Designing a Simple Loss Function for the Fed: Does the Dual Mandate Make Sense?

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Conduct of monetary policy delegated to central banks

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  - As documented in Svensson (2010), many central banks became “inflation targeters” to strengthen credibility and facilitate accountability.
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  - But these papers were based on small calibrated models - what goes in estimated DSGE models?
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Presentation outline

- Model and parameterization
- Our exercise
- Benchmark results
- Robustness of results
- Simple rule results
- Concluding remarks
Model

Key features of model structure

- We use the estimated SW07 model. This model features monopolistic competition in both goods and labour markets.

- Nominal price and wage stickiness:
  - Calvo price contracts, indexation of non-optimizers
    \[ P_t^{NO} = \Pi_{t-1}^{\iota_p} \Pi^{1-\iota_p} P_{t-1}^{NO} \]
  - Calvo wage contracts, indexation of non-optimizers
    \[ W_t^{NO} = \gamma \Pi_{t-1}^{\iota_w} \Pi^{1-\iota_w} W_{t-1}^{NO} \]
  - Kimball (1995) aggregator; lower slope of price and wage schedules for given Calvo parameter.

- Real rigidities as in CEE (2005):
  - External habit persistence in consumption
  - CEE type of investment adjustment costs
  - Variable capital utilization
Four structural shocks that we assume affect potential output:

- Total factor productivity ($\varepsilon^a_t$), Investment-specific ($\varepsilon^i_t$), Risk-shock on financial assets ($\varepsilon^b_t$), Government-NX ($\varepsilon^g_t$),

Two “inefficient” shocks:

- $\varepsilon^p_t$ - “price markup” shock
- $\varepsilon^w_t$ - “wage markup” shock

Pay particular attention to what extent the two cost-push shocks drive our results

SW also included a monetary policy shock, but we drop it here since we consider optimized simple mandates and rules
Parameterization
Parameters adopted from Smets and Wouters

- We use the posterior mode parameters from SW07 (Tables 1.A-B in their paper, Table 1 in our paper)
- Make assumptions on adjustment functions and how we introduce the shocks so that linearized representation of our model coincides exactly with SW07
Benigno and Woodford (2006) demonstrated that households utility function could be written as:

\[
\sum_{t=0}^{\infty} E_0 \left[ \beta^t U(X_t) \right] \simeq \text{constant} - \sum_{t=0}^{\infty} E_0 \left[ \beta^t X_t' W^{society} X_t \right], \quad (1)
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where \( X_t' W^{society} X_t \) on the RHS is LQ approximation of the economy. Define Ramsey policy as a policy which maximizes (1) subject to the \( N - 1 \) constraints of the economy.
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- Define Ramsey policy as a policy which maximizes (1) subject to the $N - 1$ constraints of the economy
- Do not allow for subsidies that undo the steady state distortions in the economy - our Ramsey policy is “second-best” as the LQ approximation is computed around an inefficient output level
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- We adopt unconditional expectations operator for welfare evaluation, so the loss under Ramsey optimal policy is

\[ Loss^{Ramsey} = E \left[ \left( X_t^{Ramsey} (W^{society}) \right)' W^{society} \left( X_t^{Ramsey} (W^{society}) \right) \right] \]
Our Exercise
Simple Mandate approximation to policy behavior

We assume (arguably realistically) that the CB minimizes:

$$E_0 \sum \beta^t X'_t W^{CB} X_t,$$

where $W^{CB}$ is a sparse matrix with many zeros.

Given $W^{CB}$, the expected loss for the society is

$$\text{Loss}_{\text{obj}} = E X_{\text{obj}}^t W^{CB} X_{\text{obj}}^t.$$  

(2)

Measure welfare costs by comparing loss under mandate with Ramsey:

$$\text{CEV} = \frac{\text{Loss}_{\text{obj}}}{\bar{C} \left( \frac{\partial U}{\partial C} \right)}$$

(3)

where $\bar{C} \left( \frac{\partial U}{\partial C} \right)$ measures how welfare increases when consumption is increased 1%.

Hence, CEV is the increase in SS that make households in expectation equally well-off under simple mandate as under Ramsey policy.
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Two alternative assumptions about mandate

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2. We assume the law specifies the objective function but not the weights; the central bank determines \( W_{CB} \) by maximizing welfare:

\[
W^* (\Omega) = \arg \min_{W_{CB} \in \Omega} \left[ \left( X_{\text{optimal}} (W_{CB}) \right)' W^{\text{society}} \left( X_{\text{optimal}} (W_{CB}) \right) \right]
\]

where \( \Omega \) denotes the set of simple mandates consistent with the law. A simple example is

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- Consider three alternative measures of \( x_t \): \( y_t - y_t^{pot} \), \( y_t - \bar{y}_t \) and \( 4(y_t - y_{t-1}) \)
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- Consider three alternative measures of \( x_t \): \( y_t - y_t^{pot} \), \( y_t - \bar{y}_t \) and \( 4 (y_t - y_{t-1}) \)
- CEV as function for \( \lambda^a \) for the alternate \( x_t \) measures are reported in Figure 1
Benchmark results

CEV for simple mandates with alternative utilization measures

Output Gap

Output

Output Growth (Annualized)

\( CEV \) as function of \( \lambda^0 \)

Optimized value
Benchmark results
Volatility trade-offs for alternative utilization measures

Output Gap in Loss Function
- Opt. value ($\lambda^a = 1.042$)
- $\lambda^a = 0.01$
- $\lambda^a = 5$

Output in Loss Function
- Opt. value ($\lambda^a = 0.542$)
- $\lambda^a = 0.01$
- $\lambda^a = 5$

Annualized Output Growth in Loss Function
- Opt. value ($\lambda^a = 2.943$)
- $\lambda^a = 0.01$
- $\lambda^a = 5$
Benchmark results
Drivers of our results

- Key findings:

- Optimal weight on resource utilization is about 1.05. This is substantially higher than Woodford's (2003) value of 0.048 and Yellen's (2012) value of 0.252.

- Important volatility trade-off between inflation and the output gap (at odds with Justiniano, Primiceri and Tambalotti, 2012).

Two questions:

1. Why do we get such a large $\lambda$?
2. Why do we get important volatility trade-offs?

Are the shocks or deep parameters driving our results?
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  - Find that dynamic indexation important; $\lambda^a$ drops to 0.32 for $y^\text{gap}_t$ when $\iota_p = \iota_w = 0$ – but still 6 times larger than Woodford
Benchmark results

Sensitivity of results w.r.t. parameters and shocks
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We now turn to the second question, namely why we get an important trade-off between stabilizing the output gap and inflation. Justiniano, Primiceri and Tambalotti (2012) finds that the output gap can be stabilized without generating higher inflation volatility. But, they consider a model without a wage markup shock (allow for labor supply shock and measurement errors in the wage series to fit the data). Moreover, the JPT model features an inflation target shock as opposed to the SW price markup shock; this shock is removed in their policy analysis.
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- Justiniano, Primiceri and Tambalotti (2012) finds that the output gap can be stabilized without generating higher inflation volatility
  - But, they consider a model without a wage markup shock (allow for labor supply shock and measurement errors in the wage series to fit the data)
  - Moreover, the JPT model features an inflation target shock as opposed to the SW price markup shock; this shock is removed in their policy analysis

- Therefore, we study the influence of the price and wage markup shocks and our assumption of dynamic indexation in wage and price setting
Benchmark results

Variance frontiers for alternative calibrations
While we do not necessarily disagree with JPT, our analysis makes clear that their “no trade-off” result is a special case in the sense that it applies only if \textit{BOTH} price and wage markup shocks are irrelevant.
Robustness of results

- Importantly, we find that our results hold up when we put restrictions on std($r_t^a$):

<table>
<thead>
<tr>
<th>Loss Function</th>
<th>$\lambda^a - y_t^{gap}$</th>
<th>$\lambda_r$</th>
<th>CEV (%)</th>
<th>std($r_t^a$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodford</td>
<td>0.048</td>
<td>—</td>
<td>0.1381</td>
<td>8.92</td>
</tr>
<tr>
<td>Optimized</td>
<td>1.042</td>
<td>—</td>
<td>0.0128</td>
<td>9.00</td>
</tr>
<tr>
<td>Optimized*: $r_t^a - r^a$</td>
<td>1.161</td>
<td>0.0770*</td>
<td>0.0222</td>
<td>2.24</td>
</tr>
<tr>
<td>Optimized*: $\Delta r_t^a$</td>
<td>1.110</td>
<td>1.0000*</td>
<td>0.0246</td>
<td>2.04</td>
</tr>
</tbody>
</table>

- Obviously, commitment assumption important here
Robustness of results

- Also study the merits of an alternative mandate with nominal wage inflation and a labor market gap ($l_t - l_t^{pot}$):

\[ L_t = (\Delta w_t^a - \Delta w^a)^2 + \lambda^a (l_t - l_t^{pot})^2 \]
Robustness of results

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L_t = (\Delta w_t^a - \Delta w^a)^2 + \lambda^a (l_t - l_t^{pot})^2
\]

- Find that labor market variables warrant further attention; not surprising given that the model features labor market frictions (nominal wage frictions)
Robustness of results
On the importance of labor market variables
We also study the performance of simple rules on the form

\[ r_t^a = (1 - \rho_r) \left[ r^a + \varrho_\pi (\pi_t^a - \pi^a) + \varrho_y y_t^{gap} + \varrho_\Delta y y_t^{gap} \right] + \rho_r r_{t-1}^a \]  

Look at Taylor (1993) and (1999) and coefficients that minimize CEV

<table>
<thead>
<tr>
<th>Parameterization</th>
<th>( \varrho_\pi )</th>
<th>( \varrho_y )</th>
<th>( \varrho_\Delta y )</th>
<th>( \rho_r )</th>
<th>CEV (%)</th>
<th>std(( r_t^a ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taylor (1993)</td>
<td>1.50</td>
<td>0.50</td>
<td>-</td>
<td>-</td>
<td>0.1170</td>
<td>5.43</td>
</tr>
<tr>
<td>Taylor (1999)</td>
<td>1.50</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>0.2251</td>
<td>7.53</td>
</tr>
<tr>
<td>Optimized: ( \varrho_\Delta y = 0 )</td>
<td>11.78</td>
<td>5.76</td>
<td>-</td>
<td>0.99</td>
<td>0.0633</td>
<td>2.08</td>
</tr>
<tr>
<td>Optimized, uncon.</td>
<td>20.20</td>
<td>0.40</td>
<td>56.52</td>
<td>0.48</td>
<td>0.0097</td>
<td>7.81</td>
</tr>
<tr>
<td>Optimized, constr.</td>
<td>29.28</td>
<td>0.79</td>
<td>54.81</td>
<td>0.99</td>
<td>0.0239</td>
<td>2.08</td>
</tr>
</tbody>
</table>
We find that optimized rule is characterized by:

- High degree of interest rate smoothing ($\rho_r$)
- Large response coefficients for inflation ($\varphi_\pi$) and growth rate of the output gap ($\varphi_{\Delta y}$)
- Coefficient on the level of the output gap ($\varphi_y$)
- Substantially smaller CEV for optimized rule

So properly designed, simple mandates and rules appear to work about equally well.
Simple rule results

Interpretation of findings

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CEV for optimized rule \((4)\) is about the same as CEV for optimized simple mandate.

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