Optimal simple and implementable monetary and fiscal rules (2007)

Stephanie Schmitt-Grohé, Martín Uribe

Presented by Florencia Airaudo - UC3M

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Outline

1. Introduction
2. Model
3. Policy Evaluation
4. Calibration
5. Results
   - Model I
   - Model II
   - Model III
6. Conclusions
Introduction

Objective of the paper:
Characterize optimal, simple and implementable fiscal and monetary policies in a more realistic setting than previous papers, providing a measure of welfare costs of these policies.

- **Optimal**: Policy must maximize consumption’s wealth.
- **Simple**: Policy takes the form of rules involving a few, readily available macroeconomic variables.
- **Implementable**: Policy must guarantee local uniqueness of RE equilibrium and respect the zero lower bound on nominal rates.
Contributions

Policy evaluation in a more realistic environment:

1. Capital accumulation
2. No subsidies to eliminate long run distortions of imperfect competition
3. Non-zero long run inflation
4. Evaluation fiscal and monetary policy interaction
5. Welfare evaluation
Model

Main features of the model:

1. Monopolistic competition in product markets.
2. Sticky prices à la Calvo: each period, each firm has a probability \((1 - \alpha)\) of setting its price.
3. Money demand motivated by a Cash in Advance constraint on:
   - Wage payments by firms
   - Consumption expenditures
4. Capital accumulation
5. 2 shocks: \(z_t\) (technology shock) and \(g_t\) (government expenditures). Both are AR(1).
Model: Consumers

There is a continuum of identical infinitely lived households that solve:

\[
\max_{c_t, h_t, x_{t+1}, m^h_t, i_t} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[ c_t (1 - h_t) \right]^{1-\sigma} - 1
\]

s.t. \( m^h_t \geq v^h c_t \)

\[
\mathbb{E}_t \left[ r_{t,t+1} \frac{x_{t+1}}{P_t} \right] + m^h_t + c_t + i_t + \tau_t = (1 - \tau_t^D) (w_t h_t + u_t k_t) + \frac{x_t}{P_t} + \frac{m^h_{t-1}}{\pi_t} + \delta \hat{q}_t \tau_t^D k_t + \hat{\phi}_t
\]

\[
k_{t+1} = (1 - \delta) k_t + i_t
\]

Where: \( r_{t,s} \) is a stochastic discount factor, \( x_t \) are assets, \( \hat{q}_t \) is the market price of one unit of installed capital, \( \delta \hat{q}_t \tau_t^D k_t \) are depreciation allowance for tax purposes, \( \hat{\phi}_t \) are firm’s profits net of taxes.
Model: Firms

- Firms have monopoly power and maximize the discounted value of profits.
- Must satisfy demand at the posted price.
- Wage payments are subject to CIA constraint.

\[
\max_{p_{i,t}, h_{i,t}, k_{i,t}, m_{i,t}^f} \mathbb{E}_t \left[ \sum_{s=t}^{\infty} \alpha^{s-t} r_{t,s} P_s \left( \frac{P_{i,t}}{P_s} z_s F(k_{i,s}, h_{i,s}) - w_s h_{i,s} - u_s k_{i,s} - (1 - \frac{1}{R_s}) m_{i,s}^f \right) \right]
\]

s.t. \( z_s F(k_{i,s}, h_{i,s}) - \chi \geq \left( \frac{P_{t,s}}{P_s} \right)^{-\eta} (c_s + g_s + i_s) \)

\( m_{i,s}^f \geq v^f w_s h_{i,s} \)
There is a monetary authority and a fiscal authority. The consolidated budget constraint is:

\[ P_t \tau_t + M_t + B_t = R_{t-1} B_{t-1} + M_{t-1} + P_t g_t \]

Where: \( \tau_t = \tau^L_t + \tau^D_t y_t \).

Government finances a stochastic stream of public consumption by:

- Collecting either income or lump sum taxes.
- Printing money.
- Issuing nominal non-state-contingent debt.
Model: Government

Fiscal Authority

Define $l_t = \frac{M_t + R_t B_t}{P_t}$ as total real government liabilities at the end of period $t$. Then,

\[ \tau_t - \tau^* = \gamma_1(l_{t-1} - \bar{l}^*) \]

- Where $\tau^*$ and $\bar{l}^*$ denote the deterministic Ramsey steady state values of $\tau_t$ and $l_t$.
- When $\gamma_1 \in [0, \frac{2}{\pi^*}]$ the fiscal policy is passive, and it is active o.w., in the Leeper (1991) sense.
Passive and Active fiscal policies.

From the definition of $l_t$, we can express the GBC as follows:

$$l_t = \frac{R_t l_{t-1}}{\pi_t} + R_t (g_t - \tau_t) - m_t (R_t - 1)$$

Replacing $\tau_t$ by the fiscal policy rule, we have:

$$l_t = \frac{R_t}{\pi_t} [1 - \pi_t \gamma_1] l_{t-1} + rest$$

- $|1 - \gamma_1 \pi^*| < 1 \iff \gamma_1 \in [0, \frac{2}{\pi^*_t}]$. The FP is passive.
- $|1 - \gamma_1 \pi^*| > 1 \iff \gamma_1 \notin [0, \frac{2}{\pi^*_t}]$. The FP is active.
Model: Government

Monetary Authority

Monetary Policy Rule

\[
\ln \left( \frac{R_t}{R^*} \right) = \alpha_R \ln \left( \frac{R_{t-1}}{R^*} \right) + \alpha_\Pi \ln \left( \frac{\Pi_{t-i}}{\Pi^*} \right) + \alpha_Y \ln \left( \frac{Y_{t-i}}{Y^*} \right)
\]

For:

- \( i = 0 \): contemporaneous rule
- \( i = 1 \): backward-looking rule
- \( i = -1 \): forward-looking rule

Where: \( R^* \) and \( Y^* \) are the Ramsey steady state values of \( R_t \) and \( Y_t \) and \( \Pi^* \) is the objective rate of inflation.

We say the Monetary Policy is active if \( \alpha_\pi > 1 \).
1. Compute Ramsey steady state

2. Pick monetary and fiscal policy rule parameters $\alpha_\pi$, $\alpha_y$, $\alpha_R$ and $\gamma_1$ in $[0, 3]$ so as to maximize the unconditional welfare:

$$E\left\{ \sum_{t=0}^{\infty} \beta^t U(c_t, h_t) \right\}$$

3. Compute (second order approximation) welfare cost of policy rule relative to Ramsey allocation:

$$E_0 \left\{ \sum_{t=0}^{\infty} \beta^t U(c_t^*, h_t^*) \right\} = E_0 \left\{ \sum_{t=0}^{\infty} \beta^t U(c_t^R(1-\lambda), h_t^R) \right\}$$

$^*=$allocation associated with interest feedback rule

$r=$Ramsey allocation
Calibration

The economy is calibrated for US economy:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma$</td>
<td>2</td>
<td>Preference parameter, $U(c, h) = {c(1-h)^\gamma}^{1-\sigma} - 1}/(1-\sigma)$</td>
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<tr>
<td>$\theta$</td>
<td>0.3</td>
<td>Cost Share of capital, $F(k, h) = k^\theta h^{1-\theta}$</td>
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<tr>
<td>$\beta$</td>
<td>1.04^{-1/4}</td>
<td>Quarterly subjective discount rate</td>
</tr>
<tr>
<td>$\eta$</td>
<td>5</td>
<td>Price elasticity of demand</td>
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<tr>
<td>$\bar{g}$</td>
<td>0.0552</td>
<td>Steady-state level of government purchases</td>
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<tr>
<td>$\delta$</td>
<td>1.1^{(1/4)} - 1</td>
<td>Quarterly depreciation rate</td>
</tr>
<tr>
<td>$\nu^f$</td>
<td>0.6307</td>
<td>Fraction of wage payments held in money</td>
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<tr>
<td>$\nu^h$</td>
<td>0.3496</td>
<td>Fraction of consumption held in money</td>
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<td>$\alpha$</td>
<td>0.8</td>
<td>Share of firms that cannot change their price each period</td>
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<td>$\gamma$</td>
<td>3.6133</td>
<td>Preference Parameter</td>
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<td>$\chi$</td>
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<td>Fixed cost parameter</td>
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<tr>
<td>$\rho_g$</td>
<td>0.87</td>
<td>Serial correlation of government spending</td>
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<td>$\sigma_{\epsilon^g}$</td>
<td>0.016</td>
<td>Standard Deviation of innovation to government purchases</td>
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<td>$\rho_z$</td>
<td>0.8556</td>
<td>Serial correlation of productivity shock</td>
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<tr>
<td>$\sigma_{\epsilon^z}$</td>
<td>0.0064</td>
<td>Standard Deviation of innovation to productivity shock</td>
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</table>
Results for 3 economies:

1. A monetary sticky price economy: no fiscal policy ($\tau_t = 0$)

2. A monetary sticky price economy with a fiscal feedback rule ($\tau_t = \tau_t^L$)

3. A monetary sticky price economy with income taxation ($\tau_t = \tau_t^D y_t$)


A monetary sticky price economy: no fiscal policy ($\tau_t = 0$)

<table>
<thead>
<tr>
<th></th>
<th>$\alpha_{\pi}$</th>
<th>$\alpha_y$</th>
<th>$\alpha_R$</th>
<th>Conditional welfare cost ($\lambda^c \times 100$)</th>
<th>Unconditional welfare cost ($\lambda^u \times 100$)</th>
<th>$\sigma_\pi$</th>
<th>$\sigma_R$</th>
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<tbody>
<tr>
<td>The monetary economy</td>
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<td>Ramsey policy</td>
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<td>–</td>
<td>0</td>
<td>0</td>
<td>0.01</td>
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<td>Optimized rules</td>
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<td>Contemporaneous ($i = 0$)</td>
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<td>Smoothing</td>
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<tr>
<td>No smoothing</td>
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<td>0.001</td>
<td>0.001</td>
<td>0.14</td>
<td>0.41</td>
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<td>Nonoptimized rules</td>
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<td>Taylor rule ($i = 0$)</td>
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<td>0.598</td>
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<td>Simple Taylor rule</td>
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<td>0.85</td>
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<td>Inflation targeting</td>
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<td>–</td>
<td>–0.000</td>
<td>0.000</td>
<td>0</td>
<td>0.27</td>
</tr>
</tbody>
</table>
Results: Model I

**Figure 1:** Implementability

**Figure 2:** Response to output
Results: Model II

Fiscal feedback rule ($\tau_t = \tau_t^L$)
- Optimized fiscal rule: $\gamma_1 \in (0, 2)$
- Optimized monetary rule (no smoothing): $\ln\left(\frac{R_t}{R^*}\right) = 3 \ln\left(\frac{\pi_t}{\pi^*}\right)$
- Welfare cost: 0.001.

Figure 3: Implementability
A monetary sticky price economy with income taxation ($\tau_t = \tau^D_t y_t$)

- Optimal monetary policy rule: $\alpha_\pi = 3$, $\alpha_y = 0$, $\alpha_R = 0$.
- Optimal fiscal rule: $\gamma_1 = 0.2$.
- Welfare cost: 0.003.

Then:

- Optimal monetary policy is active and optimal fiscal policy is passive.
- Welfare cost are negligible.
Results: Model III

Figure 4: Implementability

Figure 5: Response to output
Conclusions

1. Optimal monetary policy is active ($\alpha_\pi > 1$) but the exact value of $\alpha_\pi$ plays minimum role in welfare.

2. Responding to output in feedback interest rate rule can be significantly harmful.

3. The optimal fiscal policy is passive ($\gamma \in [0, \frac{2}{\pi^*}]$).

4. The optimized simple monetary and fiscal rules attain virtually the same level of welfare as Ramsey optimal policy.

5. Interest rate smoothing has no welfare gains associated.