Unconventional Monetary and Fiscal Policies in Interconnected Economies:

Do Policy Rules Matter?

Guay C. Lim, University of Melbourne, Parkville, Australia

Paul D. McNelis, Fordham University, New York, USA.

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**Aim:** to understand effectiveness of unconventional policies for economies that are highly integrated in trade and finance. Which types of shock and policy combinations make beggar-thy-neighbor effects more likely? Which conditions create win-win outcomes?

**Feature:** optimal tax rate rules as alternative to unconventional monetary policy (QE) in times of prolonged crisis
• tax rates enter the Euler equations (like interest rates) and affect the intertemporal allocation of resources

• examines conditions when tax-rate rules are as effective in non-QE implementing countries as QE policy to manage crisis
Recent experience: QE Policies in Japan, USA, UK, Euro Zone

Methodology: policies under alternative shock scenarios

- capital quality shocks or financial incentive (leverage) shocks
- countries subject to same/different type of shocks
- base case: no policy response in either country
• country1: adopts QE; country2: (1) do nothing (2) adopt an optimal tax-rate rule for labor income

• simulation of one-off shock - impulse responses

• simulation of recurring shocks - kernel distributions

• zoom in on outcomes during crisis - event study or "dark corner" dynamics

**QE and Beggar-Thy Neighbor Effects**

• Blustein and Canova (2015): no evidence in European countries of any such effects

• Some better off, others worse off, as a result of ECB policies
• Credit and confidence channels more important than exchange-rate channel for shaping responses in non-QE countries

Model

• two-country economy model

• households, firms, financial intermediaries (bankers), government sector which is responsible for monetary and fiscal policies

• same equations apply to both economies

• banking sector financial friction, in the form of incentive-compatibility constraints linking banking balance sheets with terminal wealth
• NOT firm-level collateral constraint

• Villa has shown that financial frictions in banking sector rather than at the firm level, better explain the propagation of shocks in the Euro Area and USA.

• reference or base case is a no-policy response in both countries.

Consumption and savings

\[
\max E_t \sum_{i=0}^{\infty} \beta^i U(C_t, L_t) \tag{1}
\]

\[
U(C_t, L_t) = \frac{(C_t - hC_{t-1})^{1-\sigma}}{1 - \sigma} - \chi \frac{L_t^{1+\varphi}}{1 + \varphi} \tag{2}
\]

\[
C_t + (B_t + D_t) = (1 - \tau)w_tL_t + \Pi_t \\
+ R_{t-1}(D_{t-1} + B_{t-1}) + T_t \tag{3}
\]
\[ \varrho_t = (C_t - hC_{t-1})^{-\sigma} - \beta hE_t (C_{t+1} - hC_t)^{-\sigma} \tag{4} \]

\[ \chi L_t^\varphi = \varrho_t w_t (1 - \tau) \tag{5} \]

\[ 1 = \beta R_t E_t \frac{\varrho_{t+1}}{\varrho_t} = \beta R_t E_t \Lambda_{t,t+1} \tag{6} \]
Investment and borrowing

production - goods producers and capital producers

\[ Y_t = A_t K_t^\alpha L_t^{1-\alpha} \] (7)

\[ K_{t+1} = \xi_t((1 - \delta)K_t + I_t) = \xi(S_t) \] (8)

\[ \xi_t = \rho^\xi \xi_{t-1} + (1 - \rho^\xi)\bar{\xi} + \varepsilon^\xi; \; \varepsilon^\xi \sim N(0, \sigma^2_\xi) \] (9)

capital producers build new capital, maximize discounted profits subject to adjustment cost \( f_t(.) \)

eqn relates price of capital goods \( Q_t \) to marginal cost of producing investment goods:

\[ Q_t = 1 + f_t(.) + \frac{\partial f_t(.)}{\partial I_t} I_t + \beta \mathbb{E}_{t+1} I_{t+1} \frac{\partial f_t(.)}{\partial I_t} I_{t+1} \] (10)

\[ w_t = (1 - \alpha) \frac{Y_t}{L_t} \] (11)

\[ Z_t = \alpha \frac{Y_t}{K_t} \] (12)
producers borrow from financial sector, \(Q_t S_t\) each period at gross rate \(R_t^k\)

\[ S_t = (1 - \delta)K_t + I_t \]  \hspace{1cm} (13)

\[ Q_t S_t + Z_t K_t = R_t^k Q_{t-1} S_{t-1} + Q_t I_t \]  \hspace{1cm} (14)

firms borrow to finance the installation of capital; equal to funds provided by the home and foreign-country banks:

\[ Q_t(s_t^h + s_t^{h*}) = Q_t S_t = Q_t[(1 - \delta)K_t + I_t] \]  \hspace{1cm} (15)

Financial intermediaries - balance sheet equation:

\[ Q_{t-1} s_{t-1}^h R_{t-1}^k + Q_{t-1}^* s_{t-1}^f R_{t-1}^{k*} + D_t = Q_t s_t^h + Q_t^* s_t^f + R_{t-1} D_t \]  \hspace{1cm} (16)

International accounting

\[ Y_t + Y_t^* = C_t + C_t^* + G_t + G_t^* + (1 + f_t(\cdot)) I_t + (1 + f_t^*(\cdot)) I_t^* \]  \hspace{1cm} (17)
Banking behavior

- bankers are a subset of the householders and at any point in time, they have the option to start-up new banks, continue to invest in banking or exit - probability of exiting: \((1 - \theta)\)

- The incentive-compatibility condition is:
  \[
  V_t \geq \lambda_t W_t,
  \]
  \(\lambda_t\) is the fraction of funds which banks are willing to divert to households, \(W_t\) is the value of the bank’s balance sheet and \(V_t\) is the expected terminal wealth

- value of the bank \(W_t\) is the sum of deposits \(D_t\) and the bank’s net worth \(N\):
  \[
  W_t = N_t + D_t = Q_t s_t^h + Q_t^* s_t^f
  \]
• present value of terminal wealth:

\[
V_t = \max \beta \mathbb{E}_t \{ \Lambda_{t,t+1}[(1 - \theta)N_{t+1} + \theta V_{t+1}] \} \\
V_t = \nu_t \mathcal{W}_t + \eta_t N_t
\]

(19)  
(20)

• continuously binding incentive-compatibility constraint - expression for the law of motion for aggregate net worth \( N_t \) (comprising new and existing banks) is:

\[
N_t = \theta \left( \left[ \frac{R_t^k - R_{t-1}}{\mathcal{W}_{t-1}} \left( \frac{R_t^k - R_t^{k*}}{\mathcal{W}_{t-1}} \right) \right]^{\phi_{t-1}} \right) N_{t-1} \\
+ \omega \mathcal{W}_{t-1}
\]

(21)

start-up capital of new banks: proportion \( \omega \) of \( \mathcal{W}_{t-1} \)

• leverage ratio \( \phi_t \) defined as the ratio of the banks balance sheet to its net worth:

\[
\mathcal{W}_t = \frac{n_t}{\lambda_t - \nu_t} N_t = \phi_t N_t
\]

(22)
• For completeness, \( \nu_t \) and \( \eta_t \)

\[
\nu_t = \mathbb{E}_t[(1 - \theta)\beta \Lambda_{t+1}(R_{t+1}^k - R_{t+1}) + \beta \Lambda_{t+1}\theta x_{t+1}]
\]

\[
\eta_t = \mathbb{E}_t[(1 - \theta) + \beta \Lambda_{t+1}\theta z_t \eta_{t+1}]
\]

\[
z_{t+1} = \frac{N_{t+1}}{N_t} = (R_{t+1}^k - R_{t+1})\phi_t + R_{t-1}
\]

\[
x_{t+1} = \frac{W_{t+1}}{W_t} = \frac{\phi_{t+1} z_{t+1}}{\phi_t}
\]

• leverage ratio - financial crisis affects the relationship between households and banks

• model the incentive-compatibility ratio \( \lambda_t \) as a time-varying parameter subject to a stochastic process:

\[
\lambda_t = \lambda \exp(\varsigma_t)
\]

\[
\varsigma_t = \rho^\lambda \varsigma_t + (1 - \rho^\lambda)\xi + \varepsilon^\lambda; \quad \varepsilon^\lambda_t \sim N(0, \sigma^2_{\varepsilon^\lambda})
\]

shocks to \( \lambda \) directly affect the leverage ratio, higher \( \lambda \) (reflecting the risks of more funds being diverted by bankers), lower the leverage ratio
Crises and Policies

- two-types of crises - adverse shocks to the financial incentive compatibility ratio, $\lambda_t$ and to quality of capital, $A_t$

- capital quality shock affects production directly with consequences for effective capital, return to capital as well as bank’s net worth

- financial incentive shocks affect leverage ratios directly which in turn generates further negative real consequences

- global shocks in an integrated world - same in all experiments - can attribute the different outcomes, relative to a base scenario of no-policy rules, to the policy responses and not to the shocks
• reference case - no policy

• assume country 1 adopts a QE policy (regardless of source of shocks with endogenous changes in $G$ to maintain fiscal balance)

• other country: has a do nothing, or implements a fiscal tax-rate policy (via changes in $\tau$).

• Eqns describing household and firm behavior are identical (with the same parameter values) in all scenarios, but shocks and policy rules differ in each scenario

• assume central bank in country 1 sets its policy rule on the basis of its own domestic objective - QE policy does not take into account country 2’s policy stances
QE and tax-rate rules

- government buys private sector debt $\psi_t Q_t S_t$ where
  $\psi_t$ is a function of the risk premium:
  \[
  \psi_t = \psi + \kappa^q E_t \left( R_{t+1}^k - R_t \right) 
  \]  
  \[
  (1 - \psi_t) Q_t S_t = Q_t (s_t^h + s_t^{h*}) 
  \] 
  \[
  G_t + \psi_t Q_t S_t = R_{t-1}^k \psi_{t-1} Q_{t-1} S_{t-1} + T 
  \]
  $\kappa^q$ is the optimal policy parameter, $\psi$ is the steady-state QE parameter; $s_t^{h*} \neq 0$

- by assumption, government budget is in balance [$\psi_t > 0$ : expansionary QE policies, increase $G$; $\psi_t < 0$, tapering $G$ is reduced below its steady state]

- fiscal rule for the labor-income tax rate:
  \[
  \tau_t^* = \tau^* - \kappa^{t*} E_t \left( R_{t+1}^{k*} - R_t^* \right) 
  \] 
  \[
  G_t = T_t + \tau w_t L_t 
  \]
  $\tau^*$ is the steady-state tax/subsidy rate
Table 1: Calibrated parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>discount factor</td>
<td>$\beta$</td>
<td>0.99</td>
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<tr>
<td>risk aversion</td>
<td>$\sigma$</td>
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<td>habit persistence</td>
<td>$h$</td>
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<td>relative utility weight of labour</td>
<td>$\chi$</td>
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<td>inverse Frisch elasticity of labour supply</td>
<td>$\varphi$</td>
<td>0.276</td>
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<tr>
<td>capital share</td>
<td>$\alpha$</td>
<td>0.33</td>
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<tr>
<td>depreciation rate</td>
<td>$\delta$</td>
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<td>inverse elasticity of investment to Q</td>
<td>$\eta$</td>
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<td>government share of GDP</td>
<td>$G/Y$</td>
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<tr>
<td>start-up transfer</td>
<td>$\omega$</td>
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<td>divertible fraction</td>
<td>$\lambda$</td>
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<td>$\theta$</td>
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<td>standard deviation of productivity shock</td>
<td>$\sigma_a$</td>
<td>0.01</td>
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<tr>
<td>standard deviation of incentive shock</td>
<td>$\sigma_\lambda$</td>
<td>0.01</td>
</tr>
<tr>
<td>persistence: productivity shock</td>
<td>$\rho_a$</td>
<td>0.90</td>
</tr>
<tr>
<td>persistence: incentive shock</td>
<td>$\rho_\lambda$</td>
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<tr>
<td>steady state leverage</td>
<td>$\phi$</td>
<td>4</td>
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<tr>
<td>steady state premium</td>
<td>$(R^k - R) \times 400$</td>
<td>1.0</td>
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Table 2: Optimal parameters

<table>
<thead>
<tr>
<th>Shock Scenarios</th>
<th>$\kappa^q$</th>
<th>$\kappa^{t*}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda$ in both countries</td>
<td>16.855</td>
<td>1.070</td>
</tr>
<tr>
<td>$\lambda$ in both countries</td>
<td>58.616</td>
<td>1.071</td>
</tr>
<tr>
<td>$\lambda$ in country 1 and $\alpha$ in country 2</td>
<td>58.617</td>
<td>1.070</td>
</tr>
<tr>
<td>$\lambda$ in country 1 and $\lambda$ in country 2</td>
<td>16.241</td>
<td>1.766</td>
</tr>
</tbody>
</table>

- minimization of squared deviations of the spreads from their steady-state values and output growth

- QE parameter for country 1 is derived strictly from optimization of its own spread and output

- tax parameter for country 2 is derived strictly from optimization of its own spread and output but conditional on country 2 implementing QE
Simulations

• four shock scenarios are:
  – both countries are subjected to capital quality ($\xi$) shocks
  – both countries are subjected to financial incentive ($\lambda$) shocks;
  – country 1 is subject to $\xi$ shocks; country 2 is subjected to $\lambda$ shocks
  – country 1 is subjected to $\lambda$ shocks; country 2 is subjected to $\xi$ shocks.

• economies are identical except for the nature of the shocks and choice of policies: QE and tax-rate rules
Base case: no policy rules

- three sets of results.
  - impulse response functions
  - recurring shocks to assess the implications of policies on average, over the long run - distributions of outcomes over 10000 simulations.
  - crisis-event analysis, dynamic behavior of key variables, pre-, during and post- crisis events - sequence of adverse shocks - GDP growth is two standard deviations below its stochastic mean
Figure 1: Impulses Responses for GDP: various shock scenarios
Figure 2: Kernel Densities for Growth in GDP: various shock scenarios
Figure 3: Dark Corner Analysis for GDP Growth: various shock scenarios
- Policy Scenarios

<table>
<thead>
<tr>
<th>Shocks</th>
<th>(\kappa^t_* = 0) QE in country 1</th>
<th>(\kappa^q = 0) FT in country 2</th>
<th>QE in country 1 &amp; FT in country 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\xi \xi^*)</td>
<td>2.2158</td>
<td>0.8695</td>
<td>4.1530 5.3447</td>
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<tr>
<td>(\lambda \lambda^*)</td>
<td>2.2108</td>
<td>0.8436</td>
<td>3.4160 1.2326</td>
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<tr>
<td>(\xi \lambda^*)</td>
<td>2.2241</td>
<td>0.8690</td>
<td>4.2766 5.2823</td>
</tr>
<tr>
<td>(\lambda \xi^*)</td>
<td>2.0675</td>
<td>0.8861</td>
<td>4.9266 0.8723</td>
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Table 2: Optimal parameters
Figure 4: Impulse Responses for GDP: Various Policy Scenarios
Figure 5: Kernel Distributions for Growth in GDP: Various Policy Scenarios
Figure 6: Dark Corner Analysis for GDP Growth: Various Policy Scenarios
Summary of Results: Positive (√), Neutral (○), Negative (×)

<table>
<thead>
<tr>
<th></th>
<th>QE only</th>
<th>QE &amp; Tax</th>
<th>QE only</th>
<th>QE &amp; Tax</th>
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<tr>
<td><strong>Policy effectiveness</strong></td>
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<td></td>
<td>country 1</td>
<td>country 2</td>
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<td>ξ shocks</td>
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<td>distribution</td>
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<td>λ-ξ* shocks</td>
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<td>distribution</td>
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</table>
Concluding Remarks

- focus on the management of crisis situations for countries that are open to repercussions from each other’s policies

- investigated situations when sources of shocks (correlated real $CQ$, financial $\lambda$) are the same/different

- two policy options - QE which acts on investment and tax policies which act on labour income/supply

- effectiveness of policy depends critically on the sources of the crisis and policies adopted in closely linked countries

  - win-win; lose-lose: beggar thyself: (lose-win)
  beggar-thy-neighbour (win-lose)
• The comparative advantage of the QE policy appears to be in combating shocks to financial intermediation at home.

• An expansionary QE policy in a financially troubled country can lead to improvement in other countries which are not financially troubled (even when they experience downturns due to other sources).

• If the QE-setting country is experiencing an increase in $\lambda$, while the other country is experiencing negative $\xi^*$ shocks, the QE policy only can become a win-win situation.

• If the other country is also experiencing financial intermediation shocks, then the QE policy alone will result in a beggar thy neighbor effect (one country improves at the expense of the other).
in this case, since the simple tax-rate rules considered here are effective in mitigating the negative effects of financial intermediation shocks, taking a pro-active FT policy will offset the beggar-thy-neighbor effects from QE abroad, but the overall result is not a clear win-win outcome.