_{\text{real net worth + expected PV of future seigniorage revenue (value of CB)}} = \underbrace{E_t \sum_{T=t+1}^{\infty} R_{t,T}^* \left(\frac{T_T^C}{P_T^*} \right)}_{\text{expected PV of real transfers to and from the Treasury (dividends)}}.$$

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$\Rightarrow$ With treasury's support: RHS adjusts for given, constant, net worth

$\Rightarrow$ Without treasury's support: lower bound on net worth (RHS ≥ 0)

Non-Neutrality case I: No treasury's support ($T_t^C \geq 0$)

Federal Reserve's "Deferred Asset" regime:

- the CB absorbs losses by reducing capital (or writing a DA) and retains future profits until capital returns to the initial level (the DA is paid in full).
- lower-bound on net worth may be violated for large enough losses

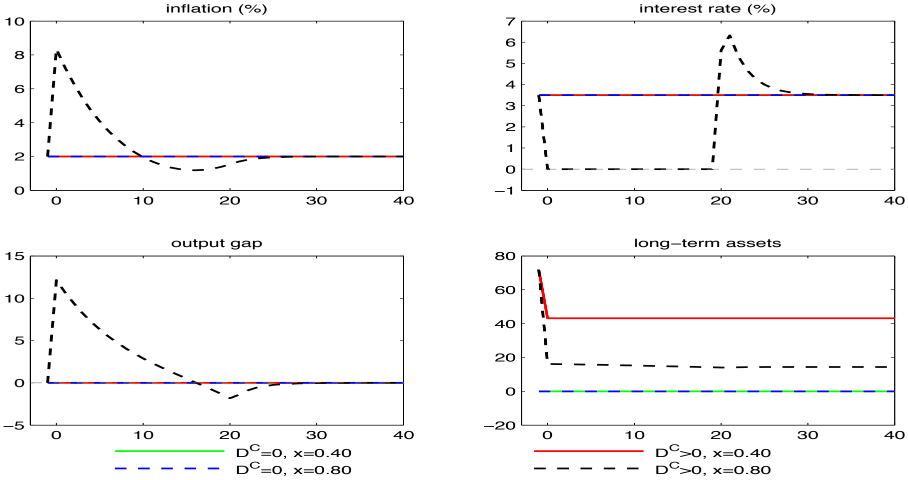
$$\frac{N_t}{P_t^*} < -E_t \sum_{T=t}^{\infty} R_{t,T}^* \left(\frac{i_T^*}{1+i_T^*} \frac{M_T^*}{P_T^*} \right)$$

- under some special case, profitability may be permanently impaired unless

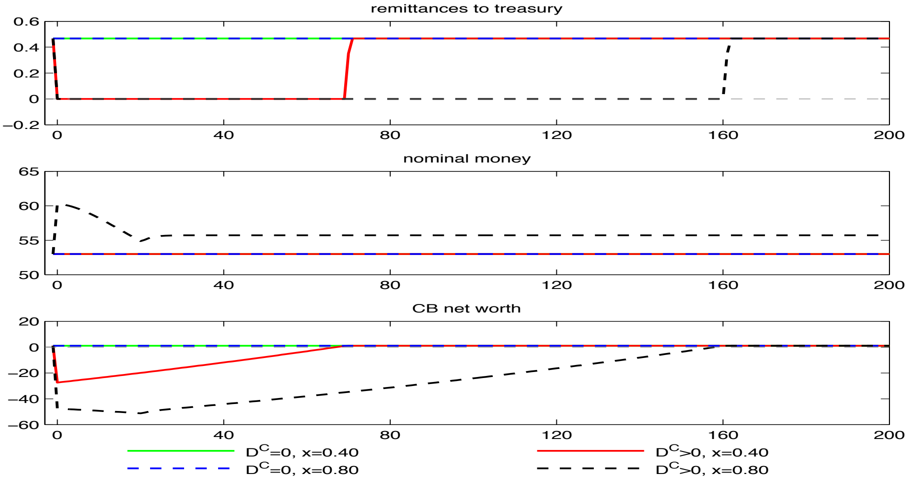
$$N_t + M_t^* > 0$$

for all $t > \tau$ and some τ: assets more than interest-bearing liabilities.

Non-Neutrality case I: Credit risk



Non-Neutrality case I: Credit risk



Non-Neutrality case I: What have we learned?

- ✓ **Neutrality Result** when losses are small in size: interest-rate risk probably not a relevant risk factor in this dimension
- ✓ **Neutrality Property** does NOT hold if losses are significant in size (at least in some contingencies): CB should buy assets of dubious quality for LSAPs program to be effective!
- ✓ **Large** losses can be inflationary because they impair the solvency and profitability of the CB: a higher price level supports higher private holdings of currency, raising seigniorage and restoring profitability.

Non-Neutrality case II: Financial Independence

1. CB lets nominal net worth decline $\Rightarrow$ eventually solvency is violated

Non-Neutrality case II: Financial Independence

1. CB lets nominal net worth decline $\Rightarrow$ eventually solvency is violated
2. CB averse to periods of declining net worth:

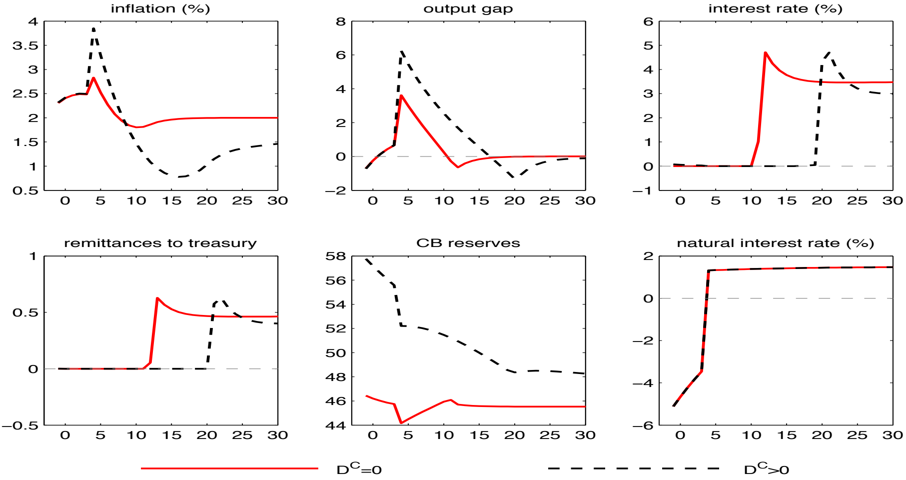
$$T_t^C = \Psi_t^C \geq 0$$

- If CB holds only short-term risk-free assets ($D_t^C = 0$, for all t) the lower-bound constraint on profits is never binding

$\Rightarrow$ Neutrality Property never holds: CB changes *conventional* MP stance to satisfy constraint on profits

$\Rightarrow$ *Unconventional* OMO's signal a change in *conventional* MP stance: higher inflation and delayed exit from liquidity trap when there is interest-rate risk.

Non-Neutrality case II: Interest-rate risk



Non-Neutrality case II: What have we learned?

"Impossible Trinity" in central banking:

1. target independence
2. financial independence
3. balance-sheet independence

- Arbitrary BSP may require Treasury's support to grant target independence

$\Rightarrow$ no **financial independence**.

- Arbitrary BSP without Treasury's support may require changes in *conventional* monetary policy

$\Rightarrow$ no **target independence**.

- Target and financial independence granted only by riskless portfolios

$\Rightarrow$ no **balance-sheet independence**.

Non-Neutrality case III: Active fiscal policy

- Exogenous primary surplus:

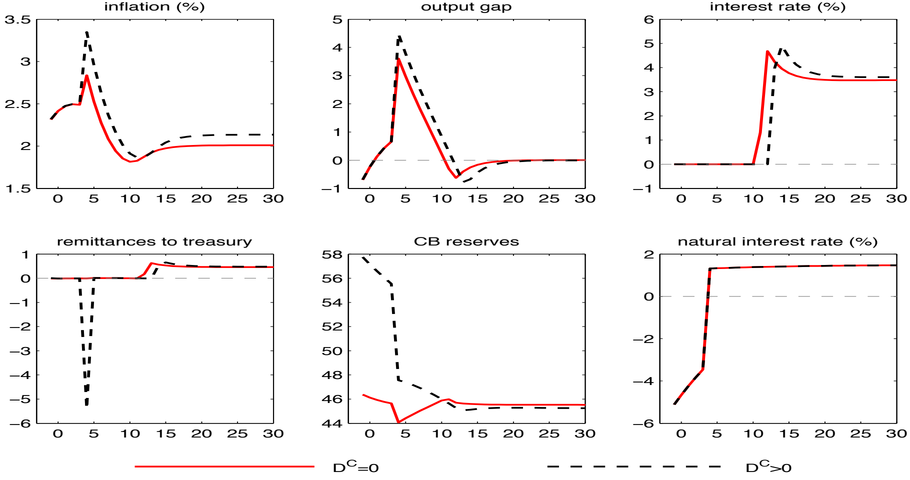
$$\frac{T_t^F}{P_t} = \bar{T}_t^F,$$

$\Rightarrow$ under Full Treasury's Support a consolidated intertemporal BC holds:

$$\frac{B_{t-1}^F}{P_t^*} + (1 + r_t^*)\frac{Q_{t-1}^* D_{t-1}^F}{P_t^*} - \frac{\overline{N} + \Psi_t^C}{P_t^*} = E_t \sum_{T=t}^{\infty} R_{t,T}^* \left[\frac{i_T^*}{1 + i_T^*} \frac{M_T^*}{P_T^*} + \bar{T}_T^F \right]$$

$\Rightarrow$ CB's income losses ($\Psi_t^C < 0$) require an adjustment somewhere else (prices, output or seigniorage revenues)

Non-Neutrality case III: Interest-rate risk



Non-Neutrality case III: What have we learned?

✓ Neutrality Property never holds:

- a reallocation of risks in the economy has fiscal consequences
- the treasury is not passing CB's losses to the private sector
- private sector therefore experiences a positive wealth effect
- higher nominal spending supports expansion in nominal money
- higher seigniorage covers financial losses of the public sector

✓ LSAP's plus active fiscal policy: way to implement "helicopter money"

Active fiscal policy and Neutrality (Wallace, 1981)

- Fiscal rule (still active):

$$\frac{T_t^F}{P_t} = \bar{T}^F - \frac{T_t^C}{P_t},$$

$\Rightarrow$ under Full Treasury's Support ($T_t^C = \Psi_t^C$) the *consolidated* BC implies:

$$\frac{B_{t-1}^F}{P_t^*} + (1 + r_t^*)\frac{Q_{t-1}^* D_{t-1}^F}{P_t^*} - \frac{\overline{N} + \Psi_t^C}{P_t^*} = E_t \sum_{T=t}^{\infty} R_{t,T}^* \left[\frac{i_T^*}{1 + i_T^*} \frac{M_T^*}{P_T^*} + \bar{T}_T^F - \frac{\Psi_T^C}{P_T} \right]$$

Note: under Full Treasury's Support CB is always solvent, then:

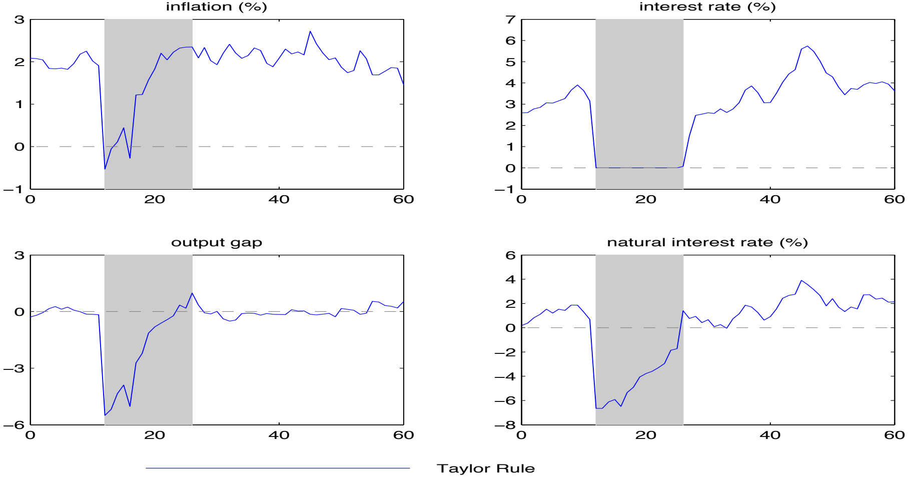
$$\frac{B_{t-1}^F}{P_t^*} + (1 + r_t^*)\frac{Q_{t-1}^* D_{t-1}^F}{P_t^*} = E_t \sum_{T=t}^{\infty} R_{t,T}^* \bar{T}_T^F$$

$\Rightarrow$ CB's balance sheet **irrelevant** for BC of Treasury, though FTPL still applies.

Conclusions

- Study effects of BSP under alternative fiscal/monetary regimes: irrelevance of QE crucially depends on institutional settings bwn Treasury and CB
- Neutrality Results quite pervasive
- Unconventional OMO's can be non-neutral if
  1. Treasury does not back CB losses that are significant in size
  2. CB averse to income losses (financial independence)
  3. Treasury does not pass CB losses to private sector (active fiscal policy)
- Caveats:
  1. limits to arbitrage in the private financial intermediation
  2. non-pecuniary returns for risky debt securities
  3. CB accounting procedures
- Unconventional OMOs additional dimension of monetary policy BUT they lead to sub-optimal equilibria wrt what can be achieved with full commitment using conventional monetary-policy instruments.

Stochastic Simulations



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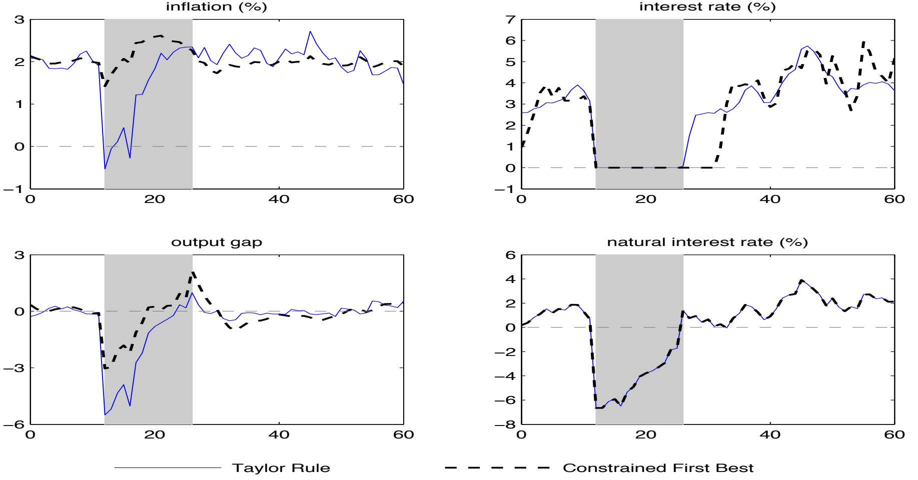

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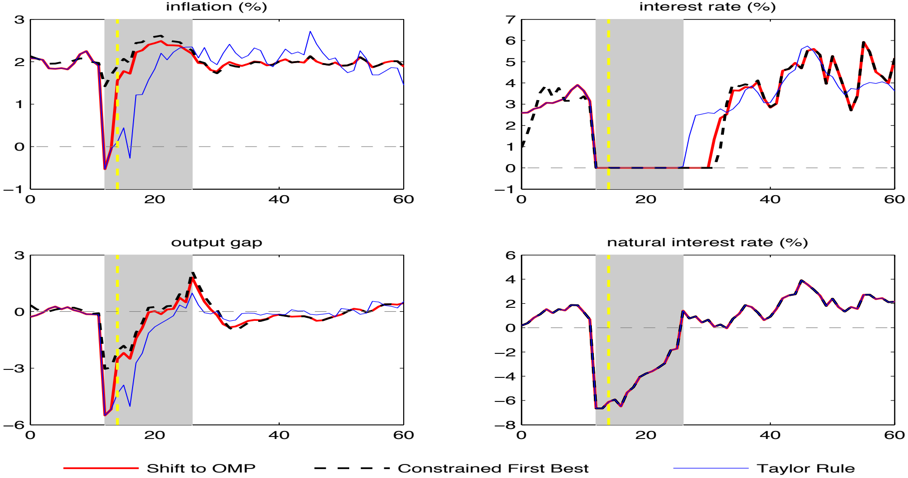

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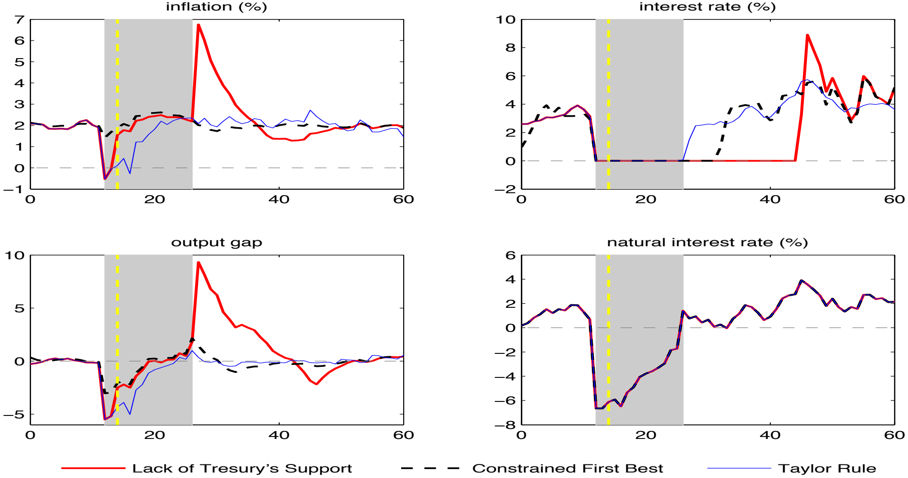
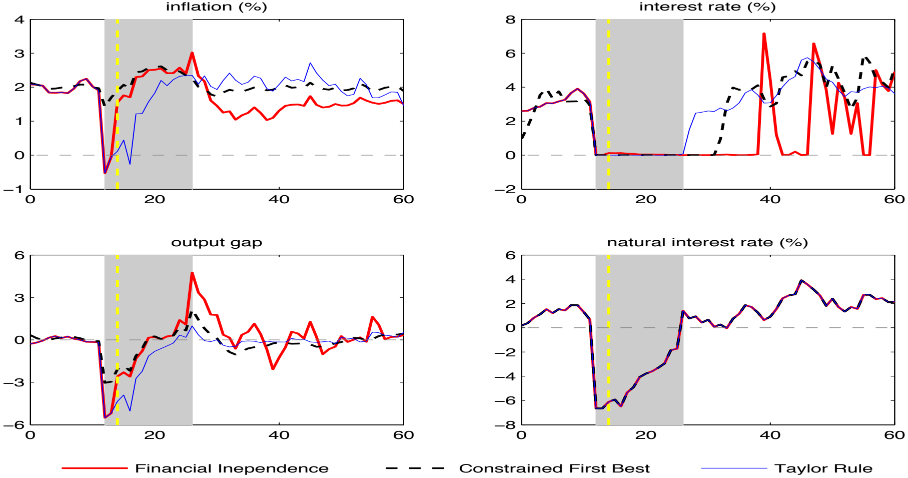
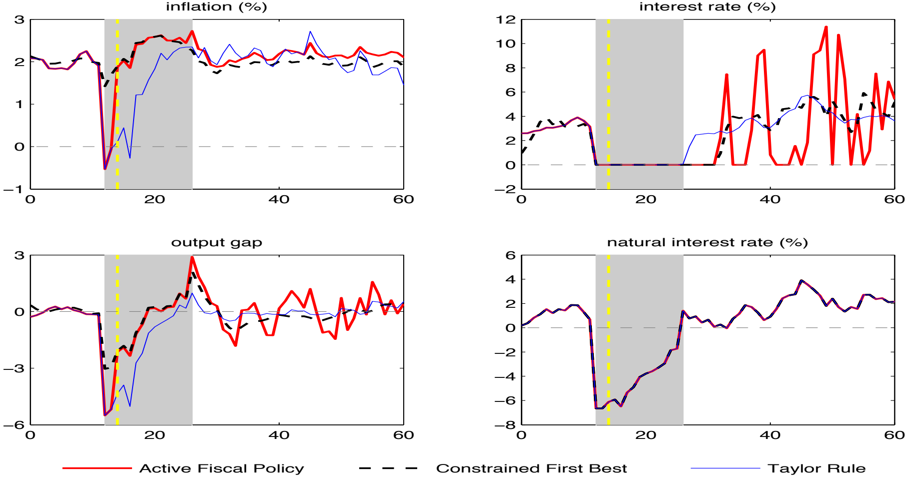



inflation (%)
4
3
2
1
0
−1
0
20
40
60
interest rate (%)
8
6
4
2
0
−2
0
20
40
60
output gap
6
3
0
−3
−6
0
20
40
60
natural interest rate (%)
6
4
2
0
−2
−4
−6
−8
0
20
40
60
Financial Inependence
Constrained First Best
Taylor Rule

Stochastic Simulations



Stochastic Simulations

Table 1: Welfare Losses

Benchmark Regimes		Non-Neutral OMO Regimes	
Constrained First Best	0.92	Lack of Treasury's Support	5.62
Taylor Rule	6.92	Financial Independence	3.93
Switch to Optimal Monetary Policy	3.47	Active Fiscal Policy	4.64

Note: Welfare losses are basis points of steady-state consumption. OMO stands for Open Market Operations.