Optimal Fiscal and Monetary Policy in a Medium-Scale Macroeconomic Model

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A medium-scale macroeconomic model

• Nominal Frictions:
  1. Sticky product prices
  2. Sticky nominal wages
     (indexed to lagged price inflation)
  3. Cash-in-advance constraint on wages
  4. Money demand by households

• Real Rigidities:
  1. Distortionary income taxation
  2. Monopolistically competitive product and factor markets
  3. Habit persistence in consumption
  4. Investment adjustment costs
  5. Variable capacity utilization
• Sources of Uncertainty

  1. Government consumption shocks

  2. Government transfer shocks

  3. Technology shocks

• Government Policy Objective: Ramsey-Optimal Stabilization

• Policy Instruments

  1. Distortionary income taxation

  2. Issuance of money and nominally risk-free bonds
Long-run Inflation: Policy Tradeoffs

- Price stickiness calls for $\pi = 0\%$

- Money demand by HH and firms calls for Friedman rule ($\pi = -3.8\%$)

- Under an income tax regime, positive nominal interest rates allow for differential taxation of capital and labor income

- Positive nominal interest rates allow for indirect taxation of transfers, $n_t$. 
The Optimal Rate of Inflation

<table>
<thead>
<tr>
<th>Environment</th>
<th>Ramsey Steady State</th>
<th>(\chi)</th>
<th>(\bar{n})</th>
<th>(\pi)</th>
<th>(R)</th>
<th>(\tau^h)</th>
<th>(\tau^k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<td>0.2</td>
<td>4.2</td>
<td>35.4</td>
<td>-6.3</td>
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<td>24.1</td>
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</table>

\(\chi\) = Degree of Price Indexation.
\(\bar{n}\) = Government Transfers.
BM = Benchmark Value.

Note: The inflation rate, \(\pi\), and the nominal interest rate, \(R\), are expressed in percent per year. The labor income tax rate, \(\tau^h\), and the capital income tax rate, \(\tau^k\), are expressed in percent.
Capital Income Taxation: Policy Tradeoffs

• Monopolistic competition calls for a capital subsidy, $\tau^k < 0$, such that social and private return on capital are equated.

$$(1 - \tau^k)(uF_k/\mu - \delta - a(u)) = uF_k - \delta - a(u).$$

• The optimal profit tax is 100%. So, when profits and capital are restricted to be taxed at same rate, the optimal level of $\tau^k_t$ increases.

<table>
<thead>
<tr>
<th>$\tau^k_t$</th>
<th>Ramsey Steady State</th>
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<tr>
<td>$\tau^\phi_t$</td>
<td>$\pi$</td>
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<tr>
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<td>4.2</td>
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<tr>
<td>1</td>
<td>0.3</td>
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$\tau^\phi_t = \text{Profit Tax Rate}$.
Resolution of Long-run Policy Tradeoffs:

- The optimal inflation rate is **positive** but close to zero.

- The optimal capital tax rate is **negative** but close to zero.
Optimal Policy Under Income Taxation

\( \tau^k_t = \tau^h_t = \tau^\phi_t \)

Short-Run Policy Tradeoffs

• Surprise inflation acts as a lump-sum tax on nominal assets

• Sticky prices make inflation volatility undesirable because it creates price dispersion

• Sticky wages: Set inflation so as to bring about efficient real wage

• Smooth income tax rates so as to smooth distortions over time.
Ramsey Dynamics under Income Taxation
\[ \tau^k_t = \tau^h_t = \tau^\phi_t = \tau^y_t \]

No Transfers \((n_t = 0)\)

<table>
<thead>
<tr>
<th>(\alpha)</th>
<th>(\tilde{\alpha})</th>
<th>(\tilde{\tau}^y_t)</th>
<th>(R_t)</th>
<th>(\pi_t)</th>
<th>(w_t)</th>
<th>(a_t)</th>
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Resolution of Short-run Policy Tradeoffs:

- The optimal volatility of inflation is **small**.

- **Tax smoothing** is optimal.

- **Near-random walk** in government debt.
Welfare Losses of NOT conduction optimal fiscal policy

Ad-hoc fiscal policy: zero (secondary) fiscal deficits, $a_t = a$

Ramsey Optimal Monetary and Fiscal Policy:

\[
\text{Consumption and labor: } \{c_t^r, h_t^r\}_{t=0}^{\infty}
\]
\[
\text{Welfare: } E_0 U(\{c_t^r, h_t^r\}_{t=0}^{\infty})
\]

Ramsey Optimal Monetary BUT ad hoc Fiscal Policy:

\[
\text{Welfare: } W^a = E_0 U(\{c_t^a, h_t^a\}_{t=0}^{\infty})
\]

Welfare Cost, $\lambda$:

\[
W^a = E_0 U(\{(1 - \lambda)c_t^r, h_t^r\}_{t=0}^{\infty})
\]

\[
\lambda = 0.0088 \text{ percent}
\]
(or 19 cents per month per person)
Welfare Losses of NOT conducing optimal monetary policy

Ad hoc monetary policy: $\hat{R}_t = 0.5\hat{\pi}_t$

$\lambda = 0.0130$ percent
(or 28 cents per month per person)
Implementing the Ramsey equilibrium with policy rules

\[
\hat{R} = \alpha_\pi \hat{\pi}_t + \alpha_W \hat{\pi}_W^t + \alpha_y \hat{y}_t + \alpha_R \hat{R}_{t-1}
\]

and

\[
\hat{\tau}_t^y = \beta_a \hat{a}_t + \beta_y \hat{y}_t + \beta_\tau \hat{\tau}_{t-1}^y
\]

Pick 7 policy coefficients so as to match the impulse response functions of all endogenous variables for 20 periods for each of the 3 shocks.

\[
\begin{align*}
\alpha_\pi & = 0.37 \\
\alpha_W & = -0.16 \\
\alpha_y & = -0.06 \\
\alpha_R & = 0.55 \\
\beta_a & = -0.06 \\
\beta_y & = 0.02 \\
\beta_\tau & = 1.88
\end{align*}
\]
Impulse Response to a Technology Shock
Solid line: Ramsey, dashed line: optimized rule
Welfare Costs of the Optimized Rule

Consumption and labor processes under the Ramsey Policy:
\[ \{c_t^r, h_t^r\}_{t=0}^\infty \]

Welfare under the Ramsey Policy:
\[ E_0U(\{c_t^r, h_t^r\}_{t=0}^\infty) \]

Welfare Cost of the Optimized Rule, \( \lambda \):
\[ E_0U(\{c_t^0, h_t^0\}_{t=0}^\infty) = E_0U(\{(1 - \lambda)c_t^r, h_t^r\}_{t=0}^\infty) \]

\( \lambda = 0.017 \) percent
(or 39 cents per month per person)
Impulse Response to a Government Purchases Shock

Solid line: Ramsey, dashed line: optimized rule
Impulse Response to a Transfer Shock
Solid line: Ramsey, dashed line: optimized rule

Output
Consumption
Investment
Hours
Wage rate
Tax rate
Nominal Interest Rate
Inflation
Last, by not least, ...

The paper makes a methodological contribution by showing how to find the equilibrium conditions of Ramsey problems for a quite general class of models analytically using symbolic algebra tools.

The programs used for this paper, illustrating the use of this technique, are posted at the authors’s websites.